The WTO-EU Environmental Policies for the International Olive Oil Market and Trade Competitiveness: A Case Study for Syria

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Prof. Dr. Thomas Kuhn

The WTO-EU Environmental Policies for the International Olive Oil Market and Trade Competitiveness: A Case Study for Syria

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Chemnitz, January 2014
To my mother and father, Hend Abdlrhman and Kamel Ahmad,
who taught me about love and living and instilled
in me the courage that enabled me
to write this dissertation\(^1\).

\(^1\) This work has been presented and published partially, i.e., the case of “end-of-the-pipe”
environmental policies, as a conference paper and a submitted paper, and it has been cited as taken
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<tbody>
<tr>
<td>AOAD</td>
<td>Arab Organization for Agricultural Development</td>
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<tr>
<td>CTD</td>
<td>Committee on Trade and Development</td>
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<tr>
<td>CTE</td>
<td>Committee on Trade and Environment</td>
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<tr>
<td>EC</td>
<td>European Commission</td>
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<td>EEC</td>
<td>European Economic Community</td>
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<td>EGS</td>
<td>Environmental Goods and Services</td>
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<td>ESTs</td>
<td>Environmentally Sound Technologies</td>
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<td>EU</td>
<td>European Union</td>
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<td>FAO</td>
<td>Food and Agriculture Organization of the United Nations</td>
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<td>GATT</td>
<td>General Agreement on Tariffs and Trade</td>
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<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
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<tr>
<td>HACCP</td>
<td>Hazard Analysis and Critical Control Points</td>
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<tr>
<td>HIID</td>
<td>Harvard Institute of International Development</td>
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<tr>
<td>ICTSD</td>
<td>International Centre for Trade and Sustainable Development</td>
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<tr>
<td>IISD</td>
<td>International Institute for Sustainable Development</td>
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<tr>
<td>IPM</td>
<td>Integrated Pest Management</td>
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<td>IPPC</td>
<td>International Plant Protection Convention</td>
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<td>IPRs</td>
<td>Intellectual Property Rights</td>
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<td>IOOC</td>
<td>International Olive Oil Council</td>
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<td>ISO</td>
<td>International Organization for Standardization</td>
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<td>MEAs</td>
<td>Multilateral Environmental Agreements</td>
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<td>METAP</td>
<td>Mediterranean Environmental Technical Assistance Program</td>
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<td>MTAs</td>
<td>Multilateral Trade Agreements</td>
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<td>MNE</td>
<td>Multinational Enterprises</td>
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<tr>
<td>MP</td>
<td>Montreal Protocol on Substances that Deplete the Ozone Layer</td>
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<tr>
<td>NGOs</td>
<td>Non-Governmental Organizations</td>
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<td>OECD</td>
<td>Organization for Economic Co-operation and Development</td>
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<td>PPMs</td>
<td>Processes and Production Methods</td>
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<td>SPS</td>
<td>Sanitary and Phytosanitary Measures (also WTO SPS Agreement)</td>
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<td>SMEs</td>
<td>Small and Medium-Sized Enterprises</td>
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<td>R&amp;D</td>
<td>Research and Development</td>
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<tr>
<td>TBT</td>
<td>Technical Barriers to Trade (also WTO TBT Agreement)</td>
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TC/CB  | Technical Cooperation and Capacity Building
TDCs  | Technology Dissemination Centres
TNC   | Trade Negotiations Committee
TREM  | Trade-Related Environmental Measure
TRIPS | Trade-Related Aspects of Intellectual Property Rights
UN    | United Nations
US    | United States
UNCED | United Nations Conference on Environment and Development
UNCTAD| United Nations Conference on Trade and Development
UNDP  | United Nations Development Programme
UNEP  | United Nations Environment Programme
UNESCAP | United Nations Economic & Social Commission for Asia and the Pacific
UNESCWA| United Nations Economic & Social Commission for Western Asia
WEO   | World Environmental Organization
WHO   | World Health Organization
WTO   | World Trade Organization

### Symbols

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<td>e.g.</td>
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<td>and other things</td>
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<td>Syrian Pounds</td>
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Part One: Institutional Setting and Background

1. Introduction

1.1. Problem and Motivation

A debate over environmental policies and trade competitiveness, “Do environmental policies really matter to impact trade competitiveness?” still exists during the past decade (Babool, 2007; López-Cálix et al., 2010). In principle, a significant change has been seen in the implementation of compliance with environmental policies for the international olive oil market during recent years. This change is the result of an increasing trade competition due to the introduction of new environmental technologies, the focus of attention on the consumers’ preferences and the growth of worldwide markets for green products (UN-ESCWA, 2005; UN-ESCAP, 2009; World Bank, 2010).

The idea that environmental policies can adversely affect the country’s international trade competitiveness in export markets is a topic of growing policy concern. As the World Trade Organization (WTO) continues to tighten restrictions on international export programs, environmental policies are being increasingly scrutinized as potential instruments for influencing trade competitiveness. The WTO and the European Union (EU) Commission have recently paid special attention on the issue of evaluating how possible environmental policies impact on trade competitiveness, particularly for developing countries (see, e.g., Hamilton & Requate, 2004; Kuhn et al., 2010b:2). Thereby, the impact of environmental policies on trade competitiveness has been an important global policy issue, and moreover, concern from both environmental analysts and policy makers about the adverse trade-environment impacts continues to grow in developing countries (see, e.g., Jenkins, 1998; Babool & Reed, 2005).

The non-EU countries in the Mediterranean region are an ideal testing ground for the potential effects of compliance with environmental policies on trade competitiveness of key economic sectors in the future (Panayatou, 2000:2). More specifically, the Arab countries in particular, as developing economies in the Mediterranean area, are considered as key partners to the developed economies of the EU countries. They depend on a few export commodities and sectors while there are traditional markets in the EU countries. Environmental policies in the EU countries are among the strictest in the world market, while the Arab countries in the Mediterranean region have had generally lenient environmental policies. The established access of the Arab countries exports in the Mediterranean region to the EU countries markets
is thus being endangered by the enforcement of environmental regulatory policies in the EU, where these exports may fail to meet its requirements. The competitive advantage of their exports is also being challenged by the enforcement and strengthening of environmental regulatory policies both at home and abroad (see, e.g., Panayatou, 2000).

In particular, for the Arab countries, understanding the relations between environmental policies and trade competitiveness is key to maintain and expand their export markets while at the same time to protect the environment in the Mediterranean region (Panayatou, 2000). Accordingly, in responding to these challenges and concerns, the MedPolicies Initiative of the Mediterranean Environmental Technical Assistance Program (METAP) sponsored the completion of a number of case studies. They analyzed the impacts of compliance with environmental regulatory policies on international trade competitiveness of specific agro-industrial sectors in the non-EU Mediterranean region. The main countries and products covered are fertilizers products in Jordan, textile products in Morocco and Syria, dates and citrus products in Tunisia, leather products in Egypt and Turkey, and potatoes products in Cyprus. These case studies include a range of environmental policies issues that are likely to impact trade competitiveness in the non-EU Mediterranean region; natural resource issues, environmental quality issues and environmental policies in exports markets. More details about these case studies can be clearly found in HIID (2000), in Larson et al. (2002) and in UN-ESCWA (2005).

Based on a theoretical modeling approach, these case studies produce mixed results. For some of the studies, expected environmental policies changes would most likely have small impact on trade competitiveness, while in other studies the impacts could be significantly larger. The empirical findings are also questioned because the studies lack sufficient and reliable data on environmental policies changes. The empirical findings will be explained later in more depth and further detail in the economic literature review in section 1.2 of the study. Thus, the debate about the linkage between environmental policies and trade competitiveness continues. Motivated by these case studies and the policy debate that they have encouraged, we propose to explore in this study the environmental policies impacts on trade competitiveness of Syrian olive oil products. The proposal is mainly taken because (a) little has been written on this subject in the Arab countries; and (b) too little has been written about the Syrian economy and particularly about the olive oil sector which is of prime importance for Syria.
Syria is one of the Arab countries in the Mediterranean region, and it therefore certainly shares similar concerns and faces similar effects and trade-offs like other Arab countries (see, e.g., Babiker, 2002). In addition, “Syria is an open economy embarking on a road to sustainable development and diversifying its agro-industrial base” (see Kuhn et al., 2010a, 2010b, 2011a:2). Moreover, the Syrian government is undertaking the processes of joining the WTO and signing the Association Agreement with the EU. “In the framework of the negotiations for accession to the WTO-EU agreements, Syria will have to comply with the WTO-EU environmental policies adopted in the international markets as a precondition for its admission, especially those policies concerning the olive oil agro-industrial sector” (Kuhn et al., 2010a, 2010b, 2011a:2). “It therefore needs to develop and to enforce environmental policies that are necessary to protect the environment in the region” (Kuhn et al., 2012a:2). “Whether environmental policies will affect international competitiveness and whether they can be used as barriers to trade flows is the issue that is likely to become increasingly important for Syria” (see Kuhn et al., 2010a, 2010b, 2011a:2). Thus, “the Syria olive oil exports will most likely be adversely affected by the implementation of countervailing measures that include trade sanctions on the exports of countries that do not comply with environmental policies agreed to within the framework of the WTO-EU Agreements” (see Kuhn et al., 2010a, 2010b, 2011a:2). “Given the growing importance of the relationship between environmental policies and international trade competitiveness, it is important to analyse this relationship with a specific reference to the case of the olive oil agro-industrial sector in Syria” (see Kuhn et al., 2010a, 2010b, 2011a:3).

The olive oil agro-industrial sector plays a fundamental role in the Syrian economy as one of the most important agro-industrial sectors, and it is a major contributor to the national economy (see Mohammad, 2006:1; Kuhn et al., 2010a, 2010b, 2011a:3). The contribution of this sector ranged between 1.2% and 3.5% of the Syrian gross domestic product (GDP) over the period 2000-2006. “Syria is currently one of the largest world producers and exporters, accounting in 2006 for 9% of olive oil world production and 8% of world olive oil exports” (Kuhn et al., 2010a, 2010b, 2011a:11, 2012a:2). Furthermore, “Syria is the homeland of olive oil production” (Kuhn et al., 2011a:3, 2012a:2). “However, in recent years concerns about the pollution problems caused by the olive oil agro-industrial sector have increased and raised the issue of environmental protection” (Kuhn et al., 2012a:2). The increase in the number of olive oil mills, which amount to 857 mills (see Table 2.2 in the next Chapter), is the main determinant to the problem of environmental pollution related to olive oil production (see
Kuhn et al., 2010a, 2010b, 2011a:11). These concerns are also coupled with growing domestic and international pressures on the Syrian government to develop and to enforce environmental policies that are related to the international olive oil market (see Kuhn et al., 2010a, 2010b, 2011a:2).

At the same time, the Syrian government is adopting a more developing-open economy and trade regime as an essential part of its economic growth strategy. “Yet, in Syria there are often concerns that compliance with environmental policies involves additional costs that would mainly affect the domestic production costs and disrupt the international trade competitiveness of the olive oil sector” (Kuhn et al., 2012a:2). Ultimately, it is a matter of empirical investigation whether environmental compliance would have adverse or positive impact on trade competitiveness. However, in a dynamic context, efforts made to enforce compliance with environmental policies may also be offset by productivity gains brought about through innovation in the production process. This is the so-called Porter hypothesis (see Porter & Van der Linde, 1995a, 1995b, 2000). More details about this hypothesis will be explained later on with further depth in the economic literature review in section 1.2 of the study. This is exactly the point on which we would like to put emphasis in the present study.

Accordingly, the hypothesis of this study is that strict environmental policies affects trade competitiveness in the pollution-intensive sectors. In particular, we put special emphasis on the olive oil sector. This mostly happen by means of inducing changes in production costs and promoting technical and technological innovations. That is because the costs and innovations levels are the main factors influencing the price and production levels respectively, and the price and production levels respectively have direct impact on the sector’s trade competitiveness in export markets (see, e.g., Qing & Honglei, 2009).

Reality has shown that each country increasingly enhances environmental policies in the process of economic development. Based on what has been studied on this subject under METAP and motivated by Porter hypothesis, the purpose of this study is to contribute to update the METAP MedPolicies Initiative by showing considerable promise in measuring the environmental policies impacts on trade competitiveness in the Arab countries. Specifically, the present study focuses on assessing the impact of compliance with the WTO-EU environmental policies on trade competitiveness in the case of the Syrian olive oil sector. In particular, we take specific emphasis on the production and export levels.
To that end, the basic questions of this study can be formulated as follows: (1) “Will the implementation of compliance with environmental policies in Syria lead to an increase in production costs and a reduction in export competitiveness for the olive oil sector; (2) by about how much will production and exports levels of the olive oil sector changes if compliance with environmental policies is adopted and enforced; (3) and does the adoption and enforcement of compliance with environmental policies create new incentives and opportunities for the olive oil sector to reduce environmental compliance costs?” (Kuhn et al., 2010a, 2010b, 2011a:15).

In line with the preceding discussion of the study’s problems, motivations and questions, the analysis adopted in the present study follows, with some modifications, a theoretical trade model developed by Larson under the METAP MedPolicies Initiative. This model explains trade competitiveness as influenced by environmental compliance costs. The Porter hypothesis, which demonstrates the relationship between trade competitiveness and environmental policies, motivates the approach used here. The most novel part of this approach consists of including the innovation offsets due to compliance with environmental policies. In this approach, we propose to confirm the Porter hypothesis that suitably designed environmental policies can generate innovation that may partially or more than fully offset the compliance costs (Porter & Van der Linde, 1995b:98). In other words, environmental policies are to foster the innovation offsets that arise from new technologies and approaches to production processes, and consequently, environmental policies may have a positive impact on trade competitiveness, in particular, of environmentally sensitive sectors (see, e.g., Ambec et al., 2011; Silverman, 2011).

Driven by the general issues discussed above, “we try to set up a theoretical model suited to this approach. This is mainly in order to capture the main environmental measures and policy options available. In particular, we take specific emphasis on the following three effects; the environmental compliance costs, the induced technological progress, and the burden shifting onto consumers in foreign market” (Kuhn et al., 2011b:5, 2012a:2, 2012b:2). The logic of this model is designed to be applied and implemented at the industry and/or sector level in a particular market of the economy. This model evaluates sector-specific trade impacts of environmental policy changes, assumes a perfectly competitive market.
The model procedure is developed by Larson (2000a, 2000b) and Larson et al. (2002) for the “input-specific” environmental policies and modified by Kuhn et al. (2011b, 2012a, 2012b) for the “end-of-the-pipe” environmental policies. “In particular, we first set up a partial-equilibrium trade model for an open economy in order to compute theoretically the impact of environmental compliance costs on the production and export levels. Then, we estimate the relevant elasticities values by means of econometric regressions. Finally, we simulate the implementation of the environmental policies and assess their impacts on both production and exports levels. This model therefore calculates the percentage changes in the production and exports levels determined by compliance with environmental policies for the case of olive oil in Syria” (Kuhn et al., 2011a:7, 2011b:2, 2012a:2, 2012b:2).

“As far as our approach is concerned, we should put emphasis on the differences between our approach and other approaches described in the related trade-environment literature. While other approaches paid special attention on the price increase of primary inputs induced by environmental policies that target key economic sectors, in our approach we pay special attention on the environmental policies that target the treatment of wastewaters released into the environment by harmful production processes. In view of that, the basic approach developed by Larson under the METAP MedPolicies Initiative has to be modified. In particular, the link between the compliance costs and the innovation offsets due to efficiency improvements has to be taken into account with more caution. In other word, the impact of the increase of environmental compliance costs on the efficiency of production processes and the choice of technological options is modeled as a further impact of the compliance unit cost on the input’s shadow price. This further impact has not been thoroughly explored so far in the economic literature, and which to a large extent drives the main results of the present study” (Kuhn et al., 2012b:4).

“The model implemented in the present study therefore specifies theoretically and empirically the relationship among the compliance costs, the technological option and the level of production under some environmental policies” (Kuhn et al., 2012b:3). “Three main scenarios are simulated from the application of this model for the olive oil agro-industrial sector in Syria. The first scenario (a basic model case) estimates the impact of the compliance costs increase on the production and exports levels. The second scenario (an efficiency improvements case) incorporates the use of more efficient production technologies in the production process. In this scenario, the burden of the environmental compliance costs
imposed on the sector is considered to foster the implementation of advanced production technologies in line with the Porter-like induced technological improvement. The third scenario (a large country case) takes into account the possibility of shifting along a part of the burden of the environmental compliance costs to the consumers in export markets” (Kuhn et al., 2010a, 2010b, 2011a:3, 2012a:2-3). However, “to which extent the production and exports levels will be affected will depend on the particular composition of the three effects mentioned, the environmental compliance costs’ increase, the induced technical progress and the world market price’ shift” (Kuhn et al., 2011b:5, 2012a:6, 2012b:6).

“The main results of this study certainly disprove the legitimacy of concerns that stricter environmental policies in Syria may have negative impacts on its production and export competitiveness levels. Specifically, our empirical analysis for Syria finds that compliance with environmental policies in the case of output price adjustments, i.e., assuming that Syria is a large economy in the world olive oil market, would have positive impacts on the Syrian olive oil production and export competitiveness levels. In addition, the empirical findings provide strong support to the Porter hypothesis and its application to the international markets for the agro-industrial sectors. Achieving compliance with environmental policies would stimulate innovation and the use of environmentally clean technologies, which in fact lead to a reduction in the effective environmental compliance costs. The policy implications for Syria suggest, therefore, that the implementation of stricter environmental policies supporting environmentally sound technologies (ESTs)” (see Kuhn et al., 2011a:1, 15-16, 2012a:1, 15).

These results are important for several reasons. First, it is imperative for the Syrian government and policy analysts to have the ability to predict environmental policies facing olive oil producers to ensure that assessing the impact of them can be dealt with it effectively. Second, the results are expected to assist the Syrian government in examining how compliance with environmental policies can help improve the international trade competitiveness for the olive oil agro-industrial sector. Third, the results should help the Syrian government explore the need for supporting compliance with environmental policies in the olive oil sector as the best way to avoid environmental dumping in the region before the environmental damage occurs. For example, the olive oil sector should enhance efficiency, lower costs, and increase competition with a goal to comply with environmental policies. The olive oil sector rules and regulations should be revised to promote compliance with environmental policies.
1.2. Literature Review

This study relates to the economic literature dealing with the hypothesis that environmental policies have impacts on international trade competitiveness for developing countries. Therefore, the economic literature on several dimensions of environmental policies impacts on international trade competitiveness is reviewed in this section. An important topic in this context is the relationship between environment policies and trade competitiveness. This relationship has recently been analyzed in various theoretical and empirical studies investigating the impacts of environmental policies on international trade competitiveness (net exports). The issue is whether more stringent environmental policies might increase production costs and make pollution-intensive sectors less competitive in international markets, thereby affecting the international trade competitiveness of the countries concerned (Caporale et al., 2010). From a theoretical point of view, “the introduction of stringent environmental policies involves additional compliance costs and will certainly raise the domestic sector’s production costs. These higher costs shift the sector’s supply curve accordingly to the left and therefore result in a reduction in both production and export levels” (Kuhn et al., 2011a:7, 2012a:6). As a result, environmental policies reduce the country’s international trade competitiveness (see Ayadi & Matoussi, 2007; Babool & Reed, 2010).

In regard to the relationship between environmental policies and trade competitiveness, the academic debate comes to three kinds of hypotheses; race to the bottom hypothesis, pollution haven hypothesis and Porter hypothesis. At the heart of those hypotheses is the impact of environmental policies on trade competitiveness. Recently, the research on this subject matter or theme has grown to become essential and important. While many empirical studies have been applied to those three hypotheses, however, they cannot provide clear support to either of these views (see, e.g., Managi et al., 2005; Temurshoev, 2006; Qing & Honglei, 2009). Therefore, we begin by clarifying those three hypotheses before reviewing the existing trade-environment literature.

Regarding the race to the bottom hypothesis, countries with strict environmental policies undertake additional costs to abate pollution and reduce environmental damage, and thus, they tend to have higher compliance costs than those with lower environmental policies. In the world market, this implies sectors in countries with more stringent environmental policies will be less competitive than those in countries with lower environmental policies. In this framework, countries are motivated to lower their environmental policies to keep their
pollution-intensive sectors competitive in the international market. Therefore, when trade between countries with different levels of environmental policies is liberalized, there will be a race to the bottom tendency. However, when the impact of environmental policies on trade competitiveness is insignificant and negligible, there will be no need to fear a race to the bottom tendency. In reality, this hypothesis does not come true because each country increasingly enhances its environmental policies in the socio-economic development process (see, e.g., Gareth, 1999; Qing & Honglei, 2009).

As to the pollution haven hypothesis, environmental policies may have a dynamic influence on the relocation of pollution-intensive sectors in an open economy. In other words, more stringent environmental policies in one country may cause dirty sectors to migrate to countries with more low environmental policies. There is a general belief that developed countries implement more stringent environmental policies than developing countries. According to this hypothesis, pollution-intensive sectors will migrate from developed countries to developing countries. Over time, the developing countries will become “havens” for the world’s polluting sectors, and thus they will lose in terms of environmental quality from trade. In general, when the impact of environmental policies on trade competitiveness is insignificant and trifling, dirty sectors will not migrate to locations with lower environmental policies. Thus, the pollution haven hypothesis would be proved to be unsupported and groundless (see, e.g., Temurshoev, 2006; Qing & Honglei, 2009).

The literature hypothesis which most strongly motivated this study is that of Porter hypothesis. Unlike the hypothesis of adverse effect of strict environmental policies on trade competitiveness, Porter argued that environmental policies have a positive impact on international trade competitiveness. According to this hypothesis, a country with strict environmental policies can benefit from the quality of environmental improvements, the introduction of cleaner technologies, and the efficient of production processes. The cost savings that can be achieved are enough to offset both the compliance costs and the innovation costs imposed by environmental policies. This country is therefore likely to develop and to set up novel comparative advantages in the environmentally more sensitive sectors. These advantages might more offset the net exports losses and enhance the country’s international trade competitiveness (see, e.g., Wagner, 2003; Karaman & Alpay, 2004; Hoffmann & Rotherham, 2006).
There is a large body of the related trade-environment literature that examines the link between environmental policies and trade competitiveness since a long time; however, the empirical evidence on this issue is mixed and not at all clear cut” (Kuhn et al., 2011a:2, 2012a:3-4, 2012b:3). The review of the most recent empirical studies has been taken from Kuhn et al. (2011a:2, 2012a:3-4, 2012b:3) and is listed below in order to give some examples.

The economic literature includes different methodologies that used in order to empirically estimate the environmental policies impacts on international trade competitiveness (see e.g. Babool, 2007; Iraldo et al., 2009). Concisely, we distinguish between two groups of empirical studies in the trade-environment literature (see Kuhn et al., 2012b:3). The first group argued on the negative impact of compliance with environmental policies on international competitiveness. They have found evidence to support the hypothesis that environmental policies influence and lead to loss of international trade competitiveness of pollution-intensive sectors (see, e.g., Van Beers and Van den Bergh, 1997; Mulatu et al., 2004; Busse, 2004). The second group of studies argued on the positive impact of compliance with environmental policies on international trade competitiveness. They found evidence to support the hypothesis that environmental policies do not significantly impact international trade competitiveness of the key agro-industrial sectors (see, e.g., Jaffe et al., 1995; Ratnayake, 1998; Grote et al., 2001; Harris et al., 2002; Ederington et al., 2005; Hesse, 2007; Babool & Reed, 2010). As to our knowledge, the most common finding in these studies is that environmental policies encourage innovation, enhance productivity and increase net exports in support of the Porter hypothesis (see Porter & Van der Linde, 1995b, 2000; Caporale et al., 2010; Kuhn et al., 2012b:3).

“In the most recent studies; using the standard factor endowment approach, Babool and Reed (2010) investigated empirically the effects of environmental policies on international trade competitiveness in different product-based industries. They constructed an econometric model, which includes factor endowments and environmental policies to examine how strict environmental policies impact international trade competitiveness. Their results indicate that each industry is unique in the way how the factors determine its international trade competitiveness and in many instances environmental policies are found important. They also found a positive relationship between international competitiveness and environmental policies for the respective products. In examining the same proposition, Caporale et al. (2010) analyzed the relationship between environmental policies and international trade...
competitiveness for the case of Romania. More precisely, they estimated gravity models to examine empirically whether the implementation of more stringent environmental policies has affected international competitiveness of the pollution-intensive products. They showed that stricter environmental policies do not affect international trade competitiveness significantly, possibly because of a comparative advantage as well as environmental costs representing a very small percentage of total production costs” (Kuhn et al., 2012a:3, 2012b:3).

“Among the empirical studies which are most closely related to this study are the following. Grote et al. (2001) conducted an international comparative analysis on the production and processing of selected agricultural products. They tested the hypothesis that compliance costs of higher environmental policies lead to unfair competitive disadvantages of countries. According to them, the case studies for selected agricultural products have shown that the compliance costs deriving from environmental policies on the production cost is relatively small and insignificant for impacting on the international competitiveness in case of the typical farms considered” (Kuhn et al., 2012a:3, 2012b:3).

“As far as the economic literature specific on the Arab-Mediterranean region is concerned, the impact of compliance with environmental policies on the international trade competitiveness has been widely addressed. Yet there has been little empirical analysis on this issue and particularly for Syria” (Kuhn et al., 2012a:4, 2012b:3). Under the METAP MedPolicies Initiative, there are few theoretical and empirical case studies addressing the same issue by using the same methodology followed in this study. Some case studies focus on agricultural markets: potato exports from Cyprus, fertilizer exports from Jordan, and date and citrus exports from Tunisia. Other case studies focus on textile and leather markets: textile exports from Syria and Morocco; and leather exports from Turkey (see HIID, 2000; Larson et al., 2002; UN-ESCWA, 2005). “As to our knowledge, there are no theoretical or empirical studies on the Syrian olive oil market addressing international competitiveness impacts of environmental policies” (Kuhn et al., 2012a:4).

The study this related to the existing literature in the Arab region as follows. It builds upon the MedPolicies case studies (HIID, 2000; UN-ESCWA, 2005) that analyze the impact of environmental policies on international trade competitiveness in agro-industrial sectors. Under the METAP MedPolicies Initiative, Larson (2000a, 2000b) and Larson et al. (2002) addressed questions about proposed changes in environmental policies in developing
economies where the time may preclude the use of more complicated theoretical and empirical analysis. The findings indicate that environmental policies changes have mix of both small and large impacts on production and net exports. For example, they found that environmental policies had a little impact on net exports in some cases (Jordan, Morocco and Cyprus); while in other cases the impact was substantially larger (Syria, Tunisia and Turkey). These results are based on the enormity of the environmental policies changes, the magnitude of different inputs in production, the lack of information on international export market conditions and other factors. They concluded that the impact of environmental policies on net exports depends on the case-study details and, as a result, it makes little sense to create extensive generalizations that environmental policies have no effect on international competitiveness on the one hand, or that more stringent environmental policies will harm international competitiveness on the other hand. “The UN-ESCWA (2005) conducted sector-specific analyses in the Arab region on the agro-food, textile and garment industries, The Findings show that environmental policies that target primary inputs of key economic sectors are likely to have significantly negative impacts on both production and exports levels and thus on the sector’s competitiveness in export markets” (see Kuhn et al., 2012b:3).

Similarly, other studies that jointly investigate this issue are the following. “In his study Babiker (2002) examined qualitatively and quantitatively the possible impacts of compliance with environmental policies (both domestic and international) on Kuwait exports of chemical and petrochemical industry using a partial equilibrium framework. He found that stricter environmental policies have negative impacts on this industry. Ayadi and Matoussi (2007) analyzed how stringent environmental policies might affect net exports of key agricultural sectors in the future. They assessed the impact of higher irrigation water costs on the production and exports of Tunisian dates and citrus products. Their results showed that higher environmental policies have negative impacts on these products as well as these impacts differ from one product to another. As reflected in their results, a major concern for policymakers in developing countries is that any environmental compliance costs increase will hurt the international competitiveness of key sectors, resulting in lower production and exports levels. The assessment of the link between compliance costs and key exports will definitely help in the drawing of better environmental policies” (Kuhn et al., 2012a:4, 2012b:3).

Overall, the critical review of the trade-environment literature on the relationship between environmental policies and trade competitiveness highlights that the existing empirical
analyses do not allow us to confirm that any strand of study has succeeded over the others (Iraldo et al., 2009). As to our knowledge, no unique relationship has prevailed in related literature or empirical evidence so far. For instance, most empirical studies use either the partial equilibrium models, the general equilibrium models of trade and pollution or the gravity models. However, these studies generate mixed results based on the study period, the countries/industries modelled, the adequate and reliable data on environmental policies and other factors. Thus, the debate about the environmental policies impacts on the international trade competitiveness continues (Babool & Reed, 2010). In general, one may conclude that the results depend heavily on the details of the studies with respect to the region under consideration, the characteristics of the sectors concerned and the forms of environmental policies adopted (Kuhn et al., 2012b:3). The methodology applied for assessing the impact may also generate different estimates (Kuhn et al., 2012b:3).

Accordingly, since we are interested in examining the relationship between environmental policies and trade competitiveness for the olive oil agro-industrial sector in the Arab region, the study is inspired by the literature on the MedPolicies case studies. While the MedPolicies case studies showed how to estimate the impact of “input-specific” environmental policies, in the present study we focus on estimating the impact of “end-of-the-pipe” environmental policies, and which we think might be more appropriate to the policy of Integrated Waste Management predominantly put in place in Syria. For all the MedPolicies case studies, much of the needed information on different sectors is basically missing due to the lack of data and resources for such information. The unique features of this study comprise the data measuring environmental policies as well as the extensive sector coverage. It could be therefore speculated that the analysis used here is clearer to follow than in the procedure outlined in the MedPolicies case studies. Furthermore, all of the empirical analysis discussed in this study is new and was not contained in the MedPolicies case studies.

In line with the economic trade-environment literature, “this study has aimed to fill the gap in the theoretical and empirical analyses that examining the problem of environmental policies impacts on trade competitiveness for the olive oil market in the Arab countries. It includes important details on the international competitiveness impacts of environmental policies for the olive oil sector in Syria. This study adds to the above related economic literature in a number of respects. First, this study modifies an approach that estimating the impact of “end-of-the-pipe” environmental policies on trade competitiveness for the Syrian olive oil market.
Second, 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. Third, the importance of this study also lies in the fact that it is a “first” in the agricultural sector addressing the olive oil products in the Arab countries. Finally, this study provides a strong support to the Porter hypothesis and its application to international markets for agricultural products in the Arab-Mediterranean region countries” (Kuhn et al., 2010a, 2010b, 2011a:16-17).

1.3. Outline of the Dissertation

The study is divided into three main parts including eight chapters. Part one provides the institutional setting and background. Part two provides the theoretical model and empirical analysis for Syria, while part three provides the environmental policy recommendations. After the introduction (Chapter one), Chapter two discusses the issue of international market for the olive oil agro-industrial sector. In Chapter three, the environmental baseline for the olive oil agro-industrial sector is provided by reviewing the environmental regulatory policies related to the olive oil agro-industrial sector in Syria. Chapter four explains the environmental problem and the potential environmental regulatory policies of this study.

As to the Theoretical Model and Empirical Analysis for Syria (part two), Chapter five analyzes the issue of modeling the impact of compliance with the WTO-EU environmental policies on trade competitiveness for the olive oil agro-industrial sector in Syria as a case study. Chapter six provides the empirical application and the analysis of the exploratory results by performing the econometric regression and environmental policy estimations of the case study.

Regarding the Environmental Policy Recommendations (part three), in Chapter seven, the matter of implementing the WTO-EU environmental policies for the international olive oil market is discussed: Where do the international trade competitiveness’ opportunities for Syria located? The final chapter (Chapter eight) presents in detail the policy implications and policy recommendations of this case study for Syria. In addition, the summary and concluding remarks will be presented. The Appendices provide the basic database, the proofs of some main results, the econometric regression and the sensitivity analysis with a view to study and analyze the main exploratory results, as well as providing the EU environmental regulatory policies related to the olive oil agro-industrial sector.
2. The International Market for the Olive Oil Agro-Industrial Sector in Syria

2.1. Introduction and Background

Olive oil production is currently a significant agro-industrial sector in Syria with important environmental and economic considerations. Moreover, the requirements to integrate environmental concerns into trade policies are enshrined in the WTO-EU agreements (see, e.g., Gebrselassie, 2010:131-132). However, until now there have been considerable obstacles to achieving this integration, such as the lack of clear and comprehensive information concerning the international markets of particular agro-industrial sectors. This is particularly apparent in the case of the olive oil agro-industrial sector in the Arab countries of the Mediterranean region and particularly in Syria.

In this Chapter, there is an analysis of the main features of the international market for the olive oil agro-industrial sector in Syria. Its constraints and potentials in relation to the domestic and international marketing issues are also identified. Marketing issues have become significantly important since olive oil production has exceeded the olive oil domestic consumption. The gap between olive oil production and export could therefore grow because of the adoption of environmental policies in the international markets. This study analyses the main issues in relation to these aspects. In particular, it analyses the development of the international market related to the olive oil production, consumption and export in the Mediterranean region and particularly in Syria (see, e.g., Malevolti, 1999:3).

2.2. General Overview of the International Olive Oil Market

Olive oil production: Countries in the Mediterranean region are considered to be the natural home for olive oil production. These countries are mainly; Spain, Italy, Greece, Syria, Turkey, Tunisia and Morocco as evidenced by the next graph. These seven countries alone account for 96% of world production in 2006 (UNCTAD, 2006b) (see Appendix 1, Table 1.1 for more details).
The quantities of olive oil world production and their evolution during the last ten years are shown in the graph below. Production trend by country is ascending but the great influence of the two major Arab producing countries introduced a high level of uncertainty in the production level. Indeed, the fact that production in Syria and Tunisia in addition to the major EU producing countries (Spain and Italy) changed much more than the one of the other producing countries, explains the high volatility of global production (UNCTAD, 2006b).

Figure 2.1: Main producing countries of olive oil in 2006
Source: Author’s elaborated based on data from the IOOC (2006)

Figure 2.2: Production of olive oil, 1997-2006 (1,000 tons)
Source: Author’s elaborated based on data from the IOOC (2006)
Figure 2.3 shows a growing trend for the production of olive oil in the Arab countries in general and in Syria in particular, where the production of olive oil increased from about 260 and 78 thousand tons in 1997 to about 574 and 252 thousand tons in 2006 respectively. This is mainly due to the increased production of olives, which in turn is linked to the substantial increase in the cultivated areas with olives. This is also attributable to the introduction of new varieties of olives, which contain higher percentages of oil output.

**Olive oil consumption:** The major olive oil consuming countries are also the major olive oil producing countries, as evidenced by the next graph. European Union accounts for 72% of world consumption. Arab countries account for 9% of world consumption. Syria accounts for 4% of world consumption. Mediterranean region countries represent 83% of world consumption. Other countries such as Australia, Canada and United States are also considered to be the olive oil consuming countries (UNCTAD, 2006b).
Olive oil exports: Main producing countries are also the main exporting counties as it can be seen from the graphs below. Thus, olive oil exports in the Mediterranean region countries provide more than 95% of the total olive oil world exports (UNCTAD, 2006b) (see Appendix 1, Table 1.1 for more details).
Figure 2.6: Exports of olive oil, 1997-2006 (1,000 tons)
Source: Author’s elaborated based on data from the IOOC (2006)

Syrian exports of olive oil are closely linked to the alternative bearing phenomena and the amount of available production from year to year shown by the olives trees, where the exports increase in the years that attest production significantly, and they decrease in the years that less production (see, e.g., Mohammad, 2006:1-2; Mohammad, 2009:1-2).

As noted from the Figures 2.7 and 2.8 below, Arab exports of olive oil in general and the Syrian exports of olive oil in particular, have increased significantly during the period 1997-2006 from about 133 and 3 thousand tons in 1997 to about 291 and 56 thousand tons in 2006 respectively. In addition, the general trend of olive oil exports in terms of value indicates significant growth during the same period from about 403 and 10 million dollars in 1997 to about 793 and 205 million dollars in 2006 respectively.
Figure 2.7: Exports of olive oil, 1997-2006 (1,000 tons)
Source: Author’s elaborated based on data from the IOOC (2006) and Syrian Central Bureau of Statistics (2007b)

Figure 2.8: Exports of olive oil, 1997-2006 (Million $US)

Based on the above Figures, the presence of an increased growth in production, consumption and exports of olive oil products is noted. The existence of a large surplus of olive oil production for export in Arab countries in general and in Syria in particular is also noted.
Therefore, there is an urgent need highlighted to improve and develop the production and extraction processes of olive oil products. This is in particular with regard to compliance with environmental policies adopted in the international markets by the WTO and EU.

From the above discussion it follows that Syria is considered as one of the major countries in producing, consuming and exporting olive oil products. In addition, Syria is basically the country of origin for olives trees as reported below in Figure 2.9. Moreover, Syria has the existence of other features that suit this study and analysis (e.g., implementing the Integrated Pest Management and Integrated Waste Management policies for the olive oil agro-industrial sector). It is, therefore, quite reasonable based the above discussion, to take the olive oil agro-industrial sector in Syria as an example to estimate the impact of compliance with the WTO-EU environmental policies for the international olive oil market on trade competitiveness for the Arab developing economies.

2.3. Overview of the International Olive Oil Market in Syria

Syria is seeking to join the WTO-EU agreements, and thus, needs to apply compliance with environmental policies adopted by the WTO-EU agreements as a precondition for its admission. These policies involve “input-specific” and “end-of-the-pipe” policies related to the olive oil market. Compliance with these environmental policies could adversely affect the Syrian olive oil production and exports levels. In the following sections, therefore there will be a discussion on the history and status of olive oil production in Syria. The most important issues related to the contribution of this agro-industrial sector to the GDP are discussed. Moreover, trade and environmental issues concerning the Syrian olive oil production and exports at the domestic and international levels are highlighted (see Kuhn et al., 2010a, 2010b, 2011a).

2.3.1. History and Status of the Olive and Olive Oil Production

Syria is considered as the homeland of the olive tree prior to its spread to the rest of the world, as can be seen from the next graph (see Kuhn et al., 2010a, 2010b, 2011a:3, 2012a:2). The relevant literature and the views of researchers have indicated that the olive tree was primary a native of the greater Syria almost six thousand years ago, e.g., in some references 12000 years (see Kuhn et al., 2010a, 2010b, 2011a:3). Phoenicians spread the olive plant in 16th century B.C. to the Greek islands. Starting from 11th century B.C. olive entered Spain. In the 6th century B.C. olives moved to several of Mediterranean coasts (Mohammad, 2006:1).
The agro-industrial olive oil sector is one of the most important production sectors in Syria (see Kuhn et al., 2010a, 2010b, 2011a:3). It is also “a major contributor to the national economy because of the economic importance of this sector and due to its contribution to GDP” (Kuhn et al., 2010a, 2010b, 2011a:3). “Not only does it earn foreign currency from exports it also generates rural employment where olive farming is located” (Mohammad, 2006:1; Kuhn et al., 2010a, 2010b, 2011a:3). Besides, “this sector has nutritional importance, for olive oil is considered as a major source for various nutritional elements such as fatty acids and carotene” (Mohammad, 2006:1; Kuhn et al., 2010a, 2010b, 2011a:3). More to the point, “planting olive trees in general improves the natural environment quality both aesthetically and in terms of sustainable development” (Mohammad, 2006:1; Kuhn et al., 2010a, 2010b, 2011a:3).

Olive trees constituted an area of 565 thousand hectares in 2006, and about 10% of the cultivated area and 63% of the land area cultivated with fruit trees. The cultivated area of olive tree plantation in Syria includes about 82 million olive trees, 74% of which are in the process of fruiting. There are about 850 million trees in the world with 98% share in the Mediterranean region countries (IOOC, 2006; Dimashki & Al Rawas, 2006:7, 10; Statistical Abstract, 2007a:130-131; Asfari, 2007:5). The olive plantations are mainly located in the northern and western areas. They are also broadly extended in the southern and middle areas. In addition, they are scarcely spread in the eastern region, as can be seen in the next Figure 2.10. There are more than 10 government centers for producing young olives trees. They produce more than 4 million seedlings annually. These seedlings are distributed among the farmers with symbolic prices. In particular, “Syria has a fortune of the most excellent varieties
of olives in the world. Some of these varieties are destined for olive oil extraction. Other varieties are for the preparation of table olives” (Mohammad, 2009:1). The most important of these varieties are explained in the Table 2.1 below.

<table>
<thead>
<tr>
<th>Varieties names</th>
<th>Location</th>
<th>Properties</th>
<th>Plantation area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al-Zeiti</td>
<td>Aleppo</td>
<td>28-30% oil</td>
<td>33%</td>
</tr>
<tr>
<td>Al-Sourani</td>
<td>Idleb</td>
<td>25-30% oil</td>
<td>27.5%</td>
</tr>
<tr>
<td>Al-Dou’aybli (Al-Darmlali &amp; Al-Tamrani)</td>
<td>Syrian coastal region</td>
<td>20-24% oil</td>
<td>12%</td>
</tr>
<tr>
<td>Al-Khdeiri</td>
<td>Coastal regions</td>
<td>22-26% oil</td>
<td>10.5%</td>
</tr>
<tr>
<td>Al-Jlot</td>
<td>Damascus, Dar’a</td>
<td>Relatively Large fruit</td>
<td>5%</td>
</tr>
<tr>
<td>Al-Qaisi</td>
<td>Aleppo</td>
<td>Good for fermentation</td>
<td>4.5%</td>
</tr>
<tr>
<td>Mohazzam abou Satel</td>
<td>Southern and middle regions</td>
<td></td>
<td>4.5%</td>
</tr>
<tr>
<td>Al-Dan</td>
<td>Damascus and its suburbs</td>
<td>20-24% oil</td>
<td>1.5%</td>
</tr>
<tr>
<td>Al-Mas’abi and other varieties</td>
<td>Damascus, its suburbs &amp; Dar’a</td>
<td>Voluminous fruit</td>
<td>1.5%</td>
</tr>
</tbody>
</table>

Table 2.1: Varieties planted of olives in Syria, their properties and geographical distribution
Source: Ministry of Agriculture and Agrarian Reform, 2005; Dimashki & Al Rawas, 2006:7; www.emocsyria.com/history.htm

Figure 2.10: Locations & distribution of olive trees plantation in Syria
Source: Ministry of Agriculture and Agrarian Reform, 2005; Dimashki & Al Rawas, 2006:10
2.3.2. The Structure of the Production for the Olive Oil Agro-Industrial Sector

“Syria is ranked the fourth largest producer of olive oil production in the world after Spain, Italy and Greece in 2006” (Kuhn et al., 2010a, 2010b, 2011a:11, 2012a:11), as shown in Figure 2.1 (IOOC, 2006). This did not come from a vacuum but from extensive efforts to reach this place. Table 2.2 below “presents the key statistics of the olive oil agro-industrial sector in Syria for the period 1990-2006” (Kuhn et al., 2010a, 2010b, 2011a:11, 2012a:11). “Production in 2006 is evaluated at about 1.2 million tons of olives and a quarter million tons of olive oil, which constitute 9% of world production” (Kuhn et al., 2010a, 2010b, 2011a:11, 2012a:11). This important article of food is called green gold if oil is called black gold. Where, Syria is likely to export about 125 thousand tons of olive oil, valued at about 455 million Euros, which would provide more foreign currency for the Syrian economy. In contrast, there is an increase in the number of olive oil mills, which amount to 857 mills at the country level in 2006. This is the main determinant of the problem of pollution related to olive oil production. This problem needs for concerted efforts to solve it (see Kuhn et al., 2010a, 2010b, 2011a:11).

<table>
<thead>
<tr>
<th>Years</th>
<th>Production of olives (ton)</th>
<th>No. of olive mills (per unit)</th>
<th>Olives for oil (ton) (X)</th>
<th>Production of olive oil (ton) (Y)</th>
<th>Domestic consumption (ton) (B)</th>
<th>Exports (ton) (E)</th>
<th>Price/ton (P)</th>
<th>Syrian Pounds</th>
<th>Euro</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>460468</td>
<td>614</td>
<td>369590</td>
<td>85893</td>
<td>62000</td>
<td>na</td>
<td></td>
<td>94000</td>
<td>na</td>
</tr>
<tr>
<td>1991</td>
<td>225861</td>
<td>645</td>
<td>160083</td>
<td>39032</td>
<td>66000</td>
<td>na</td>
<td></td>
<td>94000</td>
<td>na</td>
</tr>
<tr>
<td>1992</td>
<td>513315</td>
<td>627</td>
<td>405602</td>
<td>102955</td>
<td>67000</td>
<td>na</td>
<td></td>
<td>108000</td>
<td>na</td>
</tr>
<tr>
<td>1993</td>
<td>325164</td>
<td>655</td>
<td>234561</td>
<td>60139</td>
<td>69000</td>
<td>140</td>
<td></td>
<td>117000</td>
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<td>85000</td>
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<td></td>
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<td>95384</td>
<td>86000</td>
<td>2245</td>
<td></td>
<td>140000</td>
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<td>752</td>
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<td>194599</td>
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<tr>
<td>2003</td>
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<td>759</td>
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<td></td>
<td>121000</td>
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<tr>
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<td>779</td>
<td>875342</td>
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<td>135000</td>
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<td></td>
<td>137000</td>
<td>2027</td>
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<tr>
<td>2005</td>
<td>612223</td>
<td>827</td>
<td>500840</td>
<td>123143</td>
<td>94000</td>
<td>44671</td>
<td></td>
<td>181000</td>
<td>2710</td>
</tr>
</tbody>
</table>

Table 2.2: Key statistics of the olive oil agro-industrial sector in Syria
Source: Author’s elaborated based on data from the IOOC (2006); Syrian Central Bureau of Statistics (2007b)

1This section has been taken identically from Kuhn et al. (2010a, 2010b, 2011a, 2011b, 2012a, 2012b).
As reported above, Table 2.2 shows that the total olive oil production varies greatly from year to year. This is mainly due to the alternate bearing phenomena or the so-called the fluctuation phenomena for olive oil production. “The dataset also shows an upward long run trend of production, domestic consumption and exports of olive oil from year to year” (Kuhn et al., 2010a, 2010b, 2011a:11, 2012a:11). “This is mainly due to (a) the fluctuated production in this period as a result of the alternative bearing phenomena (production decreases to about half in seasonal years); (b) the existence of olive oil imports as a result of the regional and international free trade agreements; and (c) the possibility of storing olive oil production from year to year without any negative impact on its quality so that it be used during the following year” (Kuhn et al., 2010a, 2010b, 2011a:11, 2012a:11). “The dataset reveals further that the sector consists mainly of a large number of olive oil mills, which have increased significantly, at a rate of about 30% between 1990 and 2006” (Kuhn et al., 2010a, 2010b, 2011a:11, 2012a:11). In addition, “it is noted that there was a doubling in the production and domestic consumption of olive oil during the same period” (Kuhn et al., 2010a, 2010b, 2011a:11). 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 olive oil during the same period” (Kuhn et al., 2010a, 2010b, 2011a:11, 2012a:11).

The growing production of olive harvest and olive oil products may help Syria to improve its position shortly if it modern methods and technologies are applied, especially with respect to compliance with environmental regulatory policies adopted globally. Impressively, the olive-mill industry in Syria rests entirely in the hands of the private sector, where the policy of deregulation of prices and agricultural support schemes has led to a rise in all rates and numbers of olive trees, cultivated areas, olive production, olive oil production and the increase of exports. In addition, there are about 400 thousand families (between 20 - 25% of the Syrian population) working in the olive cultivation, olive oil production and trade and olive cultivation is considered as their main source of income, and they constitute 10% of the labor force (Dimashki & Al Rawas, 2006:10; Mohammad, 2009:1). “The European Union, the United States of America, Eastern Asia, Australia and the Arab Gulf states are considered the most promising markets for Syrian exports of olive oil products” (Kuhn et al., 2010a, 2010b, 2011a:11).
2.3.3. The Contribution to the GDP of the Olive Oil Agro-Industrial Sector

The contribution of the olive oil agro-industrial sector to the GDP is rather high in Syria, in view of the fact that the olive oil sector is a growing sector. Table 2.3 below provides this contribution in the form of a percentage of the agriculture sector, the manufacturing sector and of the GDP over the period 2000-2006. As can be seen from the table, the share of the olive oil agro-industrial sector has increased from 10% in 2000 to 17% in 2006 of the total GDP for agriculture, and it has also increased from 8% in 2000 to 13% in 2006 of the total GDP for manufacturing, while it has ranged between 1.2% and 3.5% of the total GDP during the same period. This implies that the economy-wide costs of any environmental policy measures affecting the olive oil agro-industrial sector (for example, compliance with environmental regulatory policies) should be reasonably considered. Moreover, this would support the partial equilibrium approach to be followed later in this study (in Chapter 5), which is aimed at assessing the economic impact of compliance with environmental policies on trade competitiveness for the olive oil agro-industrial sector in Syria.

<table>
<thead>
<tr>
<th>Sector</th>
<th>Year</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>Olive Oil</td>
<td></td>
<td>22770</td>
<td>13300</td>
<td>23595</td>
<td>12584</td>
<td>27674</td>
<td>22263</td>
<td>59850</td>
</tr>
<tr>
<td>Agriculture</td>
<td></td>
<td>223749</td>
<td>246404</td>
<td>254181</td>
<td>264840</td>
<td>281177</td>
<td>305351</td>
<td>347361</td>
</tr>
<tr>
<td>Manufacturing</td>
<td></td>
<td>272514</td>
<td>264569</td>
<td>265108</td>
<td>259742</td>
<td>331959</td>
<td>418503</td>
<td>466859</td>
</tr>
<tr>
<td>GDP</td>
<td></td>
<td>903944</td>
<td>974008</td>
<td>1016519</td>
<td>1067265</td>
<td>1263139</td>
<td>1490798</td>
<td>1708745</td>
</tr>
<tr>
<td>% of Agriculture</td>
<td>10.1</td>
<td>9.3</td>
<td>9.3</td>
<td>8.9</td>
<td>8.3</td>
<td>8.3</td>
<td>7.3</td>
<td>17.2</td>
</tr>
<tr>
<td>% of Manufacturing</td>
<td>8.4</td>
<td>5.4</td>
<td>9.3</td>
<td>4.8</td>
<td>9.8</td>
<td>8.3</td>
<td>7.3</td>
<td>17.2</td>
</tr>
<tr>
<td>% of GDP</td>
<td>2.5</td>
<td>1.4</td>
<td>2.3</td>
<td>1.2</td>
<td>2.2</td>
<td>1.5</td>
<td>3.5</td>
<td></td>
</tr>
</tbody>
</table>

Table 2.3: Contribution to GDP of the olive oil agro-industrial sector in Syria  
(The value in million SP)  
Source: Author’s calculations based on data from the Syrian Statistical Yearbooks 2000-2007

2.3.4. The Structure of the Exports for the Olive Oil Agro-Industrial Sector

Important competitiveness aspects of environmental policies are the impacts on the production and exports levels. Table 2.4 shows the export performance of the olive oil sector in Syria over the period 2000-2006. In Table 2.4, row 1 presents the total quantity of olive oil exports, row 2 presents the value of exports in Syrian pounds and Euros, row 3 presents its percentage share of the total exports, row 4 presents its percentage share of the total non-oil exports, and row 5 presents the value of exports in Euros to the major export destinations, namely: Spain, Italy, the United States, Saudi Arabia, and the United Arab Emirates.
<table>
<thead>
<tr>
<th>Year</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total (ton)</td>
<td>1737</td>
<td>2245</td>
<td>4739</td>
<td>30445</td>
<td>22161</td>
<td>44671</td>
<td>56526</td>
</tr>
<tr>
<td>Total (m SP)</td>
<td>276</td>
<td>308</td>
<td>605</td>
<td>3751</td>
<td>3014</td>
<td>8145</td>
<td>13538</td>
</tr>
<tr>
<td>% of Total Exports</td>
<td>6.4</td>
<td>7.5</td>
<td>12.5</td>
<td>59.2</td>
<td>44.6</td>
<td>122</td>
<td>207</td>
</tr>
<tr>
<td>% of Non-Oil Exports</td>
<td>0.1</td>
<td>0.1</td>
<td>0.2</td>
<td>1.4</td>
<td>1</td>
<td>2</td>
<td>2.7</td>
</tr>
<tr>
<td>Flows to Major Destinations (m €)</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spain</td>
<td>na</td>
<td>na</td>
<td>0.42</td>
<td>3.8</td>
<td>3.5</td>
<td>22.1</td>
<td>32</td>
</tr>
<tr>
<td>Italy</td>
<td>na</td>
<td>na</td>
<td>0.20</td>
<td>27.6</td>
<td>21.5</td>
<td>48.3</td>
<td>86.1</td>
</tr>
<tr>
<td>Germany</td>
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<td>na</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td>Switzerland</td>
<td>na</td>
<td>na</td>
<td>1.3</td>
<td>9.9</td>
<td>5.3</td>
<td>10.5</td>
<td>na</td>
</tr>
<tr>
<td>United States</td>
<td>0.30</td>
<td>0.06</td>
<td>0.01</td>
<td>0.54</td>
<td>1.02</td>
<td>2.2</td>
<td>7.1</td>
</tr>
<tr>
<td>Iran</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>0.58</td>
<td>0.61</td>
<td>1.1</td>
<td>10</td>
</tr>
<tr>
<td>Lebanon</td>
<td>0.04</td>
<td>0.04</td>
<td>na</td>
<td>na</td>
<td>0.41</td>
<td>2.7</td>
<td>11.3</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>0.68</td>
<td>0.50</td>
<td>2.7</td>
<td>3.1</td>
<td>3.1</td>
<td>3.8</td>
<td>17.7</td>
</tr>
<tr>
<td>United Arab Emirates</td>
<td>0.25</td>
<td>0.06</td>
<td>0.34</td>
<td>0.61</td>
<td>1.02</td>
<td>5.4</td>
<td>6.4</td>
</tr>
<tr>
<td>Kuwait</td>
<td>0.12</td>
<td>0.10</td>
<td>0.70</td>
<td>1.0</td>
<td>1.4</td>
<td>1.9</td>
<td>6.7</td>
</tr>
</tbody>
</table>

Table 2.4: The values and direction of Syrian exports of olive oil product
Source: Author’s calculations based on data from the Syrian Central Bureau of Statistics 2000-2007

In Table 2.4, “the main feature to note is the large increase in the volume and value of olive oil exports after 2002” (Kuhn et al., 2010a, 2010b, 2011a:11, 2012a:11). This is mainly “due to the rise in the amount of olive oil production and the existence of an increasingly large surplus for export” (Kuhn et al., 2010a, 2010b, 2011a:11, 2012a:11). This maximizes the contribution of the sector to the total country exports from less than 0.1% to 2.7% and its contribution to non-oil exports from less than 0.4% to 4.2%. Another important feature is the dramatic increase in the quantity of olive oil exports after 2002. This has been determined by “the growing importance of EU markets as mainly outlets for Syrian olive oil exports, which are account for more than 50% of the total export market for the year 2006, where large quantities of Syrian olive oil production are exported to some European countries such as Spain and Italy” (Kuhn et al., 2010a, 2010b, 2011a:11). “This is because the olive oil domestic production in these countries in some specific years is not sufficient to cover their binding contracts with the main importing countries” (Mohammad, 2006:8; Kuhn et al., 2010a, 2010b, 2011a:11). In contrast, the Gulf market comes second by about 20% of the total Syrian exports for the year 2006. Moreover, the markets of Lebanon, Iran and the United States came in third place, where they accounted for about 5.6%, 5% and 3.5% respectively. It
should also be noted that the size of the East Asia and Australia markets is not reported because of their small shares of the total Syrian olive oil exports during the same period.

At the international level, the IOOC was established in 1959 as the organization responsible for the administration of the International Olive Oil Agreement signed in 1956. The IOOC strategy aims to improving olive oil production in terms of its quantity and quality, in addition, it aims to organize the trade and market of olive oil products, as well as aiming to find a solution for the environmental problems and obstacles in the fields of olive oil production and trade (IOOC, 2008:1-2; Mohammad, 2006:5; Mohammad, 2009:5). The olive oil standards based on the IOOC standards are as following (IOOC, 2008:1-2; Mohammad, 2009:5):

- Extra-virgin olive oil comes from the first milling of the olives, and must contain no more than 0.8% acidity. It also has better-quality taste and flavor with no refined olive oil.
- Virgin olive oil is obliged to have no more than two percent acidity. It also has a good taste with no refined olive oil.
- Olive oil is a mix of virgin olive oil and polished virgin olive oil. It must contain no more extra than one percent acidity. This type in general lacks a strong flavor.
- Olive-pomace oil is a mixed of refined olive-pomace oil and sometimes some virgin olive oil. It is fit for human consumption. It may not be called olive oil. It is rarely found in grocery stores. It is often used for certain types of cooking in restaurants.
- Lampante olive oil is olive oil that not healthy for human consumption. This type is mostly consumed and used in the agro-industrial markets.

With respect to international trade liberalization, the Syrian government has signed several multilateral trade agreements that aim to set up free trade zones (Mohammad, 2006:9). In addition, the government is actively pursuing the draft of the Syrian-EU Association Agreement. This agreement provides preferential treatment and full tariff exemption for the agro-industrial processed products that are Syrian of origin (including olive oil and unspecified quantities of olive oil in bulk containers) when exported to EU countries (Al Issa, 2005:4).

Furthermore, the trade relations between Syria and the EU until the signing of the Syrian-EU Association Agreement will be based on the Cooperation Agreement signed in 1977. In this
context, the Syrian industrial exports would be exempted from all customs duties. The Syrian agricultural exports would also be granted preferential treatment in the European markets.

At the domestic level, the Syrian government has exempted many of the major olive oil export industries from the systematic controlling provision on exports by the External Trade Center. Where, these industries will be subjected to selective control by the External Trade Center according to international environmental standards and regulatory policies (Mohammad, 2006:9).

The Syrian government is therefore actively encouraged to work for the investment of the strategic olive oil production in the process of advancing and improving the reality of the Syrian economy. The government needs to implement many of the procedures, plans, programs and laws related to the olive oil agro-industrial sector. The government also needs to adopt and enforce the international environmental regulatory policies related to the olive oil agro-industrial sector in order to remove all the olive oil production and marketing obstacles at both domestic and international levels. Consequently, the Syrian government needs to find solutions to the environmental pollution problem related to the olive oil agro-industrial sector. Thereby, olive oil producers as well as owners of olive oil mills are able to implement these solutions as is the case in the rest of the olive oil producing countries in the Mediterranean region. This is for the most part in order to develop and improve the olive oil production and exports levels.
3. The Implemented Domestic and International Environmental Policies Affecting the Olive Oil Agro-Industrial Sector in Syria

The pursuit for achieving the sustainable protection of the largely natural environment has become a central aspiration of all the political systems in most countries in recent years (OECD, 2006:18). Many elements and components of the natural environment (clean air, calm, tranquility, water, peace and landscape) are considered to be public or quasi-public benefits. In the context of the absence of effective governmental intervention policies, the social cost of use will exceed the private cost. In addition, the public good and interest will be subject to reducing welfare by over-exploitation of the natural resources (Coase, 1960). This would lead to the so-called the phenomenon tragedy of environmental commons (Hardin, 1968).

Institutions aimed at protecting the environment have existed in most of the developing countries since many years. Until relatively recently, these institutions have begun to set up an environmental regulatory program upon which a polluting industry could or could not do. For example, a polluting industry has to do putting a cover on its emissions, the installation of advanced technologies, building central treatment plants, or limiting entry to conduct of the activity (Perman et al., 2003; Heyes & Liston, 2006). The objective of this program is to limit damage to the natural environment, and to achieve that end without generating excessive economic burdens.

The potential use of environmental policies as the best way to enhance trade competitiveness in the worldwide markets is a topic of growing policy concern (see, e.g., Hamilton & Requate, 2004:260). Indeed, the environmental characteristics of products and production processes are increasingly becoming an influential factor in determining the quality of products and trade competitiveness at the local and international levels. The Syrian producers and exporters must strive to the maximum extent possible to meet compliance with environmental policies that relate to the olive oil agro-industrial sector and are adopted in foreign export markets. Therefore, they are able to compete effectively in the international markets. Where achieving compliance with environmental regulatory policies has become an integral part of the quality of products and trade competitiveness, the Syrian producers and exporters need to be able to meet such policies in order to achieve customary market prices. “Meeting such regulatory policies leads both to price premiums and to higher market shares for them” (Kuhn et al., 2010a:2, 2010b:2). Thus, environmental policies related to the international olive oil market
are increasingly appearing as one of the main tools in the race to enhance international trade competitiveness (see, e.g., Hoffmann, 2004:4).

3.1. The Domestic Environmental Regulatory Policies Related to the Olive Oil Agro-Industrial Sector

In 1991, Syrian government established a ministry for dealing with environmental issues; an action which witnessed the formation of the first Ministry of the Environment in the Arab countries. The review of the environmental regulatory policies related to the olive oil production available in Syria points to the existence of several laws on environmental protection, including the Environment Law No. 50/2002, the General Cleanness Law No. 49/2004, Water Law No. 10/2005, and Law No. 9/2006 for the Protection of the Marine Environment (Dimashki et al., 2007:38). As part of its mandate, the Ministry of Environment attempted to incorporate environmental aspects into national development policies. The environmental law Number 50 was passed in 2002 (Ministry of Local Administration and the Environment, 2002). This law specified the responsibilities and authorities of the Ministry of State for Environmental Affairs, which includes signifying responsibilities for damages and compensation in cooperation with the Ministry of Justice and other relevant agencies.

According to the Environment Law No. 50/2002, the Ministry of Environment in cooperation with the Environmental Directorates in all the governorates are responsible for monitoring and controlling wastes effluents discharging from industrial and commercial installations. Law No. 50 also stated that pollution caused by any person or a factory must be eliminated on their/its own cost and in certain cases must pay compensation. This law has required the owners of plants producing pollutant emissions to the environment to set up pollutant control systems on their such facilities by which systems to control solid particle diffusion prior to the emission thereof from the plant at limits to be identified under ensuing directions in this respect. The polluter pay principle is also empathized in Law No. 50. Punishment to polluters (persons, factories, or industries) is also presented in the law and varies from penalties to imprisonment (Al Cheikh Kassem, 2007:21; Dimashki et al., 2007:38). Among the articles affecting the olive oil sector in the Environment Law No. 50/2002 are the following (Ministry of Local Administration and the Environment, 2002:2-9):

- Article 4 (5) requires the preparation of specifications and standards for the environment elements, and laying the foundations and procedures required for the environmental
impact assessment. Article 4 (6) requires conducting and supporting researches and studies on environmental affairs, and evaluating the risks resulting from the use of various substances that threaten the safety of the environment. Article 4 (7) requires controlling activities with environmental impact in the public and private sectors, in order to verify the extent of their compliance with environmental standards and regulatory policies adopted locally. Article 4 (8) requires the development of environmental instructions, conditions and specifications required for agricultural and industrial projects, in order to abide to and adopt them as part of the preconditions for a license or license renewal.

- Article 23 (1) refers to controlling irregularities relating to this law, standards, regulations, specifications, requirements and other environmental regulatory policies adopted by the Environmental Protection Council.
- Article 24 stipulates that the punishment of one hundred thousand to two million Syrian pounds penalty shall be imposed on the industry in charge of its management if it gets rid of the waste of any type whether it is solid or liquid contrary to the provisions of this law.
- Article 25 (1) stipulates that the industry who commits any violation of environmental standards and specifications proven according to provisions of paragraph (1) of Article 23, including standards-based water pollution, shall be punished by a penalty of ten thousand to one million Syrian pounds. Article 25 (2) sets out the closure of the business or institution in violation of the provisions of this Law under paragraph (1) of Article 23.
- Article 27 (1) specifies standards and regulatory policies for emissions generated by production processes.
- Article 29 (1) calls for the punishment of anyone cause damage to the environment, whether by design or negligence or non-observance of laws and environmental regulations, as well as claiming compensation for any damage caused.

In addition, among the articles affecting the olive oil sector in the General Cleanness Law No. 49/2004 are the following (Al Cheikh Kassem, 2007:22):

- Article 6 stipulates that the followings are prohibited under penalty of executing punishment declared in chapter 7 of this law: 6 (9) to dispose all types of wastes in rivers, watercourses, fountains and the lands at the side of them by the owners of the agro-industrial plants; 6 (10) to dispose wastes of all types in seas, lakes or coasts; and 6 (18) to dispose all types of oils, grease, lubricants and related substances in the containers and water surface region or in the public sewage and rivers or the watercourses or in the open.
Who generates these substances must gather them in appropriate cans and move them to spaces specified by the government council.

- Article 38 stipulates that without discrimination to the harder penalties mentioned in effectual laws, policies and regulations the punishment will be: 38 (2) everybody who infringes the provisions of sections (9-10) of article 6 of this law shall pay a fine range from 1000 – 3000 Syrian pounds; and 38 (3) everybody who infringes the provisions of section (18) of article 6 of this law shall pay a fine range from 3000-5000 Syrian pounds.

- Article 39 stipulates that the fine declared in article 38 of this law will be doubled in case of recurrence of the breach except it is below a more severe provision.

There are not any national regulatory policies that are specifically related to the disposal of wastes generated by olive mills and its complementary industries (Dimashki et al., 2007:38). On the other hand, there are many national environmental standards for the regulation and control of wastes effluents discharge to the environment including (Dimashki et al., 2007:39):

- Syrian National Environmental Standards No. 2580/2002, about the restrictions of discharged liquid and solid wastes of economic actions or activities into the sewer network.
- Syrian National Environmental Standards No. 2752/2003, about the reclaimed wastewater for irrigation usage.
- Syrian National Environmental Standards No. 2665/2002, about the allowable application of municipal biosoilds products on lands.

- National Environmental Guidelines adopted by the Ministerial Council for the protection of environmental quality:
  - Standards on the maximum limits for the discharge of industrial pollutants into the water environment.
  - Standards on the classification of hazardous industrial solid wastes according to the concentration of hazardous components in these solid wastes.
  - Standards on the maximum permissible concentrations of air pollutants at source.

Therefore, there is an urgent need to develop and enhance the environmental circumstances for the olive oil agro-industrial sector in Syria. While the Syrian olive oil product has an excellent natural quality, the poor production processes in the olive oil mills generate additional waste. In particular, the provision of facilities to deal with waste from the process of milling olives is the main problem generated by the olive-mill industry. This is mainly due
to several reasons including: Firstly, the olive oil mills are disorganized and geographically scattered due to the fact that most of these mills are family-owned businesses, where the short duration work makes the possibility of setting up central treatment plants a costly option.

Secondly, olive oil mills lack the necessary infrastructure, as the liquid waste of olive oil mills is disposed on the streets, fields and rivers without any consideration to environmental controls. While some of the owners of olive oil mills have built underground channels that carry waste to municipal sewers in some areas that are suitable, the decayed infrastructure, however, makes it difficult to establish central processing units.

Thirdly, the weakness of environmental regulatory policies adopted encourages the owners of olive oil mills to dispose waste illegally, which causes pollution to drinking water sources, soil and air. All these reasons would sometimes prevent the Syrian olive oil exporters from meeting the compliance with environmental regulatory policies in the international export markets.

Thus, the olive-mill industry has to comply with environmental laws, standards and regulatory policies, and it needs to avoid the negative effects resulting from the production of olive oil. Accordingly, this industry needs to introduce advanced technologies and the emission control systems and building central treatment plants. Therefore, the Syrian government has decided to put an end to the environmental problems caused by this industry without affecting the productivity of this agro-industrial sector and its growth. This would be achieved through the enforcement 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” (Kuhn et al., 2010a, 2010b, 2011a:4). “The project is funded by the EU, managed (administered) by the UNDP Organization and implemented (executed) by the Ministry of Environment in Syria” (Kuhn et al., 2010a, 2010b, 2011a:4). “The project will be implemented through the following phases” (Ministry of Local Administration and the Environment, 2006; Dimashki et al., 2007:5; Kuhn et al., 2010a, 2010b, 2011a:4):

1. Establishing a database with regard to the Syrian olive oil production sector and its complimentary industries.
2. Introducing the concepts of cleaner production options, in addition to the prevention, management, control and treatment measures to the olive-mill industry in the project area.
3. Training and providing technical assistance to the concerned stakeholders and producers in order to maintain principles of “green” production of olive oil.

4. Setting standards and limits related to the olive-mill industry pollutions in Syria.

5. Setting a monitoring strategy to be adopted by the related ministries and local authorities in controlling and regulating olive oil production and associated industries.

6. Developing financial and technical incentives to olive oil mills in order to promote the mandates of previously agreed Memorandums of Understanding concerning the proposed environmental quality standards and compliance strategy between the Ministry of Environment and the owners of olive oil mills.

7. Undertaking awareness activities with regard to mitigating the environmental effects of waste resulting from the olive oil milling industries (Kuhn et al., 2010a, 2010b, 2011a:4).

Recently, “a Syrian Ministerial Decree (No. 190 dated 5th, September 2007) has established further criteria and technical features for the entire production cycle of the olive-mill effluents (production, storage, transport and spreading), as well as for the agronomic utilization of these effluents” (Kuhn et al., 2011b, 2012a:5-6). “The various articles of a Ministerial Decree (No. 190) clarify the competences of the regions (Art. 1.1). Art. 1.2 clarifies the technical aspects for the management of the olive-mill effluents and the maximum period of vegetable water storage. Art. 1.3 clarifies the maximum quantities of these effluents to be administered to the soil and the spreading methods. Art. 1.4 clarifies the areas of prohibition. Art. 1.5 clarifies the awareness and guidance activities. Additionally, Art. 2 clarifies the transport documents and the sanctions for non-observance of the law” (Kuhn et al., 2011b, 2012a:5-6). This Ministerial Decree approved the closure of partially or completely and not to give any license or license renewal to any olive-mill industry if not and before taking into account the environmental conditions such as implementing wastewater treatment plants (Ministry of Agriculture and Agrarian Reform, 2007a:1-3; Kuhn et al., 2011b, 2012a:5-6).

As a daily consumption product in the Mediterranean region, olive oil production is an important agro-alimentary branch in Syria. In Syria about 51% of olive oil mills still adopt a three-phase olive oil production and extraction technology system with a consequent production of huge quantities of vegetable water and pomaces. Although faced with increasingly restrictive environmental regulatory policies, the relevant work accomplished by Research Institutions and Authorities the Syrian regulatory policies authorize a sustainable agronomic utilization of olive-mill wastewater effluents.
3.2. The International Environmental Regulatory Policies Related to the Olive Oil Agro-Industrial Sector

At the international level, there are two major international environmental regulatory policies in the export markets, which affect the production and export of the Syrian olive oil products. The first is the EU environmental regulatory policies associated to/with the olive oil agro-industrial sector. The second is the multilateral trade and environmental agreements, particularly the WTO agreements related environmental regulatory policies for the olive oil agro-industrial sector.

3.2.1. The EU Environmental Regulatory Policies Related to the Olive Oil Agro-Industrial Sector

EU has the most stringent system of environmental regulatory policies in the world. The olive-mill industry has to comply with all European environmental regulatory policies in force for food industries and specifically the olive-mill industry (TDC-OLIVE, 2004). Reviews of the most important EU environmental regulatory policies in this area are reported below (see Appendix 2 for more details).

The Council Directive (February, 2001) aims to achieve a high level of protection for human health and the environment while maintaining industrial competitiveness through: Firstly, calling for global coordination of testing procedures, and thus testing obligations are extended to exporters and a recognition of non-EU tests is achieved. Secondly, in line with EU obligations under the WTO, it must be essential to ensure equal treatment between imports and domestic products in terms of testing requirements and compliance with international environmental regulatory policies (TDC-OLIVE, 2004).

The principal European legislative framework with respect to “waste” management is the Directive on waste (75/442/EEC) which represents the overall “framework” of EU environmental regulations and policies. This Directive sets out control methods for all types of waste. Moreover, there are many directives and decisions taken by the EU Council with the obligation of the entire member countries to submit a plan of action for the management of waste resulting from industrial facilities. EU environmental regulatory policies is therefore implemented and applied by the EU Member States which have referred to local and regional authorities the task of defining the vegetable water basin capacity, the transport procedures of
the olive oil mill effluents and the controls that foresee sanctions according to the gravity of the violations (Cimato, 2007:11).

In Italy, a specific law (No. 574 dated November 11th, 1996) has been introduced as to distinguish the olive oil mill effluents from other types of “waste” and specifies the quantities and the methods to be adopted for the agronomic use of vegetable water and pomace. The various articles of Law (No. 574) clarify the competences of the regions (Art. 7) and the maximum quantities to be administered to the soil (Art. 2). They clarify the spreading methods (Art. 4) and the areas of prohibition (Art. 5). They also clarify the technical aspects of managing olive oil mill effluents and the maximum period of vegetable water storage (Art. 6). Additionally, they clarify the transport documents and the sanctions for non-observance of the law (Art. 8) (Cimato, 2007:11).

Recently, a Ministerial Decree (July 6th, 2005) has established further criteria and technical features for the entire production cycle of the olive oil mill effluents (production, storage, transport and spreading) and for the agronomic utilization (Cimato, 2007:11). Further, it should be noted that markets in the United States of America, Eastern Asia, Australia and the Arab Gulf states have environmental regulatory policies that are similar to the EU environmental regulatory policies, in particular for product specifications.

3.2.2. The WTO-Multilateral Trade and Environmental Agreements Related Regulatory Policies for the Olive Oil Agro-Industrial Sector

There is no doubt that because Syria’s developing economy fails to enact and enforce domestic and international environmental regulatory policies, it risks its place in the olive oil agro-industrial sector. This would be in a situation where it becomes uncompetitive exporter as it fails to meet environmental regulatory policies imposed in targets markets. Since the quantity of Syrian exports of olive oil products is increasing relatively, the threat of being adversely affected by product-related environmental regulatory policies in export markets is the fact that should be taken seriously.

The extent of the impact of international environmental policies on the production and export levels of Syrian olive oil products will depend on the degree of inclusion of environmental issues in international trade agreements. For example, on the one hand, under the WTO rules, the product-related environmental regulatory policies are generally accepted, but the process-
related environmental regulatory policies are becoming more difficult to be applied. On the other hand, most States are also concerned about the possible misuse of environmental regulatory policies to restrict international trade, as there is an increasing use of voluntary regulatory policies, such as eco-labeling schemes. However, changes in consumer preferences have made some of these voluntary regulatory policies effective requirements, since the private sector importers are increasingly opting to import products of a certain qualities and types. In this case, the exporters who do not take into account the changes in consumers’ preferences and desires with regard to the qualities of goods and services will lose their shares in the international markets (Shahin, 1997).

Thus, the position of Syrian economy towards compliance with the domestic and international environmental regulatory policies becomes an important factor in determining the ability of Syrian olive oil agro-industrial sector to gain access to international markets. The promotion and enforcement of environmental regulatory policies in Syria would make Syrian producers more aware of cleaner production methods, and thereby reducing their chance of being adversely affected by export market requirements. Moreover, their final products would include lower concentrations of harmful substances and residues that would be better for Syrian people and the Syrian environment.

Currently, Syria is seeking accession to the WTO and the signing of the Association Agreement with the EU, where new Directorate is established to coordinate negotiations with the WTO and the EU. Whether environmental regulatory policies will affect international competitiveness or being used as barriers to trade flows is the issue that is likely to become increasingly important for Syria. With reference to that the Barcelona Declaration was dated 2010 for the completion of bilateral agreements between EU and Mediterranean region countries. It was also expected that by 2010 there would be an international commitment by the entire WTO-EU members to comply with international environmental regulatory policies concerning agro-industrial exports, which are likely to include more stringent environmental regulatory policies (see, e.g., HIID, 2000:182). Therefore, the Syrian olive oil exports will be adversely affected in the event of failure to enforce compliance with environmental regulatory policies adopted within the framework of the WTO Agreements and the Euro-Mediterranean Association Agreements.
Syria is also a part of several international environmental agreements, something which makes it necessary to observe its obligations under these agreements in its production and trade of olive oil products. For example, Syria was one of the first countries acceded to the Vienna agreement, which aimed for the protection of the ozone layer and its Montreal Protocol in 1989. Syria also joined in 1999 the list of countries in the world, which ratified the London, Copenhagen and Montreal amendments. In 1992, Syria participated in the first Earth Summit, which held in Rio de Janeiro. Syria has also ratified the three conventions arising from this Summit in relation to biodiversity, climate change and desertification. In 2002, Syria took part in the World Symposium on Sustainable Development, which convened in Johannesburg. In its concluding statement, the conference specified the objectives and principal requirements for sustainable development in combating poverty, altering unsustainable behavior in production and consumption and protecting and managing the natural resources base for economical and social development (Syrian Ministry of the Environment/ World Bank/UNDP, 2003:6).

In this context, the Syrian Ministry of Environment has started a consultative process involving all the major contributors of the relevant ministries and institutions to develop a national environmental action plan. This action plan contains a number of environmental projects and programs that designed primarily to address existing environmental problems and to provide the needs for achieving a comprehensive sustainable development. The national environmental action plan aimed to develop a comprehensive strategy involving all stakeholders, each in their respective and relevant areas of work. This is in order to build up an effective action program that would contribute significantly to achieving the overall environmental objectives. This plan fulfills the commitments of the Syrian Arab Republic towards Agenda 21 of the Rio Conference, and it is in accordance with the objectives and principal requirements for sustainable development, which were adopted in Johannesburg in 2002 (Syrian Ministry of the Environment/ World Bank/UNDP, 2003:6,47).

The most important provisions in these multilateral trade and environmental agreements and in particular the WTO agreements that are related to the production and international trade in olive oil products are reported as the following:

First: Articles XX and XIV of the WTO agreement include general exceptions to the WTO rules. These exceptions can be used to protect the lives of humans, animals and plants. They
can also be used to maintain the non-renewable natural resources. In addition, they can be used for the imposition of countervailing measures for environmental protection of local industry (WTO, 2004:30 and 51).

Secondly, the WTO’s SPS agreement allows the application of necessary environmental rules and regulations to protect the health of humans, animals and plants. Article 5(7) of the SPS agreement establishes the rules concerning the measures and procedures to be followed in case of danger and insufficient scientific evidence (WTO, 2004:56; WTO, 2005:133).

Thirdly, the WTO’s TBT agreement allows member countries to identify environmental standards and regulatory policies or any other policies for products received by them. This is particularly with regard to the industrial and productivity standards and environmental regulatory policies. The agreement also provides that specific conditions such as notification, transparency and account to be taken of the damages and risks to human health, animal health and environment in regulatory measures (WTO, 2004:54; WTO, 2005:130).

In addition, the Doha Ministerial Declaration allows any country to enforce the necessary rules and regulations to protect human health and the environment at any levels it considers appropriate, provided that they are applied in a fairly manner (WTO, 2004:10). The Agreements on the Protection of the Ozone Layer also restrict trade in products that cause damage or deplete the Ozone Layer.

Moreover, the international documents dealing with the prevention of plants are the International Plant Protection Convention, the International Code of Conduct on the distribution and use of pesticides and the Codex Alimentarius Commission. They aimed to implement effective and safe preventive measures for plants in order to protect human health and the environment (FAO, 2005). Compliance with these international documents will improve product quality and facilitating trade between countries. The method of IPM for the olive oil agro-industrial sector is one of the important mechanisms for ensuring compliance with these documents at the international level.

Furthermore, the UNEP/FAO rules stipulate that exporters must inform importers of the products that cause harm to the environment before being exported.
Finally, there is a worldwide recognized and accepted system for products certification. This system is developed by the International Organization for Standardization (ISO). It is an international group with 140 member countries. In particular ISO14000 is an environmental management certification system, which provides comprehensive environmental investigation of products, and thus helps manufacturers to comply with product-related environmental regulatory policies (Viadiu et al., 2006:142).

In this Chapter, the implemented domestic and international environmental policies affecting the olive oil agro-industrial sector in Syria have been presented. In particular, there has been a focus on those policies relating to the Integrated Waste Management and Integrated Pest Management policies for the olive oil agro-industrial sector. The relevant policy question, however, is ‘what will be the impact of compliance with these environmental regulatory policies on trade competitiveness of the Syrian olive oil production and exports levels?’ To help answering this question, the next Chapter will present a detailed overview of the Integrated Pest Management and Integrated Waste Management policies for the olive oil agro-industrial sector in Syria.
4. The Environmental Problem and the Potential Environmental Policies in Syria

4.1. Introduction and Background to the Environmental Problem

There is no doubt that facing of environmental threats nowadays deserves considerable efforts and interests by all countries of the world at all levels, locally, regionally and internationally. It also deserves a high level of consistency and co-work in many fields. So it is natural for each country to have the right to monitor possible effects of trade exchanges with other countries to protect its environment from possible dangers. Each country, at the same time, is responsible for facing world environmental problems collectively. The focus on environmental considerations in world trade has become an increasing source of pressure to many countries particularly developing one, for example, exaggeration in applying higher environmental regulatory policies with developed countries (Jansen & Keck, 2004; Frankel, 2009; Mathur & Dang, 2009).

The international negotiations on the need and methods of linking the trade-environment policies are still at a standstill. Sensitivity changes have clearly emerged between the global trend of trade liberalization and the people’s desire of environmental protection during the ministerial conferences and meetings of the WTO negotiations (Panayatou, 2000:1). In other words, the simmering tension between the environment’s pursuits of cleaner environment and the trade’s pursuits of free trade became an open clash in the meetings of the WTO Ministerial Conferences, it started in Doha during November 2001, in Cancun during September 2003, in Hong Kong during December 2005, and even it continued in the recent meeting of the WTO Ministerial Conference in Geneva during November 2009.

The global negotiations between developing and developed countries on the possibility and how to link the trade-environment policies are still ongoing to date, and there is no doubt that they would continue for many years to come, as shown that the Doha Round negotiations failed completely. The failure of the Doha Round negotiations on the trade-environment policies would encourage the hand of all those who argue that the economic growth should continue unchecked and without taking into account the environmental considerations (Lamy, 2006).

While developing countries need to access markets in developed countries, there is a growing concern in developed countries that weak environmental policies in developing countries would reduce competitiveness of their products in both their markets and the developing
countries markets. Therefore, there is an urgent need to reach a compromise in the negotiation process where developed countries would agree to eliminate all their barriers to imports from developing countries, and in return developing countries would do more to protect domestic and international environments. Indeed, the WTO must be made to deliver a comprehensive sustainable development (Lamy, 2007).

Syria as developing economy has a serious concern that accelerating the pace of both domestic and worldwide environmental regulatory policies could adversely affect its trade competitiveness, and reduce its access to international markets. This situation would be, in particularly, in the framework of the Syrian government’ pursuits and efforts for the accession into the international trade and environmental agreements. Therefore, the Syrian government has to comply with environmental policies adopted by the WTO, EU, MTAs and MEAs at the international level. The government needs additional policies to liberalize trade, and it also needs other complementary policies to upgrade and improve the level of its local environmental performance.

In this context, the Syrian government is facing two main types of environmental pressures (Panayatou, 2000:1): The first type is internal pressures to improve the local environment through the tightening of domestic and international environmental policies and the introduction of new ones aimed at reducing pollution and conserving scarce natural resources. Hence, the Syrian government fears that the adoption and enforcement of such environmental policies may have adverse effects on its main productive and export commodities sectors. Such adverse effects may be observed primarily through increases in production costs, reductions in profits and losses in trade competitiveness at the international level.

The second type of pressures on the Syrian government is coming from the international efforts to improve the environmental performance in order to engage it in the international environmental agreements (Panayatou, 2000:1). The Syrian government is concerned that the ratification and implementation of such agreements may have significant impacts on its international trade competitiveness. Moreover, the Syrian economy will most likely be adversely affected by the implementation of measures including trade sanctions on the production and exports of countries that do not comply with environmental policies agreed upon in the framework of these agreements.
Moreover, within the framework of the WTO-EU agreements, it must be taken into account that little is known about the cost impacts of various product-related environmental policies and how they affect the Syrian olive oil exporters. For instance, there are direct costs as a result of complying with prescribed environmental policies besides numerous costs associated with continuously changing environmental policies across export markets. Thus, further efforts must be making by the Syrian government to address the costs impact of meeting compliance with international environmental policies in this field. This is important for the Syrian government in terms of increasing knowledge and expertise on the compliance cost impacts of meeting various environmental policies related to products, particularly with regard to possible affects on Syrian olive oil exporters (see, e.g., Wilson, 2002:436).

Furthermore, Syrian olive oil exporters face a key challenge represented in the growing use and adoption of environmental regulatory policies in international markets, where there are special production conditions with regard to health and safety, and environmental protection. This would lead to the rejection of exports from countries that do not meet these environmental policies. For the Syrian economy, such a procedure could be catastrophic; especially as it depends on the olive oil agro-industrial sector as one of the key export sectors (see, e.g., Panayatou, 2000:1).

Syrian olive oil exporters also face growing diffusion of eco-labeling regulatory policies in the international markets besides facing growing trend of consumers’ preferences towards environmentally friendly products. Such conditions would impose on the Syrian olive oil exporters, particularly the olive oil small and medium-sized industries, either to meet the environmental regulatory policies in the international markets or to face the loss of their export quotas and the reduction of their international trade competitiveness (see, e.g., Cosbey, 2004:13).

While, meeting compliance with environmental policies in the olive oil agro-industrial sector in Syria may increase its production costs at the domestic level in the short-term. This is mainly due to the requirements of additional technical, artistic treatments and quality tests as well as the introduction of new technologies, among other things (see, e.g., Hengrasme, 2004; Cosbey, 2004:13). However, at the same time, meeting compliance with environmental policies can encourage the transfer in the environmentally sound technologies and raise the confidence in the Syrian olive oil products. Moreover, meeting compliance with
environmental policies in the olive oil agro-industrial sector in Syria may contribute to improving its domestic production efficiencies and enhancing its international trade competitiveness in the long-term (see, e.g., Porter, 1990; Porter & Van der Linde, 1995a, 2000; Mulatu et al., 2001). This is mainly due to the adoption of advanced techniques and technologies in the olive oil agro-industrial sector in Syria, which would assist the Syrian olive oil exporters in meeting compliance with both domestic and international environmental regulatory policies related to the olive oil market.

<table>
<thead>
<tr>
<th>Costs</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Upgrade of laboratory infrastructure</td>
<td>• Crisis containment, as when traceability system prevents an alert from becoming a crisis</td>
</tr>
<tr>
<td>• Upgrade of processing facilities</td>
<td>• Increased attention to overall efficacy of controls</td>
</tr>
<tr>
<td>• Investments in firm-level facilities to comply with environmental requirements</td>
<td>• Access to more remunerative markets and supply chains</td>
</tr>
<tr>
<td>• Reduced investment in new product development</td>
<td>• Greater efficiency, thus lower costs</td>
</tr>
<tr>
<td>• Reduced investment in domestic food safety controls</td>
<td>• Less waste in production processes</td>
</tr>
<tr>
<td>• Collection and analysis of laboratory tests</td>
<td>• Reduced incidence of product inspection and detention abroad</td>
</tr>
<tr>
<td>• Additional costs for ‘certified’ raw materials</td>
<td>• Enhancement of product quality</td>
</tr>
<tr>
<td>• Additional costs for implementing hazard analysis and critical control point system</td>
<td>• Higher morale of inspection and production staffs</td>
</tr>
<tr>
<td>• Reduced flexibility in production processes</td>
<td>• Improved reputation of firm and/or country</td>
</tr>
<tr>
<td>• Reduced domestic food safety enforcement</td>
<td>• Improved worker safety and reduced environmental degradation</td>
</tr>
</tbody>
</table>

Table 4.1: Costs and benefits of complying with environmental regulatory policies

(World Bank, 2005b; Jaffee, 2006:371)

Specifically, the small and medium-sized industries in the olive oil agro-industrial sector in Syria are dominated in the export market. The greatest concern for these industries is the difficulties in understanding the complex environmental policies of foreign export markets. They face several problems in this respect such as the difficulties in identifying appropriate environmental regulatory policies and implementing the necessary technical changes. Moreover, addressing such problems tends to be more complex and costly for the small and medium-sized industries in the olive oil agro-industrial sector in Syria (UN-ESCWA, 2003).

Regarding the international trade competitiveness, the olive oil agro-industrial sector in Syria is suffering from the lack of wastewater treatment facilities. It is also suffering from the use of
old technologies in the production process. This situation is exacerbated by the fact that 47.8% of the total olive oil mills are traditional, in addition, they continue to conduct “business as usual” despite the opening of the Syrian economy to foreign competition (Dimashki et al., 2007:11). This situation therefore leaves an extremely negative effect on all elements of the surrounding environment (air, soil, water). This is mainly as a result of the indiscriminate discharges of olive mills wastewater, where the indiscriminate discharges do not take into account the environmental controls, requirements and policies adopted locally and globally.

Currently, the olive mills wastewater in Syria constitutes a great challenge for the people in the areas of which such olive mills are located. In the coastal region, the olive mills wastewater is polluting the groundwater and sabotaging the soil with other adverse environmental effects. This situation is particularly growing in the areas of production due to the secondary outputs of the process of milling the olives. Where, the process of milling the olives produces two main types of waste, which vary by the milling technique used; solid waste and liquid waste or olive mills wastewater (Shaheen & Abdel Karim, 2007:65-66). The inefficient management of the olive mills wastewater would lead to environmental damage and pollution of natural water resources (Dimashki & Al Rawas, 2006:7). This is incompatible with environmental regulatory policies for the protection of groundwater. However, this problem prevails in all countries of the Mediterranean region. This area is the most suitable for growing olives and olive oil production in the world.

Accordingly, the Syrian government should adopt and enforce environmental policies both local and international, if it wishes to be able to compete in the new global economy in the olive oil agro-industrial sector. The olive oil producers is therefore actively encouraged to adjust their production methods in line with the new environmental regulatory policies adopted universally, and whether those imposed on them or those preferred by consumers in foreign export markets. However, to do so, they need first to come into compliance with existing domestic environmental regulatory policies. Achieving full compliance with domestic environmental regulatory policies is the first step towards achieving compliance with international environmental regulatory policies related to the olive oil market.

Thus, the ability of the Syrian government to maintain the opening of export markets depends to a large extent on the ability of the olive oil agro-industrial sector to achieve compliance with domestic environmental regulatory policies, and it then has to upgrade itself gradually
towards compliance with international environmental regulatory policies that imposed by foreign export markets.

Given that there is a growing importance of the relationship between environmental policies and international trade competitiveness, it is thus important to analyse this relationship with a specific reference to the above issues in the case of the olive oil agro-industrial sector in Syria. We therefore present in the following section a detailed overview of the potential environmental regulatory policies scenarios used in the analysis.

4.2. The Potential Environmental Policies Scenarios Used in the Analysis

4.2.1. The Policy of Integrated Pest Management for the Olive Oil Sector

The policy of IPM refers to careful consideration of all available pest control techniques and subsequent integration of appropriate measures that discourage the development of pest populations. It also seeks to keep pesticides and other interventions to levels that can be justified economically, as well as reducing and minimizing risks to human health and the environment. The policy of IPM emphasizes the growth of a healthy crop with the least possible disruption to agro-ecosystems and encourages natural pest control mechanisms (FAO, 2005:6; FAO/WHO, 2010:5).

The process of relying on pesticides as a key tool to combat pests in recent decades has led to the creation of many serious problems in the agricultural sector. These problems include the confusion of agricultural ecosystems and causing adverse effects on the environment and public health. The policy of IPM based on environmental principles and legislations has been confirmed and proved to be a sound approach to reduce these problems.

Moreover, the continuous development of the world economy has increased the potential spread of pests and their movement to different countries over the world. This requires more attention from organizations interested in preventing plants and taking appropriate action in this regard. Quality control policies such as policies for the remainder of pesticides have become more stringent for both local consumption and export, especially for Western markets.

Given that the study aims to estimate the impact of compliance with the policy of IPM on the olive oil agro-industrial sector in Syria, which makes it important to analyze the cost structure for the olive oil product in Syria.
### Nature cost

<table>
<thead>
<tr>
<th>Items</th>
<th>2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tillages</td>
<td>3240</td>
</tr>
<tr>
<td>Racking around trees</td>
<td>1125</td>
</tr>
<tr>
<td>Breeding and pruning</td>
<td>5000</td>
</tr>
<tr>
<td>Wood collection</td>
<td>330</td>
</tr>
<tr>
<td>Irrigation costs</td>
<td>-</td>
</tr>
<tr>
<td>Controlling</td>
<td>1125</td>
</tr>
<tr>
<td>Organic fertilizer</td>
<td>500</td>
</tr>
<tr>
<td>Chemical fertilizer</td>
<td>500</td>
</tr>
<tr>
<td>Harvesting 12-15% from production/year</td>
<td>13543</td>
</tr>
<tr>
<td>Rebate</td>
<td>500</td>
</tr>
<tr>
<td>Crops transportation</td>
<td>941</td>
</tr>
</tbody>
</table>

#### 1- Agricultural operations

#### 2- Production requirements

<table>
<thead>
<tr>
<th>Items</th>
<th>2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organic fertilizer value</td>
<td>5000</td>
</tr>
<tr>
<td>Chemical fertilizer value</td>
<td>7784</td>
</tr>
<tr>
<td>Package value</td>
<td>500</td>
</tr>
<tr>
<td>Chemical control value</td>
<td>1000</td>
</tr>
</tbody>
</table>

#### Total

<table>
<thead>
<tr>
<th>Items</th>
<th>2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>26804</td>
</tr>
</tbody>
</table>

#### 3- 4.5% of Interest capital

43108

#### 4- 5% Incidental expenses

1377

#### 5- Total of costs (1+2+3+4)

46417

#### 6- Costs / Year of study

3309

#### 7- Total of costs (5+6)

2742

#### 8- Average yield of olives (5 years) Kg/ha

16.4

#### 9- Kg. Costs of olives / Syrian Pounds

44969

#### 10- Total costs of olives (8*9)

55217

#### 11- Cost of milling (including transport)

682

#### 12- Total of costs (7+11)

160

#### 13- Average yield of olive oil (5 years) Kg/ha

109120

#### 14- Average price of olive oil (5 years) Kg / Syrian Pounds

53903

#### 15- Gross revenue (13*14)

109120

#### 16- Net profit (15-12)

53903

10-16: Author’s calculations.

Table 4.2: Production cost average for Syrian olive oil product (The value in SP)


Table 4.2 shows the structure of the average costs for the olive oil product. The cost structure in general has organic and chemical fertilizations represent about 25% of total costs, chemical controlling pesticides represent about 4% of total costs, the cost of olive milling represents about 16% of total costs, services and other expenses represent about 31% of total costs. This corresponds with the structure of the average costs for the olive oil product in the Arab developing countries.
As can be seen from the table above, the share of chemical controlling represents a small proportion of total production costs. This explains the emergence of a number of problems in the olive oil agro-industrial sector in Syria due to the infection by the olives fruits’ pests. First, the infected olives fruits fall on the ground before maturity. Consequently, this would lead to the loss of a large quantity and a significant proportion of the olives crop. The loss percentage of the olives crop due to the infection by the olives fruits’ pests in the States of the Mediterranean region is evaluated at about 30%, especially in the absence of IPM action (Ministry of Agriculture and Agrarian Reform, 2006a:3). In general, it is a dangerous pest in all important olive-growing areas in the world. Secondly, the proportion of the olive oil product from the infected olives fruits decline considerably. Thirdly, the quality of the olive oil product from the infected olives fruits is low (high acidity and peroxide), and therefore the marketing value for the olive oil product is low as well.

Therefore, there is an urgent need to overcome these problems that face the olive oil agro-industrial sector in order to improve the olive oil sector and its development. This could be achieved with the enforcement of IPM programs for olive production aimed at controlling the main insect pests attacking olive orchards. The good programs in the area of IPM for olive production play a key role in improving olive oil production. This is mainly by improving the quantity and quality, reducing costs and enhancing trade competitiveness for olive oil production, something which can be achieved through adhering to the policies set out in international charters and conventions.

In this context, many of the regional programs have been implemented in the area of IPM for olive production in the territory of the Near East, and in collaboration with international organizations such as FAO and UNDP. Their results have shown that the IPM is a sound approach that allows farmers to achieve further savings in production costs. For example, in Jordan, the IPM programs for olive production have helped reduce the cost of pesticides by 40% (Regional Conference XXVIII for the Near East, 2006). Moreover, the IPM is increasingly responding to the stringent environmental policies that are raised in local, regional and export markets, and particularly, those policies are relating to the remainder of pesticides in the olive oil products, where it has been possible to reduce the use of pesticides, and thus to reduce the risks to human health and the environment.
More specifically, the policy of IPM for the olive oil agro-industrial sector in Syria is represented in the enforcement of the collective fishing program (quantitative) using fisheries attracting pests. This can be done through hanging a certain number of diverse fisheries at 50-100 fisheries per hectare (5-10 in acres), where they aim to control the insect community and the reduction of their numbers to a minimum (Ministry of Agriculture and Agrarian Reform, 2006b:9).

As reported above in Table 4.2, the average price per hectare of olives is computed to what equals 44969 SP. In addition, based on the study by the Ministry of Agriculture and Agrarian Reform (2006b:9), the range of compliance costs with the policy of IPM ranges between 1500 SP (a price of 50 fisheries) and 3000 SP (a price of 100 fisheries) per hectare of olives. Therefore, if these costs are added to olives prices, the price increase due to the costs of compliance with the policy of IPM would be between 3.3% and 6.7%. Both the low (i.e., 3.3%) and the high (i.e., 6.7%) costs compliance options are taken to demonstrate the possible range of compliance impacts on the Syrian olive oil production and exports levels.

In light of the previous discussion, the first scenario involves estimating the impact of compliance with the policy of IPM on the production and export levels of Syrian olive oil products, something which can be achieved through gradual compliance with the price increase in the olive oil agro-industrial sector. In view of the above findings, the costs of compliance with the policy of IPM will lead to between 3.3% and 6.7% increase in the prices per hectare of olives production for the producer.

4.2.2. The Policy of Integrated Waste Management for the Olive Oil Pressing Industry

The olive oil extraction industry is considered to be one of the most traditional agricultural industries in the Mediterranean countries. This industry is still important to the process of building the economies of most of the Mediterranean countries where “the treatment and disposal of olive mills wastewater is currently one of the most serious environmental problems as the case is in Spain, Italy, Greece; for example, and particularly in Syria where olive oil products are mainly produced” (Rozzi & Malpei, 1996:135; Owen et al., 2000:976; Vlyssides et al., 2004:603; Kuhn et al., 2010a, 2010b, 2011a:4, 2012a:4).

1This section has been taken identically from Kuhn et al. (2010a, 2010b, 2011a, 2011b, 2012a, 2012b).
As a source of pollution, olive-mill wastewater has existed for thousands of years, but their impact on the natural environment is presently more noticeable due to the following reasons (see, e.g., Rozzi & Malpei, 1996:135; Kuhn et al., 2010a, 2010b, 2011a:4). “First, the production of olive oil has increased remarkably over the last few decades. Secondly, in the past, the olive oil mills were small and scattered throughout the country and discharged their wastewater directly on the environment ground or under the land (particularly in coastal areas), but they are now much greater, and some of them are connected to sewerage. Thirdly, the public awareness of the environmental problems is now much higher than it was in the past” (Kuhn et al., 2010a, 2010b, 2011a:4).

Typically, the olive oil production generates two types of wastes; pomace as a solid residue and olive-mill wastewater (Shaheen & Abdel Karim, 2007:65-66). “The improper management of these wastes, especially olive-mill wastewater, causes several negative environmental effects related to its high organic and phenolic content mainly affecting soil and water sources” (Kuhn et al., 2011a:4, 2012a:4). More specifically, “the process of unregulated and uncontrolled dumping of untreated olive mills wastewater into watercourses in Syria constitutes a major threat to groundwater, natural water sources and the environmental quality” (Dimashki & Al Rawas, 2006:7; Kuhn et al., 2011a:4, 2012a:4).

Therefore, the olive mills wastewater generated by the olive oil extraction industry is a great pollutant to the natural environment. It involves a seasonal disturbance and an overloading for receiving waters or for the sewage treatment plants. This is mainly due to its high organic load and its high content of phytotoxic and antibacterial phenolic substances. This is also due to its high content of the Biological and Chemical Oxygen Demand (BOD and COD), which resist biological degradation (Saez et al., 1992: 1261; Shaheen & Abdel Karim, 2007:64). “The characteristics and contents of olive-mill wastewater in terms of both its quantity and its quality are heavily dependent and to a large extent on the extraction process used” (Shaheen, 2004:441; Shaheen & Abdel Karim, 2007:65-66; Kuhn et al., 2010a, 2011a:4, 2012a:4).

“In Syria, the olive oil product is extracted mainly in two ways” (Kuhn et al., 2010a, 2010b, 2011a:4, 2012a:4). “One way is the traditional olive press technology (the traditional method of extraction based on press) that the olive-mill industry used for many centuries with only slight modifications. In the traditional technology the olives are pressed in bags then the oil is estranged from the liquid mixer by resting in a series of tanks or by using a centrifuge. After
the extraction by pressing, a solid part, called olive husk, is obtained as by-product along with a mixture containing the olive oil that is estranged by decantation from the residual olive-mill wastewater. This technology constitutes 47.8% of total olive oil mills” (Roig et al., 2006:961; Syrian Statistical Abstract, 2007; Shaheen & Abdel Karim, 2007:65-66; Dimashki et al., 2007:11; Kuhn et al., 2010a, 2010b, 2011a:4, 2012a:4).

“Another way is the so-called new centrifugation technology that the olive-mill industry has taken over in the last decades in order to enhance processing capacity and extraction yield and to decrease labor. There are also two new centrifugation technologies, called three-phase and two-phase technologies. In the three-phase olive press technology (the continuous full-automatic decanting processes), the trampled olive fruits are pumped into a three-phase decanter and then the polluted oil is centrifuged. The three-phase technology generates a stream of olive oil and two waste streams, aqueous waste (i.e. olive-mill wastewater) and wet solid waste (i.e. pomace). In spite of the advantages of this technology compared to the traditional pressing technology (full automation, superior oil quality, smaller area needed), it also presents some inconveniences (greater water and energy consumption, higher wastewater production and more costly installations). This technology amounts to 51% of total olive oil mills” (Roig et al., 2006:961; Syrian Statistical Abstract, 2007; Shaheen & Abdel Karim, 2007:65-66; Dimashki et al., 2007:11; Kuhn et al., 2010a, 2010b, 2011a:4, 2012a:5).

“In the two-phase olive press technology (the semi-automatic decanting method), the trampled olive fruits are pumped into a two-phase decanter and then the polluted oil is centrifuged. The two-phase technology was launched to the market with the labeling of ecological products. This is mainly because of the decrease in water consumption, and of two-phase, because it created two fractions: a solid one (called in various ways: wet pomace, olive wet husk or two-phase olive-mill waste) and a liquid one (olive oil). More to the point, because of the high dampness in the two-phase olive-mill polluting waste, the drying method demands a lot of energy that considerably increases production costs. This technology constitutes 1.2% of the total olive oil mills” (Roig et al., 2006:961; Syrian Statistical Abstract, 2007; Shaheen & Abdel Karim, 2007:65-66; Dimashki et al., 2007:11; Kuhn et al., 2010a, 2010b, 2011a:4, 2012a:5). “To compare the wastewater amounts resulting from olive oil mills, Table 4.3 below presents the comparative mass balances for the three different olive oil extraction processes technologies” (Improlive, 2000; Roig et al., 2006:961; Shaheen & Abdel Karim, 2007:72; Kuhn et al., 2010a, 2010b, 2011a:5, 2012a:5).
<table>
<thead>
<tr>
<th>Production process</th>
<th>Input</th>
<th>Amount of input</th>
<th>Output</th>
<th>Amount of output</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Traditional olive press technology</strong></td>
<td>- Olives</td>
<td>1000 kg</td>
<td>- Oil</td>
<td>200 kg</td>
</tr>
<tr>
<td></td>
<td>- Washing water</td>
<td>0.1-0.12 m³</td>
<td>- Solid waste (c. 25% water + 6% oil)</td>
<td>400 kg</td>
</tr>
<tr>
<td></td>
<td>- Energy</td>
<td>40-63 kWh</td>
<td>- Wastewater (c. 88% water)</td>
<td>600 kg</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Two-phase olive press technology</strong></td>
<td>- Olives</td>
<td>1000 kg</td>
<td>- Oil</td>
<td>200 kg</td>
</tr>
<tr>
<td></td>
<td>- Washing water</td>
<td>0.1-0.12 m³</td>
<td>- Solid waste (c. 60% water + 3% oil)</td>
<td>800-950 kg</td>
</tr>
<tr>
<td></td>
<td>- Energy</td>
<td>&lt;90-117 kWh</td>
<td>- Wastewater (c. 88% water)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Three-phase olive press technology</strong></td>
<td>- Olives</td>
<td>1000 kg</td>
<td>- Oil</td>
<td>210 kg</td>
</tr>
<tr>
<td></td>
<td>- Washing water</td>
<td>0.1-0.12 m³</td>
<td>- Solid waste (c. 60% water + 3% oil)</td>
<td>500-600 kg</td>
</tr>
<tr>
<td></td>
<td>- Fresh water for decanter</td>
<td>0.5-1 m³</td>
<td>- Wastewater (c. 88% water)</td>
<td>1000-1200 kg</td>
</tr>
<tr>
<td></td>
<td>- Water to polish the impure oil</td>
<td>10 kg (1344 kg)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Energy</td>
<td>90-117 kWh</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4.3: Comparative mass balances for the three olive oil extraction processes technologies
(Improlive, 2000; Roig et al., 2006:961; Shaheen & Abdel Karim, 2007:72)

“As can be seen in Table 4.3, olive-mill wastewaters are the main pollutant from three-phase and traditional olive oil mills. They are formed by vegetable water of the fruit in addition to the water used in various stages of oil extraction process (Roig et al., 2006:962). In particular, the wastewater amounts resulting from olive oil mills differ substantially and depend on the technology of extracting oil used. In traditional mills it is about 600 kg per ton of olives; while in two-phase and three-phase 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. On average, a surplus amount of wastewater of around 50% can be considered for the three-phase oil extraction if compared to the traditional and two-phase oil extraction processes (Shaheen, 2004:446; Shaheen and Abdel Karim, 2007:70). The amount of olive-mill wastewater in Syria is evaluated at about 800-944 thousand tons annually (Ministry of Agriculture and Agrarian Reform, 2007b; 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; Kuhn et al., 2010a, 2010b, 2011a:5, 2012a:5). The olive mills wastewater is an enormous polluting waste to the natural environment as we mentioned above. This will require further efforts to address and benefit from the olive mills wastewater (Kuhn et al., 2010a, 2010b, 2011a:5).
“From the above discussion it follows that regarding the pollution problems caused by olive oil production, incorporated solutions using different clean technologies within the production extraction processes and the improvement of new wastewater treatment technologies in connection with by-product utilization approaches can significantly decline these problems (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. In other words, this could be achieved through the introduction of the principles of the environmental sound technology concept in the production process and the establishment of the central treatment plants. According to this policy, an integrated pollution prevention technique in a pilot scale is tested (see Appendix 1, Figures 1.1 and 1.2). In the conventional three-phase olive oil production method there is the adding of an olive stones removal stage before the malaxing stage. This leads to a 50% decrease of the added water and a consequential 50% decrease of the generated wastewaters with all the advantages of a three-phase method and in part of a two-phase method. Besides, there is a 1.5% raise in the olive oil mill capacity and a 50% decrease of solid wastes (olive oil processing cakes) with a concomitant diminution of the quantity of the olive oil absorbed by them. This process proved to be effective for the reduction of wastewater pollution load and its detoxification” (Vlyssides et al., 2001, 2004:608-9; Kuhn et al., 2010a, 2010b, 2011a:5, 2012a:5).

Furthermore, orchard use the olive mills wastewaters after their treatment as a fertilizer added to the soil can result in improved olive orchard management. This process could lead to a dramatic reduction in the use of chemical and organic fertilizers and to improving the productivity of the orchard. According to some experts’ expectations and the experiments results that had been conducted show that there is a decrease in the proportion of the usage of chemical fertilizers by 50%, which means lowering the production costs and preservation of the environment (Ministry of Agriculture and Agrarian Reform, 2007b).

Accordingly, “the extraction process modification is the best appropriate management and treatment option for olive-mill wastewater. In this strategy, olive-mill wastewater is collected from the olive oil mills, transported via vacuum tankers and treated at the centralized treatment plants. Moreover, by means of various process modification technologies, a further reduction or even the prevention of water pollution can be achieved. The replacement of the traditional and the three-phase technology for a two-phase technology will reduce the amounts of olive-mill wastewater as less water quantities are used in the process, but higher
concentrations of hazardous chemicals are produced. The modification technology of the oil extraction process has been applied in large scale in more than 200 olive-mill industrial plants in the Mediterranean area, predominantly in Spain, Italy and Tunisia (Improlive, 2000). In Syria, this modified technology should be considered too and is recommended in any future development plan of the olive-mill industry. This can go parallel with the suggested plan of establishing large scale olive-mill industry at preferred commercial locations to replace the scattered small scale olive-mill industry” (Shaheen & Abdel Karim, 2007:78-79; Kuhn et al., 2011b, 2012a:2). In Figure 4.1 below, “cost estimations of the proposed olive oil process modification and wastewater treatment method are presented” (Vlyssides & Kyprianou, 2001; Vlyssides et al., 2004:610; Kuhn et al., 2010a, 2010b, 2011a:6, 2012a:20).

![Graphs showing cost estimations](attachment:image.png)

**Figure 4.1:** Compliance cost estimation of olive oil processing modifications and wastewater treatment process (Vlyssides & Iaconidou, 2003; Vlyssides, 2003; Vlyssides et al., 2004:608)
Figure 4.1 above illustrates “the average compliance costs generated at maximum production capacity as obtained from the surveyed olive oil mills based upon results derived from a pilot-plant scale study” (Vlyssides et al., 2004:608; Kuhn et al., 2011b, 2012a:5). Here, the olive-mill industry is aggregated taken into account the composition of olive oil mills and technology types. Taking the weighted average of all olive oil mills, we compute the average of environmental compliance costs for the aggregate olive-mill industry as a measure of the importance of environmental regulation in that industry.

As a result, based on Vlyssides et al. study (2004:608) and as highlighted in the graph (c) reported above in Figure 4.1, “the range of compliance costs is between 120€ and 250€ per ton of olive oil production” (Kuhn et al., 2011b, 2012a:5). “We then compute the average price of olive oil for the period 2002-2006 and find it equal to 2558€ per ton of olive oil production. Therefore, if these costs are passed along in the olive oil prices, the price increase due to the costs of compliance with the policy of Integrated Waste Management would be between 5% and 10%. Both the low (i.e., 5%) and the high (i.e., 10%) costs compliance options are taken to demonstrate the possible range of compliance impacts on the Syrian olive oil production and exports levels” (see Kuhn et al., 2010a, 2010b, 2011a:6). Thus, we find that estimating the average impact of an increase in the environmental compliance costs over all olive-mill industry.

“Given the preceding discussion, the second scenario involves estimating the impact of compliance with the policy of Integrated Waste Management on the production and exports levels of Syrian olive oil products. This is mainly due to the increase in the average cost of olive oil production for the producer. In view of the above findings, cost estimation of olive oil processing modifications and wastewater treatment process will lead to a 5% to 10% increase in the compliance unit cost share of price per ton of olive oil for the producer” (see Kuhn et al., 2010a, 2010b, 2011a:6).

Accordingly, the Syrian government needs to exert more efforts in promoting the enforcement of compliance with environmental policies that aim to protect public health and to achieve economic well-being. The government should also contribute to mitigate the environmental problems arising when adopting environmental policies that are protectionist in nature, and/or when achieving compliance with more stringent environmental policies imposes additional costs on production may be hard to bear and afford by the olive oil producers and exporters.
To sum up, we are living in a world enormously dependent on product-related environmental policies. They affect our lives in ways we sometimes do not even become aware of them, other than they can have far-reaching important implications for economic activities, including international trade competitiveness. In addition, product-related environmental policies that aim at increasing market efficiency have complex trade competitiveness’ impacts. The impact of product-related environmental policies on international trade competitiveness tends to be multifaceted, and moreover, it requires to be analyzed on a case-by-case basis (WTO, 2005:31, 72).

Thus, the task is to alleviate the environmental problems and concerns facing the Syrian olive oil exporters, and it is also to assist policy makers in the Syrian region finding suitable solutions to them. We therefore present in the next Chapter a partial-equilibrium trade model, which would constitute a scientific methodology to help out better understand how to assess the impact of compliance with environmental policies on international trade competitiveness for the Syrian production and exports levels. In other words, theoretical model and empirical analysis for the olive oil agro-industrial sector in Syria are presented in the next part. This is as an example to estimate the impact of compliance with the WTO-EU environmental policies for the international olive oil market on trade competitiveness for the Arab developing economies.
Part Two: Theoretical Model and Empirical Analysis for Syria

5. The Theoretical Model of Environmental Policies and Trade Competitiveness

5.1. Understanding the Theoretical Model

How the enforcement of compliance with environmental policies in Syria affects its trade competitiveness is a motivating topic of research. As to the best of our knowledge, this topic has received no prior theoretical and empirical analysis. Thus, to help understand the magnitude of interactions between environmental policies changes and trade competitiveness effects, this study provides a partial equilibrium approach for modeling the impacts of environmental policies on trade competitiveness at the sector and/or industry level in a particular market of the economy. Such a methodology could demonstrate to be very useful and valuable in evaluating the olive oil sector-specific trade competitiveness’ impacts of environmental policies changes in a competitive market.

In particular, as far as our approach is concerned, one can first distinguish between three broadly used economic modeling approaches. They generally provide the basic methodology for modeling and analyzing the trade competitiveness impacts of environmental policies changes. These approaches are based on the notion of gravity and general or partial equilibrium trade models. Gravity trade models focus on the impact of more stringent environmental policies on foreign bilateral trade flows between pairs of countries (Caporale et al, 2010; Costantini & Mazzanti, 2012). General equilibrium trade models focus on analyzing the interaction between different markets in determining the patterns of international trade, whilst partial equilibrium trade models consider the analysis of the factors that determine international trade from the perspective of isolated markets (Van Beers, 2006:5).

On the other hand, the trade competitiveness impacts of environmental policies changes can be analyzed either with a simplistic or complex approach. In the classical trade models (a simplistic transparent approach) agricultural products in particular are assumed to be similar, perfectly substitutable and are called homogeneous products in international markets (Cagatay & Saunders, 2003:4). In this approach, the assumption of large numbers of producers and equalized prices for the homogeneous products across them provides the competitive conditions in both domestic and international markets. In addition, the assumptions of the homogeneous products and competitive conditions imply that a country can only be an exporter or an importer of this product in the international markets. Therefore, these
assumptions simplify the trade modeling approach in two main aspects (Cagatay & Saunders, 2003:4). Firstly, given that there are homogenous products and equalized prices in the international markets, the approach does not require tracking explicitly the bilateral trade among countries. Secondly, the approach requires only tracking explicitly a single trade flow for a country, as this country is either an exporter or an importer of a certain product. Thus, due to its transparency in tracing the trade patterns and its ease of interpretation at the sector or industry level, the simplistic transparent approach is used broadly in partial equilibrium analyses; especially in agriculture based specific trade-environment policies analysis (see, e.g., Cagatay & Saunders, 2003:4; Perali, 2003:2; Sigwele, 2007:77).

Accordingly, we can conclude that the choice of gravity, general or partial equilibrium approach depends primarily and foremost on the specific purposes of the case study. The partial equilibrium approach is then a reasonable methodology to be followed in this study. In particular, although the partial equilibrium approach is more restricted in scope, however, it has as many advantages for the present study. More importantly, its transparency provides the empirical simplicity of simulation and the ease with which the environmental compliance can be included in the analysis. In addition, it provides a clear result on how certain environmental policies changes influence trade competitiveness directly (see, e.g., Saunders et al, 2001:5; Perali, 2003:2; Van Beers, 2006:5).

Second, the theoretical results with regard to ecological dumping depend largely on the market structures that are being studied (Withagen et al, 2007a:130). “In the case of perfect competition on world markets and the absence of international spillovers, ecological dumping is sub-optimal from a social welfare perspective, taking into account the pollution damages” (Rauscher 1994; Neary 2006; Withagen et al, 2007b:2). On the basis of traditional theory, where the market acts competitively, as the government may not have the market power to influence world prices, the concept of ecological dumping has to be rejected (Pfluger, 2001:690). On the other hand, the impacts of environmental policies on the terms of trade depend on the type of policy and economic conditions under which a policy applies (Huang, 2002:55). In some cases, an environmental policy can improve the terms of trade, but in other cases, it may deteriorate the terms of trade (Huang, 2002:55). As in the case of a large country, it may be optimal to implement a more stringent environmental policy on the exporting sector in order to improve the terms of trade (Rauscher 1994; Withagen et al, 2007a:130).
Third, the polluter pays principle is the sensible approach in the context of the implementation of environmental policies within a country (Gardiner, 2010). For instance, if the olive-mill industry discharges wastewater into the environment, the appropriate response by the government is then to introduce an environmental compliance on the output of this industry. In this study, producers have to control the pollution caused by this industry. Here, there is a negative externality caused by the pollution of olive-mill industry. That is, externalities generate market failure that government policies seek to correct (Kolstad, 2000:151). Thus, the government implements environmental policies by means of a pollution quota enacted to correct the effects of the pollution as a negative externality. Such that the government sets the environmental compliance equals to the environmental pollution control value, which is equal to the environmental compliance cost per unit of this industry’s output. This provides an incentive for the olive-mill industry to search for different clean technologies and methods of production which generate less pollution into the environment. This result goes in line with the Porter hypothesis, which asserts that tough environmental policies will encourage the development of less polluting technologies of production.

Fourth, the environmental compliance cost is represented as an exogenous parameter to the olive oil sector. Here, we analyse a single market of the economy that ignores repercussions in other markets. In other words, no second market and interactions with other markets are taken into consideration. Consequently, the olive oil agro-industrial sector can be considered as operating in isolation from the other sectors of the economy. That is, the analysis is partial equilibrium, so this implies that changes in the sector characteristics under consideration have no impact upon factor prices and production in other sectors (Brenton et al, 1997:215). Thus, the introduction of environmental trade policies through the application of a partial equilibrium approach has a negligible effect on the rest of the economy. Based on this assumption, the welfare effects cannot be captured in this approach (Sigwele, 2007:77). As a result, we can make a sensible comparative statics analysis of the impacts of an increase in environmental compliance costs on the sector.

Finally, what we do not treat in this study is the government’s strategic policy behavior. Although this is a relevant topic, particularly in the context of its affect on a country’s economic welfare through terms of trade effects, we want to concentrate here on a particular sector-specific market of the economy. So, the effects of strategic policy actions are therefore ruled out in this analysis. In addition, the government’s optimal environmental policies are
ruled out or treated in the background throughout the underlying approach for the sake of simplicity. That is, the environmental policy is implemented as a pollution quota.

Overall, the approach presented in this study attempts to circumvent the above mentioned assumptions and limitations through examining the trade competitiveness impacts of specific changes in environmental policies for the Syrian olive oil agro-industrial sector. Here, pollution gives rise to a negative environmental externality and is modelled as a by-product generated in the production process, and therefore, an environmental compliance (a pollution quota) is imposed by the government. Accordingly, the environmental policy is modelled implicitly in terms of a comparative statics analysis based on the environmental compliance costs. The result of a comparative statics analysis thus provides a sound theoretical framework for understanding under which economic conditions the environmental compliance costs can be expected to have negative or positive effects on the sector’s production and exports levels.

As a fundamental background to the analysis included in this study, it has been suggested that the adoption of environmental policies would lead to achieving comprehensive sustainable development and benefits to the overall national economy. This is in terms of improved resource efficiency, minor pollution intensity and superior occupational safety. These benefits would be achieved particularly when effective mechanisms are put into place in order to encourage innovation and to support environmental sound technology transfer in a free market system. This argument can be supported following the partial-equilibrium trade model, which is a simple, empirical and economic policy method developed under the METAP MedPolicies Initiative (HIID, 2000; UN-ESCWA, 2005). It aims to calculate the percentage level of changes in the production and export levels from complying with environmental policies for the olive oil agro-industrial sector in Syria.

The advantage of this model lies in the way it provides an easy method for estimating the impact of compliance with environmental policies on the Syrian olive oil production and exports levels. This estimation can then be used to highlight the challenges and opportunities arising from compliance with these policies. It can also be used to identify the necessary supplementary measures that might be necessary in order to help mitigate potential adverse effects on the production and exports levels due to compliance with environmental policies related to health and public safety (For more details about this model, see Larson, 2000a, 2000b; HIID, 2000; Larson et al., 2002; UN-ESCWA, 2002; UN-ESCWA, 2005).
The purpose of this model can be seen in three dimensions. Firstly, this model explains the scientific methodology for non-academic audience. It shows how to implement and apply this methodology in a simple practical method to support policy analysis. This model is therefore designed to be easily understood and applied by those who do not have advanced formal training in economics. Secondly, this model provides the empirical basis that could be used to estimate the impact and costs due to compliance with environmental policies, and thus it can be used to support the assessment of the impact of environmental sustainability, which expands the scope of the analysis to include the effect of compliance with environmental policies on social, economic and environmental indicators. Thirdly, this model helps to increase the public awareness of the issues that lay at the link between trade and the environment for the olive oil agro-industrial sector in Syria. This can be achieved through the promotion of analytical capabilities in the Syrian economy to deal with the trade-environment issues. It can also be achieved by the development of a flexible policy analysis tool to estimate the impact of changes in environmental policies on the olive oil production and exports levels based on information that is easy to obtain and not parsimonious. All this could facilitate communication and coordination between Syrian policy makers in the area of trade and the environment. This also could contribute to improving the formulation of environmental policies related to the olive oil market, which would lead to achieve progress in both areas; trade expansion and environmental protection for the olive oil agro-industrial sector in Syria (see, e.g., Panayatou, 2000:2; UN-ESCWA, 2005:14).

The basic assumption of this model is that compliance with environmental policies will increase production costs initially for the olive oil agro-industrial sector, which needs adapt to changes in public policy. In this case, this sector is seeking to adjust decisions on production with regard to both, the amount or types of inputs used and the amount of outputs produced and sold. This would lead to changes in production processes as the olive oil producers seek to minimize costs and maximize profits. This would in turn lead to fundamental and substantial changes in the production and export levels. These changes can be mitigated through the achievement of effectiveness and efficiency gains in productivity at the sector level. Moreover, some of the additional production costs could be converted to consumers who are paying a higher price for products that meeting compliance with international environmental policies related to the international olive oil market (see, e.g., UN-ESCWA, 2005:14).
The application of this model requires access to basic information that is based on available data. This information should include answers to the following questions (UN-ESCWA, 2002:23; UN-ESCWA, 2005:14):

- What is the change in public policy related to the olive oil market?
- How compliance with this policy does affect olive oil production?
- How does the change in policy raise production costs of olive oil, and how much would the rise be?
- To what extent could the olive oil production levels adjust with cost increases?
- How can these changes in olive oil production change in export levels?
- How could the answers to the above questions change if compliance with environmental policies would lead to stronger incentives for the olive oil agro-industrial sector to make it more effective in the production extraction processes, and moreover, if this sector is able to convert some of the additional costs of compliance to consumers in the domestic and international markets in the form of higher output prices for olive oil products?

Consequently, there are three levels of analysis arising from the application of this model for the olive oil agro-industrial sector in Syria (UN-ESCWA, 2005:14-15). The first level is the “basic model case” scenario, which is about estimating the impact of compliance with environmental policies on the Syrian olive oil production and exports levels in the absence of secondary responses. The second level is the concept of “efficiency improvements”, which is based on the principle that the amended environmental policies could provide the olive oil agro-industrial sector with incentives to encourage it to seek innovative ways to reduce costs and improve profitability. The third level is the concept of output price adjustments due to the “large country case”, which is based on the principle that the olive oil agro-industrial sector by complying with new environmental policies could transfer some of the additional production costs to consumers by raising the prices of olive oil products. However, this depends on the details of the specific market. In the “large country” case, for olive oil products those are fairly homogeneous, the Syrian olive oil exporters could influence the price of olive oil product in the international market and therefore could be able to convert some additional production costs to consumers without suffering a loss in olive oil sales. In the “differentiated niche markets” case, markets with environmentally preferable products are supported by consumers who are paying a higher price for olive oil products subject to compliance with international environmental policies. This would allow olive oil producers to charge consumers some additional production costs. These differentiated markets are
increasingly emerging in developed countries and providing significant opportunities for enhancing trade competitiveness for the olive oil agro-industrial sector in Syria, where consumers are more environmentally conscious (UN-ESCWA, 2005:15).

The logic of “this model is designed to be applied at the level of a single business, i.e., at the sector or industry level. This model seeks to clarify that the impact of compliance with environmental policies on the production and export levels depends on the details of the case study. An assessment of this impact in a competitive market depends on the availability of the following basic information (UN-ESCWA, 2005:15; Kuhn et al., 2010a, 2010b, 2011a:10):

- The additional cost imposed by compliance with environmental policies;
- Profitability rates in the sector or industry;
- The supply response in the sector or industry;
- The current level of production and exports as a share of total production;
- The input elasticity of the sector or industry and the supply elasticity of the market as it responds to output price changes;
- The potential for efficiency improvements in the sector or industry;
- Additional information on the domestic demand and export conditions.

A combination of these factors will determine the impact of environmental policies on the production and export levels” (Kuhn et al., 2010a, 2010b, 2011a:10-11).

More specifically, this study is designed to begin to fill this gap in the analysis related to the Syrian olive oil market. The study therefore follows the partial equilibrium approach described above. “The objectives of this approach are to shed light on the impact of compliance with environmental policies on the Syrian olive oil production and exports levels. It also aims to assist the Syrian government in examining how compliance with environmental policies can help improve economic efficiency and trade competitiveness for the olive oil agro-industrial sector. Moreover, it aims to explore the need for supporting the use of environmental policies related to the olive oil market as the best way to promote trade flows and avoid environmental dumping in the Syrian region, especially before the environmental damage occurs. In a real sense, the basic objective has to be: prevention is more always better than cure with respect to compliance with environmental policies for the olive oil agro-industrial sector in Syria” (Kuhn et al., 2010a:3, 2010b:4, 2011a:3).
To fulfill these objectives, “we examine explicitly the relationship between environmental policies and international trade competitiveness. This is mainly achieved by assessing the scope and scale of the impact of compliance with environmental policies on trade competitiveness of the olive oil agro-industrial sector in Syria. This impact will be assessed by applying a simple, empirical and tractable economic policy model. This model calculates the percentage changes in the Syrian olive oil production and exports levels from compliance with environmental policies, particularly when effective mechanisms are put into place to encourage innovation, to improve information dissemination and to promote environmental technology transfer in a free market system based on the following three main pillars (UN-ESCWA, 2005:5; Kuhn et al., 2010a:3-4, 2010b:4-5):

(a) 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 and international competitiveness for the olive oil agro-industrial sector in Syria;

(b) 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, productivity improvements and the compliance-induced efficiency improvements in the olive oil production processes in order to maintain, or even reduce, the cost of production in a free market system;

(c) While competition in the international marketplace is rife, olive oil producers in Syria 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 the olive oil products as environmentally friendly products or specialized goods.

These conditions could therefore result in larger profits, more income and higher trade competitiveness for the olive oil agro-industrial sector in Syria” (Kuhn et al., 2010a:3-4, 2010b:4-5).

Based on the preceding discussion, the purpose of this study is to examine the possible impact of compliance with environmental policies on the production and export levels of Syrian olive oil products. A simple profit-maximizing model in a partial-equilibrium trade framework will, therefore, be adopted with some modification. The procedure is outlined in Larson (2000a, 2000b) and in Larson et al. (2002) and modified by Kuhn et al. (2011b, 2012a, 2012b). “The basic set-up of the model assumes that the olive oil agro-industrial sector is operating under
decreasing returns to scale production technology” (Kuhn et al., 2010a, 2010b, 2011a:6, 2012a:6). “Fixed costs are ruled out for the sake of simplicity” (Kuhn et al., 2012a:6, 2012b:6). In addition, “the market behavior is assumed perfectly competitive in the domestic as well as in foreign markets” (Kuhn et al., 2011a:6, 2012a:6, 2012b:6). In this context, two main types of environmental policies instruments have been taken into account: The first type is “input-specific” environmental policies in the production process, such as those regarding to content, handling and use of raw materials. The second “type is “end-of-the-pipe” environmental policies for wastewater effluents, such as wastewater treatment and waste disposal regulatory policies” (Kuhn et al., 2010a, 2010b, 2011a:6, 2012a:6).

“Regarding the market structure facing the Syrian olive oil agro-industrial sector, it is characterized by the presence of an increase in the quantity of olive oil supply. In the domestic market, given that there are a large number of olive oil producers and sellers (as evidenced by the graph in Appendix 3); the market situation reveals the presence of intense competition among olive oil producers. Thereby, the ability of olive oil producers to pass a part of the costs of compliance with environmental policies to the domestic consumers might be somewhat limited. In addition, the introduction of efficiency improvements in the production processes is possible due to the enforcement of compliance with the Integrated Pest Management and Integrated Waste Management policies as mentioned earlier in the previous Chapter (see, e.g., Porter, 1990). At the international level, the available quantities of olive oil products for export are large enough. Syrian olive oil exports make up for a significant proportion in the quantum of world olive oil exports, where the share of Syrian exports accounts for about 8% of world olive oil exports (IOOC, 2006). Thus, a change or a modification in the national olive oil production and in exported quantities can affect the world market prices of these products (see, e.g., Van Beers and Van den Bergh, 1996). Consequently, we can assume the Syrian economy to be a “large” in the world olive oil market. That is, as it will become obvious below, we primarily take Syria as a small country and we later on take for granted that Syria is a large economy in the olive oil market” (see Kuhn et al., 2010a:5, 2010b:10, 2011a:7, 2011b:5, 2012a:6, 2012b:6).

Additionally, based on the market structure situation described above, three possible cases will be considered in this study (see Kuhn et al., 2010a, 2010b, 2011a:3, 2012a:3-4). This is mainly for each of the two types of environmental policies that have been taken into account,
i.e., “input-specific” environmental policies in the production process and those with respect to “end-of-the-pipe” environmental policies.

“The first case is the basic partial equilibrium approach (i.e., the small country case). The second case is an extension that allows for the sector or industry-level efficiency improvements due to productivity changes to be induced by compliance with environmental policies. In other words, given that the olive oil agro-industrial sector is facing the low efficiency and utilization rates as mentioned before in the previous Chapter, this case takes into account the possibility where efficiency improvements result from compliance with environmental policies. The third case is an extension that allows for the inclusion of output market price adjustments due to domestic and export supply shifts (i.e., the large country assumption), where Syrian producers can pass on some of the compliance costs with new environmental policies to consumers in the domestic and export markets in the form of higher output market prices” (see Kuhn et al., 2010a, 2010b, 2011a:3, 2012a:3-4).

5.2. Applying the Methodology

1. **The basic partial equilibrium approach.** The impact of compliance with environmental policies, such as “input-specific” and “end-of-the-pipe” policies, on the production and export levels can be discussed quite easily in a simple demand and supply context. The main idea of this approach used is simple. The enforcement of compliance with new environmental regulatory policies increases production costs for the producer, e.g., the specific input cost for the first type of regulatory policies and the average cost for the second type of regulatory policies. The increase in production costs for the producer shifts the domestic supply curve to the left and reduces the quantity supplied and hence the quantity exported of the product (see, e.g., Larson, 2000a: 536, 2000b:6; Larson et al., 2002: 1062; Babiker, 2002:19; Babool & Reed, 2005:2; Kuhn et al., 2011a:7, 2012a:6, 2012b:6).

For example, consider the simple market situation in Figure 5.1 shown below. Where, the line $S^0S^0$ represents the initial supply schedule for output $Y$ (olive oil in Syria). The line $BB$ represents domestic demand of olive oil in Syria. The notation $p^0$ is the output market price for olive oil product and this price is taken as given in the world market (the world market-clearing price). That is, this world market price is determined by the intersection between the world market demand and the world market supply. The notation $E^0 = Y^0 - B^0$ is the existing level of Syrian olive oil exports to the international markets.
As shown above in Figure 5.1, in the usual demand-supply context, the increase in production costs shifts the domestic supply curve to the left from the original level $S^0$ to a new level $S^1$. Therefore, given a fixed output price at $p^0$, the quantity supplied of the produce reduces from $Y^0$ to $Y^1$ and hence the quantity exported of the produce falls from $E^0 = Y^0 - B^0$ to $E^1 = Y^1 - B^0$. For additional simple graphical overviews of this topic, see Krutilla (1991); Anderson (1992); Smith and Espinosa (1996), and for a more complete introduction to the topic, see Van Beers and Van den Bergh (1996).

2. **The inclusion of efficiency improvements into the basic model.** Does the adoption and enforcement of compliance with environmental policies create new incentives and/or opportunities for the olive oil agro-industrial sector in Syria to reduce environmental compliance costs? Indeed, this possibility is consistent with Porter Hypothesis (Porter, 1990; Porter & Van der Linde, 1995b:98). This hypothesis suggests that there are efforts being made by the agro-industrial sector in order to enforce compliance with new environmental policies.
These efforts, however, may also be offset by efficiency gains brought about through innovation and creativity at the sector level. For this case, there is a low in the efficiency and utilization rates in the Syrian olive oil sector. In addition, there is the possibility of the introduction of efficiency improvements in the production processes. This is mainly due to implementing the Integrated Pest Management and Integrated Waste Management regulatory policies for the olive oil agro-industrial sector in Syria as mentioned earlier. Therefore, it is necessary to take into consideration the possibility where efficiency improvements due to productivity level changes result from compliance with environmental policies in this analysis.

These efficiency improvements can help reduce some of the increase in production costs due to compliance with environmental policies, and thus, efficiency improvements effect can be described as a simple shift to the right in the domestic supply curve as shown in Figure 5.1. In Figure 5.1, the reduction in the production costs due to efficiency improvements shifts out the domestic supply curve to the right to $S^2S^2$ with new production levels $Y^2$ and with exports $E^2 = Y^2 - B^0$. In other words, an increase in the quantity supplied and the quantity exported of the produce will be in the efficiency improvements case.

3. The inclusion of output market price adjustments into the basic model. This is the case where olive oil producers can pass on some of the compliance costs increase to consumers in domestic and export markets in the form of higher output market prices. In this case, if compliance with environmental policies induces changes in domestic production and therefore exports, it is possible that such supply shifts could in turn affect prices received in export destination markets when export demand is not perfectly elastic, i.e., the sector faces a “downward sloping” export demand (see, e.g., Dervis, de Melo & Robinson, 1989:225).

There are two possibilities which exist where environmental policies could induce export price or output market price adjustments. First, by definition, changes in domestic supply and export supply from a “large country” will influence international market prices for that product (see, e.g., Van Beers & Van den Bergh, 1996). Second, there is likely to be some products differentiations based on country of origin in the export markets or in niche markets, which describe markets with highly differentiated products, such as those supported by consumers preferring “green” products (see, e.g., Armington, 1969). In either case, the output market price of the produce will change as the quantity supplied and the quantity exported change.
In this case, the available quantities of Syrian olive oil products for export are large enough. In addition, Syria is basically the country of origin for the olives trees. Therefore, the possibility where output market price adjustments due to the large country case result from compliance with environmental policies is taken into consideration in this analysis.

Figure 5.1 shows how to include output market price adjustments due to the large country case into the analysis. Figure 5.1 includes Figure 5.1.a for the domestic (home) market and Figure 5.1.b for the export market. In this scenario, the sector faces a “downward sloping” export demand schedule $EE$, as can be seen in Figure 5.1.b. In Figure 5.1, as compliance with environmental policies leads to shifts in domestic supply from $S^0S^0$ to $S^1S^1$ and then to $S^2S^2$ due to efficiency improvements in Figure 5.1.a, exports supply shifts back from $S^0 - B$ to $S^2 - B$ and export price increases in Figure 5.1.b from $p^0$ to $p^3$ due to the downward sloping export demand schedule.

In general, the increase in the output market price would lead to the following changes. The domestic production increases to $Y^3$. The domestic demand falls to $B^3$. The overall change in exports is from $E^0 = Y^0 - B^0$ at price $p^0$ to $E^3 = Y^3 - B^3$ at price $p^3$. In other words, an increase in the quantity supplied and the quantity exported of the produce will be in the output price adjustments case.

“The extent of the supply curve shifts, i.e., the impact on the production and export levels, however, depends on the stringency of the environmental policies, the market elasticities, the input cost shares and the average production cost increases. Thus, the task at hand is how to quantity these shifts and to estimate this impact by calculating the percentage changes in the Syrian olive oil production and exports levels from compliance with environmental policies and a given set of market data” (Kuhn et al., 2010a, 2010b, 2011a:7).

5.2.1. The Case of “Input-Specific” Environmental Policies

In this section, we are pretty much following the theoretical model built by Larson (2000a, 2000b) and Larson et al. (2002). Here, producers may have two options in this case. The first one is replacement away from the harmful input. The second option is controlling pollution caused by this input, which increases the total costs of production. This is mainly due to the rise in the price of the complied input.
The estimation of the impact of “input-specific” environmental policies on the olive oil production and exports levels is accomplished in two stages. First, we need to explain the percentage increase in the input price for the producer due to compliance with environmental policies. Second, we have to estimate the impact on both the production level and the exports level from the input price increase.

Regarding the first stage, compliance with environmental policies acts to increase input price (such as olives in our case). For example, let \( w^0 \) represents the initial input price per unit before the environmental policy change. If the environmental policy changes (e.g., implementing the policy of Integrated Pest Management) that increases the unit price of this input by “n”, the overall price of using the input after the change would be \( w^1 = w^0 + n \). As a result, the environmental policy change increases the unit price of the determined input for the producer by: \( dw = w^1 - w^0 = n \). In percentage terms, the specific input price increase can be written as: \( dw/w^0 = (w^1 - w^0)/w^0 = n/w^0 \) (see Larson et al., 2002:1063).

Regarding the second stage, some micro-economic hypothesis (see Larson, 2000a and Larson et al., 2002) will be integrated with producer profit maximization problem. We will estimate the input price supply elasticity (\( \eta_{w^0} \)) by using the standard duality relationships between the profit and cost functions. We will thus be able to compute the percentage changes of the production and exports levels (\( \Delta Y/Y \) and \( \Delta E/E \)) in response to a possible input price increase (\( \Delta w/w \)).

1. The Basic Model Case: A standard micro-economic problem can be used as a starting point. This manipulation will allow us to estimate the impact on the production and exports levels from this policy change. We suppose that the producers (e.g., the olive oil producers in Syria) maximize their profits within the context of perfectly competitive markets. Consequently, the profit function for the producer \( \pi = \pi(p, w, r) \) is defined by the following problem as (see Larson, 2000a:537):

\[
\pi(p, w, r) = \text{Max}_{x, k} \left[ pf(x, k) - wx - rk \right]
\]

Where \( x \) is the quantity of the complied input used and \( w \) is the price of the complied input; \( k \) is the quantities of other inputs and \( r \) is the prices of other inputs;
y is the level of output obtained;

\( f(x, k) \) is a production function relating inputs to output, with \( y = f(x, k) \); and 

\( p \) is the output market price.

From the profit function, we apply the envelope theorem (Hotelling’s Lemma) (Larson, 2000a:537). We can thus determine the profit-maximizing level of supply function for output \( Y \) and the profit-maximizing level of the complied-input demand function \( X \) as follows (see Larson, 2000a:537):

\[
Y = Y(p, w, r) = \frac{\partial \pi}{\partial p}
\]

and

\[
X = X(p, w, r) = -\frac{\partial \pi}{\partial w}
\]

(2)

Where (2) is the solution to the problem in (1). Moreover, we can easily show that by applying “the symmetry of the Hessian of the profit function \( \pi \) (Young’s Theorem)” (Larson, 2000a:537):

\[
\frac{\partial Y}{\partial w} = \frac{\partial^2 \pi}{\partial p \partial w} = \frac{\partial^2 \pi}{\partial w \partial p} = -\frac{\partial X}{\partial p}
\]

(3)

Thus, the change of the supply \( Y \) due to the rise in input price \( w \) is equal to the negative of a change in input demand \( X \) due to the rise in output price \( p \) (see Larson, 2000a:537).

Of another dimension, we define the cost function for the producer \( C = C(w, r, y) \) as (see Larson, 2000a:537):

\[
C(w, r, y) = \text{Min}_{x, k} \left[ wx + rk \right] \quad \text{Subject to} \quad f(x, k) \geq y
\]

(4)

By applying the envelope theorem (Sheppard’s Lemma), we can determine the cost-minimizing level of complied-input demand function \( X^c \) for the producer as follows (see Larson, 2000a:537; Larson et al., 2002:1063):

\[
X^c = X^c(w, r, y) = \frac{\partial C}{\partial w}
\]

(5)
When $y$ is evaluated at the profit-maximizing level of optimal output supply $Y$ (Larson, 2000a:537), then the profit-maximizing level of input demand $X$ equals the cost-minimizing level of input demand $X^c$ as (see Larson, 2000a:537; Larson et al., 2002:1063):

$$X(p, w, r) = X^c[w, r, Y(p, w, r)]$$

(6)

Now, by deriving $X(p, w, r)$ with respect to $p$, “the impact of higher output price on input demand can be written as” (Larson, 2000a:537):

$$\frac{\partial X}{\partial p} = \frac{\partial X^c}{\partial y} \frac{\partial Y}{\partial p}$$

(7)

Thus, the impact of the output price increase on the input demand $\partial X / \partial p$ can be determined as the function of two terms. The first term $\partial X^c / \partial y$ measures the impact of the increase in the supply level on the cost-minimizing level of input demand. The second term $\partial Y / \partial p$ evaluates the change of the output supply compared to its own price. Then, if we use the result of the equation (3), we can write (see Larson, 2000a:537, 2000b:16; Larson et al, 2002:1063):

$$\frac{\partial Y}{\partial w} = -\frac{\partial X}{\partial p} = -\frac{\partial X^c}{\partial y} \frac{\partial Y}{\partial p}$$

(8)

From this initial situation, the impact of higher price for the complied input on supply “can be written in elasticity form as” (see Larson, 2000a:537, 2000b:23):

$$\eta_{yw} = \frac{\partial Y}{\partial w} \frac{w}{Y} = -\frac{\partial X^c}{\partial y} \frac{w}{p} \frac{X}{Y} = -\left[\frac{wX}{pY} \frac{\partial Y}{\partial p} \frac{Y}{p} \frac{\partial X^c}{\partial y} X\right]$$

$$\eta_{yw} = -\frac{wX}{pY} \eta_{yp} \eta_{xy}$$

(9)

Where $\eta_{yw} = (\partial Y / \partial w)(w/Y)$ is the percentage change in output supply for a one percent increase in input price (Larson et al., 2002:1063); $wX / pY$ is the proportion of the complied input’s cost as a share of total revenues ($0 < wX / pY < 1$) (Larson, 2000a:537-8);
\( \eta_{yp} = (\partial Y / \partial p)(p/Y) \) is the percentage change in output supply for a one percent change in output price; and \( \eta_{cx} = (\partial X^c / \partial Y)(Y/X) \) is the percentage change in cost-minimizing level of input demand for a one percent increase in output level (Larson et al., 2002:1063). For reference, \( 1 \leq \eta_{cx} \) is directly related to the concept of returns to scale of the production function, which must be greater than one with decreasing returns to scale and equals one with constant returns to scale (see Larson, 2000a:538; Larson et al., 2002:1070).

Thus, for some policy changes that increase the price of the complied input by any percentage \( (\Delta w/w) \) discussed before, the cross-price elasticity in equation (9) can be used to compute the percentage change in production \( (\Delta Y/Y) \) as follows (see Larson, 2000b:23; Larson et al., 2002:1063):

\[
\Delta Y/Y = \eta_{yw} \frac{\Delta w}{w} \tag{10}
\]

Assuming that the share of exports in the total production remains constant (i.e., small country assumption), and local demand is satisfied before any product is exported, the export market carries the full weight of the reduction in production. We then translate the above production change into exports change. While “exports are equal to production minus domestic consumption \( (E = Y - B) \), the change in exports is \( \Delta E = \Delta Y \)” (Larson et al., 2002:1063). Thus, the percentage change in exports \( (\Delta E/E) \) can be computed from equation (10) as follows (see Larson, 2000b:23; Larson et al., 2002:1063):

\[
\Delta E/E = \Delta Y/Y \frac{1}{(E/Y)} = \eta_{yw} \frac{\Delta w}{w} \frac{1}{(E/Y)} \tag{11}
\]

Where \( E/Y \) represents the quantity of the product that is exported relative to the quantity of the product that is produced domestically. To give an economic intuition to our results, the relationships in equations (9), (10) and (11) show that the impact of “input-specific” environmental policies on the production and exports levels depends on five specific components (see Larson, 2000a:537-8; Larson et al., 2002:1063, 1070):

1. the proportion of the cost of the complied input as a share of total revenues \( (wX/pY) \);
2. the output supply elasticity with respect (in relation) to output price \( (\eta_{yp}) \);
3. the input demand elasticity (cost-minimizing) with respect to output level \( (\eta_{cx}) \);
4. the percentage increase in the price of the complied input \( X \) \( (\Delta w/w) \); and
5. the exports share of total production \((E/Y)\).

As a result, the changes in the production and exports levels in percentage terms \((\Delta Y/Y\) and \(\Delta E/E\)), following the rise in input prices, are negative, i.e., there will be decrease in the production and exports levels due to the increase in the complied input price \((\Delta w/w)\).

2. Including Efficiency Improvements: Compliance with environmental policies that effectively increases the price of the complied input could also alter the compliance-induced efficiency improvements with which the complied input is produced. In other words, raising the costs of the complied input will induce sectors to try to become more “efficient” in producing that input, and by becoming more efficient, sectors need less of the costs to produce the same level of input. This logic is consistent with the literature on induced innovation (see, e.g., Porter, 1990; Porter & Van der Linde, 1995b:98).

This case shows how to adjust the fundamental equations (10) and (11) to allow for the opportunity of including such compliance-induced efficiency improvements into the basic model case. We therefore have to calculate the impact with compliance-induced efficiency improvements due to productivity level changes on the production and exports levels.

For this case, producers seek to reduce the effect of the huge input price increase by shifting to more efficient controlling techniques in producing that input. Thus, we have to include the possibility that compliance with environmental policies induces efficiency improvements in the production process, i.e., this compliance improves the efficiency of the input used by a rate equal to \(q\). With efficiency improvements, \(q\) is exogenous affecting the complied input price \(w\) and in general would be a function of \(w\), i.e., \(q\) is an induced technical progress depending on \(w\): “\(q = q(w)\)” (Larson, 2000a:538) and \(\partial q/\partial w > 0\). Therefore, “the change in \(w\) and any resulting change in \(q\) due to environmental policy changes are both exogenous to the sector” (Larson, 2000a:539). Consequently, with the new form of the technical production function (i.e., the decreasing returns to scale production technology (see Larson, 2000b:16)) as \(y = f(qx,k)\), the profit function for the producer becomes \(\pi = \pi(p,w/q,r)\) and is defined by the following problem as (see Larson, 2000a:538-9):

\[
\pi(p,w/q,r) = \text{Max}_{q,k} \left[ pf(qx,k) - wx - rk \right]
\]  

(12)
Where “\( q \)’ is the input efficiency parameter” (Larson et al., 2002:1071), “the term \( w/q \) is the effective price of the complied input” (Larson, 2000a:539), and the combination \( J = qx \) is the “effective” amount of the complied input used (Larson, 2000a:538; Larson et al., 2002:1071). As a result, the final impact of any environmental policies change that increases \( w \) depends on how this effective input price \( w/q \) changes (Larson, 2000a:538).

From the profit function, the envelope theorem (Hotelling’s Lemma) can be used to determine the profit-maximizing level of complied-input demand function \( X \) and output supply function \( Y \) as follows (see Larson, 2000a:539):

\[
X = X(p, w/q, r, q) = \frac{J(p, w/q, r)}{q} = -\frac{\partial \pi}{\partial w}
\]

and

\[
Y = Y(p, w/q, r) = \frac{\partial \pi}{\partial p}
\] (13)

Where the capital letter notation for \( X \), \( J \) and \( Y \) in equation (13) is used to denote the profit-maximizing level that is the solution to the problem in equation (12) (Larson, 2000a:539). Using the notation \( L = w/q \), and continuing to assume output price remains constant, the specific form of the output supply function \( Y \) from equation (13) can be used by applying the Chain and Quotient rules to show that (see Larson, 2000a:539):

\[
\frac{\partial Y}{\partial w} = \frac{\partial Y}{\partial L} \frac{\partial L}{\partial w} + \frac{\partial Y}{\partial q} \frac{\partial q}{\partial w} = \frac{\partial Y}{\partial L} \left( 1 - \frac{w}{q^2} \frac{\partial q}{\partial w} \right)
\]

\[
\frac{\partial Y}{\partial w} = \frac{\partial Y}{\partial L} \frac{1}{q} \left( 1 - \frac{w}{q} \frac{\partial q}{\partial w} \right)
\] (14)

In the formula (14) \( \eta_w = \frac{\partial q}{\partial w} \frac{w}{q} \) gives the compliance efficiency elasticity, which postulates that a big input price increase will generate the efficiency with which the complied input is produced, and \( \frac{\partial Y^q}{\partial w} = \frac{\partial Y}{\partial L} \frac{1}{q} \) (see Larson, 2000a:539).

The formula (14) can then be written more simply as (see Larson, 2000a:539):
\[
\frac{\partial Y}{\partial w} = \frac{\partial Y^\eta}{\partial w} (1 - \eta_{qw}).
\]

From this situation, the impact of higher price for the complied input on supply can be written in elasticity form as (see Larson, 2000a:539, 2000b:23; Larson et al., 2002:1072):

\[
\Psi_{yw} = \eta_{yw}^\eta (1 - \eta_{qw})
\]  

(15)

Where the cross-supply elasticity with respect to input price \( \Psi_{yw} \) is expressed as a function of: \( \eta_{yw}^\eta \) the output supply elasticity with respect to input price holding \( q \) fixed (qualified as an inefficient situation) determined in equation (9) (Larson, 2000a:539), and of: \( \eta_{qw} \) the elasticity of the input use efficiency rate \( q \), to an increase of the input price \( w \). In general, \( \eta_{qw} \) indicates to the percentage increase in the efficiency of input use induced by the change in the price of the input due to compliance with environmental policies (Larson et al., 2002:1072). In this case, the combination \( (1 - \eta_{qw}) \) is shown how much of the initial shift back in supply (i.e., the impact on output level) from equation (9) is mitigated through including efficiency improvements case.

Then, the cross-price elasticity in equation (15) can be used to compute the percentage change in production \( (\Delta Y/Y) \) as follows (see Larson, 2000a:539, 2000b:23):

\[
\Delta Y/Y = \Psi_{yw} \frac{\Delta w}{w}
\]  

(16)

Assuming that local demand is satisfied before export can take place; we then have to translate the above production change into exports change. Thus, the percentage change in exports \( (\Delta E/E) \) can be computed from equation (16) as follows (see Larson, 2000a:539, 2000b:23):

\[
\Delta E/E = \Delta Y/Y \left( \frac{1}{E/Y} \right) = \Psi_{yw} \frac{\Delta w}{w} \left( \frac{1}{E/Y} \right)
\]  

(17)

For this case, if efficiency improvements are induced by the higher input prices, then \( (\eta_{qw} > 0) \) an increase in efficiency (an increase in \( q \)) reduces the costs of producing the complied input
w because the same level of input can be produced with less of the costs needed, so that the effective input price for the producer \( \frac{w}{q} \) actually falls (Larson, 2000a:540).

As a result, this lower effective input price due to efficiency improvements induced by compliance with environmental policies would cause an increase in the output supply and exports levels (Larson, 2000a:540). In other words, the decrease in the production and exports levels, following the rise in input prices, will be less significant if we use more efficient controlling techniques in producing that input.

3. Large Country Case: The estimation needs to implement the inclusion of output market price adjustments due to the large country case assumption (see Larson, 2000a:540; Larson et al., 2002:1065). This will allow for some of the increase in the input price to be passed along to the consumers in export markets in the form of higher output market prices (see, e.g., Dervis, de Melo and Robinson, 1989:225). This case shows how to adjust the fundamental equations (16) and (17) to allow for the possibility of incorporating equilibrium price adjustments into the model. Therefore, we have to calculate the impact with output market price adjustments which is due to the large country case on the production and export levels.

In such situation with including output market price adjustments’ effects, \( w \) is shifting export supply and thus shifting the world market price of olive oil products. Hence, the changes in the production and exports levels are smaller due to output price increase. Accordingly, additional notation related to the domestic and foreign demand functions are needed to incorporate output market price adjustments. For reference, 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 (see Larson, 2000a:540; Larson et al., 2002:1067). In addition, the form of the supply function \( Y \) will be determined as (see Larson, 2000a:539):

\[
Y = Y(p, \frac{w}{q}, r) = \frac{\partial \pi}{\partial p}
\]

(18)

The starting point is the assumption that the export price \( (p) \) clears the exports market where export demand equals export supply, and thus, \( p \) is external (given) in firms’ view and will be determined by “the equilibrium price as \( p = p(\frac{w}{q}, r) \)” (Larson, 2000a:540). However, \( p \) must be endogenously determined through the market equilibrium condition as (see Larson, 2000a:540):
\[ E(p) = Y(p, w, q, r) - B(p) \]  

(19)

For this case, let us consider an equation as:

\[ F(p, w, q, r) = Y(p, w, q, r) - B(p) - E(p) = 0 \]  

(20)

Then, by applying the implicit-function theorem rule, we can write the partial derivatives of this equation with respect to \( p \) and \( w \) as follows (see Chiang, 1984:208):

\[
\frac{dp}{dw} = - \frac{\partial F}{\partial w} \frac{\partial F}{\partial p} = - \left( \frac{\partial Y}{\partial L} \frac{\partial L}{\partial w} + \frac{\partial Y}{\partial q} \frac{\partial q}{\partial w} \right) \left/ \left( \frac{\partial F}{\partial p} \frac{\partial F}{\partial p} \right) \right.
\]

\[
\frac{dp}{dw} = - \left( \frac{\partial Y}{\partial L} q \right) \left/ \left( \frac{\partial Y}{\partial p} \frac{\partial B}{\partial p} - \frac{\partial E}{\partial p} \right) \right.
\]

(21)

Thus, the impact of higher input price \( w \) due to compliance with environmental policies on the output market price \( p \) can be computed from equation (21) as follows (see Larson, 2000a:540):

\[
\eta_{pw} = \frac{\partial p}{\partial w} \frac{w}{p} = \left[ - \frac{\partial Y^q}{\partial w} (1 - \eta_{qw}) \right] \left/ \left( \frac{\partial Y}{\partial p} \frac{\partial B}{\partial p} - \frac{\partial E}{\partial p} \right) \right.
\]

\[
\eta_{pw} = \left[ - \frac{\partial Y^q}{\partial w} (1 - \eta_{qw}) \right] \left/ \left( \frac{\partial Y}{\partial p} \frac{\partial B}{\partial p} \frac{\partial E}{\partial p} \right) \right.
\]

\[
\eta_{pw} = \left[ \frac{\eta_{pw} (1 - \eta_{qw})}{\eta_{bp} - \eta_{qp} + \eta_{ip} \eta_{r}} \right]
\]

(22)
Where $\eta_{pw}$ is the elasticity of the output market price $p$ to an increase of the input price $w$, and it indicates to the percentage increase in output price for a one percent increase in input price; $\eta_{Ep} = (\partial E/\partial p)(p/E)$ is the elasticity of foreign demand with respect to the output price (see Larson, 2000a:540; Larson et al., 2002:1067), and it gives the percentage change in foreign demand in response to a one percent change in output price; $\eta_{Bp} = (\partial B/\partial p)(p/B)$ is the elasticity of domestic demand with respect to the output price (see Larson, 2000a:540; Larson et al., 2002:1067), and it gives the percentage change in domestic demand in response to a one percent change in output price; and $B/Y$ is the share of domestic consumption in total production (see Larson et al., 2002:1067).

In general, the above two elasticities ($\eta_{Ep}$ and $\eta_{Bp}$) are almost always negative due to the inverse nature of the relationship between price and demand as described by the “law of demand” (Gillespie, 2007:43). In fact, the elasticity in equation (22) shows how much of the increase in the input price due to compliance with environmental policies is passed along to consumers in both domestic and export markets in the form of higher output market prices (see Larson, 2000a:540; Larson et al., 2002:1067).

Hence, given that the output market price is changing, and since exports are the difference between production and domestic consumption ($E = Y - B$), the expanded forms of the output supply function $Y$ and the export supply function $E$ can be written as follows (see Larson, 2000a:540, 2000b:19):

$$Y = Y(p(w, r), w/q, r)$$
$$E(p) = Y(p(w, r), w/q, r) - B(p)$$

Thus, the implications of all three cases are nested to show that the impact of higher input price due to compliance with environmental policies on output supply and exports can be written in forms of elasticities as (see Larson, 2000a:540, 2000b:23; Larson et al, 2002:1067):

$$\Omega_{yw} = \eta_{yw}^2 (1 - \eta_{pw})A$$

Or, in another way:

$$\Omega_{yw} = \eta_{yw}^2 (1 - \eta_{pw}) + \eta_{wp} \eta_{pw}$$

(25)
\[
\Omega_{Ew} = \frac{1}{(E/Y)} - \Omega_{Bp} \frac{(B/Y)}{(E/Y)}
\]

(26)

\[
\Omega_{Ew} = \Omega_{Yw} \frac{1}{(E/Y)} - \eta_{Bp} \eta_{pw} \frac{(B/Y)}{(E/Y)}
\]

Where: \( \Omega \) is the price adjustment factor and given by (see Larson, 2000a:540):

\[
\Omega = 1 + \left[ \frac{\eta_{Bp}}{\eta_{Bp} \cdot \frac{B}{Y} - \eta_{Bp} + \eta_{Ep} \cdot \frac{E}{Y}} \right]
\]

(27)

In this case, \( \Omega_{Yw} \) is the overall supply elasticity with respect to input price, and \( \Omega_{Ew} \) is the overall export supply elasticity with respect to input price (see Larson et al., 2002:1067). This export elasticity \( \Omega_{Ew} \) now takes into account supply changes and consumption changes induced by compliance with environmental policies (see Larson et al., 2002:1067). With \( 0 \leq \Omega \leq 1 \); the term \( \Omega \) or the term \( \eta_{Bp} \eta_{pw} \) shows how much of the initial shift back in supply (i.e., the impact on output level) from either equation (9) or (15) is mitigated through the large country case assumption (see Larson, 2000a:540).

Then, the overall percentage changes in the production and exports levels (\( \Delta Y / Y \) and \( \Delta E / E \)) can be computed from equations (25) and (26) as follows (see Larson, 2000b:23):

\[
\Delta Y / Y = \Omega_{Yw} \frac{\Delta W}{W}
\]

(28)

\[
\Delta E / E = \Omega_{Ew} \frac{\Delta W}{W}
\]

(29)

For this case, and since \( \Omega \) and \( \eta_{pw} \) are both positive, the negative impacts on the production and exports levels in equations (28) and (29) are smaller than that in equations (10) and (11) or equations (16) and (17). In other words, the decrease in the production and exports levels, following the rise in input prices, will be much less significant due to output price increase.
5.2.2. The Case of “End-of-the-Pipe” Environmental Policies

In this section, we are pretty much following the theoretical model built by Kuhn et al. (2011b, 2012a, 2012b). In the case of “end-of-the-pipe” pollution control technologies, the olive oil producers are not able to attribute the costs of compliance with environmental policies to specific input or inputs. In such a situation, the data or information available suggests that those producers have to implement the olive oil process modification and wastewater treatment method. This, in fact, leads to an increase in the average costs of production for those producers due to environmental compliance.

The estimation of the impact of “end-of-the-pipe” environmental policies on the olive oil production and exports levels is accomplished in two stages. Firstly, it is necessary to explain how compliance with environmental policies leads to an increase in the average production costs for the producer. Secondly, it is important to estimate the impact on both the production level and the exports level from the average production costs’ increase (Kuhn et al., 2011a:7).

Regarding the first stage, “compliance with environmental policies acts to increase the average production costs for the producer by \( m \) per unit of output” (Kuhn et al., 2010a, 2010b, 2011a:7). For example, consider the case where \( m^0 = 0 \) represents the initial policy situation without environmental compliance costs. With some environmental policies changes (e.g., implementing the Integrated Waste Management policy), the compliance costs will increase to become \( m^1 = m \). In this case, the rate of change in the average compliance costs due to environmental policies change is \( \Delta m = m^1 - m^0 = m \) (see, e.g., Larson, 2000b:20).

Olive-mill industry is coupled with considerably polluting by-products (e.g., olive mills wastewaters) that cause serious environmental problems. The main problem is the hazardous dumping or the disposal of wastewater from olive mills into the environment without any treatment, which results in enormous environmental consequences. Therefore, the policy of Integrated Waste Management represents an integrated viable and environmentally sound solution to the olive mills wastewaters problem that can be implemented and adopted by the olive-mill industry. However, the enforcement of compliance with this policy requires a wastewater treatment method that aims to alleviate the pollution problem.

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1This section has been taken identically from Kuhn et al. (2010a, 2010b, 2011a, 2011b, 2012a, 2012b).
Thus, since the policy’s primary purpose is to release the polluting load into the environment without any adverse environmental consequences, the optimal solution involves the possibility to introduce and develop suitable “end-of-the-pipe” wastewater treatment clean technologies and build storage tanks to treat olive mills wastewaters all year around. This will mainly affect the average production costs for the producer. As a result, given that the government implements this policy, the industry will face an increase in the average production costs per unit of output due to policy change.

Regarding the second stage, the focus will be about estimating how the change in the production average costs can affect the olive oil production and exports levels. To achieve this objective, “we adopt a partial-equilibrium trade model, which originally goes back to Larson (2000a, 2000b) and Larson et al. (2002)” (Kuhn et al., 2011a:6, 2011b:4, 2012a:6, 2012b:6). “However, in contrast to the related literature, we set up a modified and enlarged version of the Larson-Model, which we believe is more appropriate to the study of the “end-of-the-pipe” environmental policies predominantly put in place in Syria” (Kuhn et al., 2011b:4, 2012a:6, 2012b:6). In particular, “the link between the increase of environmental compliance costs and the innovation offsets due to efficiency improvements is modeled by extending the basic model with an additional impact of the compliance cost on the input’s shadow price” (Kuhn et al., 2012b:6). “This additional impact is reflected in some added terms and elasticities explained below, and which have not been thoroughly explored so far in the related literature” (Kuhn et al., 2012b:6). The model follows the by-product utilization approach in that a Syrian’s export competitiveness is explained by the “end-of-the-pipe” environmental policies imposed on its olive-mill industry. “In other words, we deal with the policy of Integrated Waste Management; whereas we initially take Syria as a small open economy, and then we later on assume that Syria is a large open economy” (Kuhn et al., 2012b:6). This manipulation will allow us to compute the percentage changes of the production and exports levels (\(\Delta Y/Y\) and \(\Delta E/E\)) in response to a possible compliance costs change (\(\Delta m\)).

In this model, “the study specifies the empirical relation among the compliance costs, the technological option and the level of production under some environmental policies” (Kuhn et al., 2012b:3). “Three kinds of cases will be presented where the basic case estimates the effect of the compliance costs increase on the production and exports levels” (Kuhn et al., 2011a:3, 2012a:2, 2012b:3). “The second case integrates the use of more efficient production
technologies in the production process” (Kuhn et al., 2011a:3, 2012a:2, 2012b:3). “In this case, the burden of the environmental compliance costs imposed on the industry in turn may foster the implementation of advanced production technologies just in line with the concept of Integrated Waste Management policy” (Kuhn et al., 2012a:2, 2012b:3). In addition, the industry can reduce pollution and increase output “by adopting less-polluting technologies, which is more efficient in the use of the polluting factor” (Kuhn et al., 2011b:5, 2012a:6, 2012b:6). The third case incorporates the output price adjustments process through the regulation of the production and exports levels, “since Syria is considered as a large producer in the world olive oil market” as mentioned before (Kuhn et al., 2011a:3, 2011b:5, 2012a:6, 2012b:6). “This process takes into account the possibility of shifting along a part of the burden of the compliance costs to the consumers in export markets” (Kuhn et al., 2011a:3, 2012a:3, 2012b:3). However, “to which extent the production and exports levels will be affected will depend on the particular composition of the three effects mentioned, the environmental compliance costs’ increase, the induced technical progress and the world market price’ shift” (Kuhn et al., 2011b:5, 2012a:6, 2012b:6). “In the end, this will be a matter of empirical estimation” (Kuhn et al., 2012a:6, 2012b:6).

1. The Basic Model Case: In this case, “we describe the basic model used to determine the shift in the olive oil production and exports levels as a consequence of the “end-of-the-pipe” environmental policies” (Kuhn et al., 2011b:5, 2012a:6, 2012b:6). We begin our analysis by considering a simple static model that can be used to estimate the impact on the production and exports levels from this policy change. “Further, we assume, as mentioned before, that compliance with the “end-of-the-pipe” pollution policies leads to an increase in the average production costs for the producer by some constant amount per unit of output, \( m (m > 0) \)” (Kuhn et al., 2011a:7, 2011b:5, 2012a:7, 2012b:6). Here, “\( m \) may represent the estimated cost of olive oil processing modifications and additional wastewater treatment processes, which the olive oil producing industries must implement” (Kuhn et al., 2011a:7, 2011b:5, 2012a:7, 2012b:7). To determine the optimal solution, “we suppose that the representative industry (e.g., the aggregate olive-mill industry in Syria) chooses output level that maximizes profits in a perfectly competitive market” (Kuhn et al., 2011a:7, 2011b:5, 2012a:6, 2012b:6). “Factor markets are assumed competitive too” (Kuhn et al., 2011b:5, 2012a:6, 2012b:6). We then have to analyze the behavior of the olive oil producers, and “consequently the profit function for those producers \( \pi = \pi(p - m, w, r) \) is defined by the following maximization problem as” (Kuhn et al., 2011b:5, 2012a:7, 2012b:7):
\[
\pi(p - m, w, r) = \text{Max}_{x,k} \left[ (p - m) f(x, k) - wx - rk \right] 
\]

(30)

“Where \( x \) and \( k \) are the quantities of inputs and \( x \) is considered the polluting factor; \( w \) and \( r \) are the respective inputs prices; \( y = f(x, k) \) is representing a production function of the neoclassical type; and \( p \) is the output price” (Kuhn et al., 2011b:5, 2012a:7, 2012b:7).

In this case, the inputs prices are determined in the market and taken as given (Kuhn et al., 2011b:5, 2012a:7, 2012b:7), and the industry takes the output price as given too (i.e., price taking behavior), because we assume the economy is small in world markets. As a result, an increase in the average production costs of \( m \) per unit of output acts to reduce profit just like a reduction in output price from \( p \) to \( p - m \).

From the profit function in equation (30), let \( \bar{p} = p - m \) represents the adjusted output price for the producer due to compliance with environmental policies, or “the price of olive oil net of the compliance cost, i.e., the compliance cost is equivalent to a price change” (Kuhn et al., 2011b:5, 2012a:7, 2012b:7). The envelope theorem (Hotelling’s Lemma) can then be used to determine the profit-maximizing level of supply function for output \( Y \) and the profit-maximizing level of demand function for factor \( X \) as follows (see Kuhn et al., 2011b:5, 2012a:7, 2012b:7):

\[
Y = Y(\bar{p}, w, r) = \frac{\partial \pi}{\partial \bar{p}} \\
\text{and} \\
X = X(\bar{p}, w, r) = -\frac{\partial \pi}{\partial w}
\]

(31)

Where the capital letter notation for \( Y \) and \( X \) in equation (31) is used to denote the profit-maximizing level, which is the solution to the problem in equation (30). Then, the next step is to compute the impact on production and exports (\( \Delta Y/Y \) and \( \Delta E/E \)) based on compliance costs change (\( \Delta m \)) as the following: Firstly, the specific form of the output supply function \( Y \) from equation (31) can be used to show that; deriving \( Y = Y(\bar{p}, w, r) \) with respect to \( m \) yields (see Kuhn et al., 2011b:5, 2012a:7, 2012b:7):

\[
\frac{\partial Y}{\partial m} = \frac{\partial Y}{\partial \bar{p}} \frac{\partial \bar{p}}{\partial m} = -\frac{\partial Y}{\partial \bar{p}}
\]

(32)
Where the second partial derivative of the profit function $\pi$ with respect to $p \sim$ from equation (31) is used to show that the term $\frac{\partial Y}{\partial p}$ is given by the following definition as: $\frac{\partial Y}{\partial p} = \frac{\partial^2 \pi}{\partial p^2}$ (see Kuhn et al., 2011b:5, 2012a:7, 2012b:7).

Moreover, we can easily show (by using again the specific form of the output supply function $Y$ from equation (31)) that the change in supply ($\Delta Y$) due to the compliance costs change ($\Delta m$) can be computed as (see Kuhn et al., 2011b:5, 2012a:7, 2012b:7):

$$\Delta Y = \frac{\partial Y}{\partial m} \Delta m = -\frac{\partial Y}{\partial p} \Delta m$$

(33)

Secondly, from this initial situation using “a discrete change in the compliance costs $\Delta m$, set to $\Delta m = m$” (Kuhn et al., 2011b:5, 2012a:7, 2012b:7) as discussed before, the impact of an increase in the compliance costs on supply can then be written as (see Kuhn et al., 2011b:5, 2012a:7, 2012b:7):

$$\Delta Y = -\frac{\partial Y}{\partial p} \frac{m}{Y} = -\frac{\partial Y}{\partial p} \frac{p}{Y} m = -\frac{\partial Y}{\partial p} \frac{p m}{Y}$$

(34)

By taking into account $\frac{\partial Y}{\partial p} = \frac{\partial Y}{\partial p} \frac{\partial Y}{\partial p} = \frac{\partial Y}{\partial p}$ (Kuhn et al., 2011b:5, 2012a:7, 2012b:7); we therefore conclude that for some policy changes that increase the compliance costs by any amount ($\Delta m = m$), the percentage change in production ($\Delta Y / Y$) from equation (34) can be rewritten in the following way (see Kuhn et al., 2011a:8, 2011b:6, 2012a:7, 2012b:7):

$$\Delta Y / Y = -\frac{m}{p} \eta_p$$

(35)

In the formula (35) $\eta_p = (\partial Y / \partial p)(p / Y)$ gives the price elasticity of supply representing the percentage change in output supply for a one percent change in output price (see Kuhn et al., 2011b:6, 2012a:7, 2012b:7).
Then, “assuming that the share of exports in total production $E/Y$ remains constant (i.e., small country assumption)” (Kuhn et al., 2011b:6, 2012a:7, 2012b:7), and given that the output price remains constant, the local demand is not changing. In other words, as export (foreign) demand is totally elastic, the change in exports is equal to the change in local production. The above production change can therefore be reflected in exports change. Thereby, while exports are equal to production minus domestic consumption ($E = Y - B$), the change in exports is ($\Delta E = \Delta Y$). Thus, the percentage change in exports ($\Delta E/E$) can be computed from equation (35) as follows (see Kuhn et al., 2011a:8, 2011b:6, 2012a:7, 2012b:7):

$$\Delta E/E = \Delta Y/Y \frac{1}{(E/Y)} = -\frac{m}{p} \eta_p \frac{1}{(E/Y)}$$

(36)

For this case, to give an economic intuition to our results we see that, the relationships in equations (35) and (36) show that “the impact of “end-of-the-pipe” environmental policies on the production and exports levels depends on three specific components” (see Kuhn et al., 2011b:6, 2012a:7, 2012b:7):

1. “the compliance unit cost share of output price $m/p$ ;
2. the basic price elasticity of supply $\eta_p$; and

As a result, changes in the production and exports levels in percentage terms ($\Delta Y/Y$ and $\Delta E/E$), following the rise in the environmental compliance costs, are negative. In other words, there will be decrease in the production and exports levels due to output price decrease from $p$ to $\tilde{p} = p - m$.

2. The Integrated Waste Management Policy: In this case, the estimation of the environmental compliance impact requires implementing the possibility of efficiency improvements in the production processes (see Kuhn et al., 2010a, 2010b, 2011a:8). Such efficiency improvements act to offset some of the impacts on the industries of the average production costs’ increase due to compliance with environmental policies (see Kuhn et al., 2010a, 2010b, 2011a:8). In other words, raising compliance costs will induce industries to try to become more “efficient” in the production process. By becoming more efficient, industries will have less of the effective compliance costs in producing the same level of output. If this
possible outcome is achieved, we should expect that the adverse impact of compliance with environmental policies on the olive oil production and exports levels would be diminished considerably (see Kuhn et al., 2010a, 2010b, 2011a:8), something which goes in hand with the trade-environment literature on induced innovation (see, e.g., Porter, 1990; Porter & Van der Linde, 1995b:98).

This case shows how to adjust the fundamental equations (35) and (36) to allow for the possibility of including such compliance-induced efficiency improvements. Therefore, we have to calculate the impact with compliance-induced efficiency improvements due to productivity level changes on the production and exports levels ($\Delta Y/Y$ and $\Delta E/E$).

In this case, producers seek to reduce the effect of the huge increase in compliance costs by adapting more efficient production technologies. Thus, “we consider the possibility of implementing more advanced production technologies as the olive-mill industry’s response to environmental compliance” (Kuhn et al., 2011b:6, 2012a:8, 2012b:8). Environmental compliance which leads the industry to seek ways of increasing factor productivity in order to reduce the wastewater generated in the “end-of-the-pipe” process, will also reduce the costs of the polluting inputs. Here, the compliance costs’ increase leads to the implementation of less polluting technologies. Then, “induced technological change should translate into a reduction of the effective compliance costs, which reflected in the (effective) shadow price of the polluting factor $x$” (Kuhn et al., 2011b:6, 2012a:8, 2012b:8). More specifically, “the implementation of less polluting technologies is modeled in the form of an increase in the productivity of the polluting factor $x$ by $e$, where the factor productivity ‘$e’$ is an induced technical progress change depending on and assumed to increase along with the compliance costs $m : e = e(m), \partial e/\partial m > 0$” (Kuhn et al., 2011b:6, 2012a:8, 2012b:8).

It can be included that the possibility that compliance with environmental policies by installing the olive oil processing modification technology will allow the olive-mill industry to reduce the average costs of compliance $m$ (see Kuhn et al., 2010a, 2010b, 2011a:8). If this compliance improves the efficiency of olive-mill industry by a rate equal to $e = e(m)$ (see Kuhn et al., 2010a, 2010b, 2011a:8), the new form of the technical output supply function (i.e., the decreasing returns to scale production technology) becomes $y = f(e(m)x,k)$. Consequently, “by incorporating technical progress into the basic model, the profit function
for the olive oil producers becomes \(\pi = \pi(\tilde{p}, w/e(m), r)\) and is defined by the following maximization problem as” (Kuhn et al., 2011b:6, 2012a:8, 2012b:8):

\[
\pi(\tilde{p}, w/e(m), r) = \text{Max}_{x,k} \left[ p f(e(m)x, k) - wx - rk \right]
\]

(37)

Where “\(w/e(m)\) is the effective (shadow) price of factor \(x\) and the term \(e(m)x\) represents the effective factor input \(x\)” (Kuhn et al., 2011b:6, 2012a:8, 2012b:8). Hence, “the link between the compliance costs \(m\) and the values of using less polluting technologies \(e\) must be taken into account in the analysis” (Kuhn et al., 2011b:6, 2012a:8, 2012b:8). As a result, the final impact of any environmental policies change that increases the average production costs of \(m\) per unit of output depends on how this effective price of that factor changes.

From the profit function, using the notation \(z = w/e(m)\), the envelope theorem (Hotelling’s Lemma) can be used again to determine the profit-maximizing level of output supply function \(Y\) and factor demand function \(X\) as follows (see Kuhn et al., 2011b:6, 2012a:8, 2012b:8):

\[
Y = Y(\tilde{p}, w/e(m), r) = \frac{\partial \pi}{\partial \tilde{p}}
\]

and

\[
X = X(\tilde{p}, w/e(m), r) = -\frac{\partial \pi}{\partial z}
\]

(38)

Here, again the capital letter notation for \(Y\) and \(X\) in equation (38) is used to denote the profit-maximizing level, which is the solution to the problem in equation (37) (see Kuhn et al., 2011b:6, 2012a:8, 2012b:8). Then, the specific form of the output supply function \(Y\) from equation (38) can be used to show that, deriving \(Y = Y(\tilde{p}, w/e(m), r)\) with respect to \(m\) by doing a comparative statics analysis, i.e., applying the Chain and Quotient rules yields (see Kuhn et al., 2011b:6, 2012a:8, 2012b:8):

\[
\frac{\partial Y}{\partial m} = \frac{\partial Y}{\partial \tilde{p}} \frac{\partial \tilde{p}}{\partial m} + \frac{\partial Y}{\partial z} \frac{\partial z}{\partial m} = \frac{\partial Y}{\partial \tilde{p}} \frac{\partial \tilde{p}}{\partial m} + \frac{\partial Y}{\partial z} \frac{\partial z}{\partial e} \frac{\partial e}{\partial m}
\]

\[
\frac{\partial Y}{\partial m} = -\frac{\partial Y}{\partial \tilde{p}} \frac{\partial \tilde{p}}{\partial (e(m))^2} \frac{\partial e}{\partial m}
\]

(39)
On the other hand, recalling $\frac{\partial Y}{\partial \tilde{p}} = \frac{\partial Y}{\partial p}$ and $\tilde{p} = p - m$, we can then define $\eta_{Yp}$ and $\eta_{pm}$ as follows:

$$\eta_{Yp} = \frac{\partial Y}{\partial \tilde{p}} \frac{p - m}{Y} = \frac{\partial Y}{\partial p} \frac{p - m}{p} = \eta_{Yp} \frac{p - m}{p} \tag{40}$$

and

$$\eta_{pm} = \frac{\partial \tilde{p}}{\partial m} \frac{m}{p - m} = (-1) \frac{m}{p - m} = - \frac{m}{p - m} \tag{41}$$

Where $\eta_{Yp} = (\partial Y / \partial \tilde{p})(\tilde{p}/Y)$ is the percentage change in output supply for a one percent change in adjusted output price, and $\eta_{pm} = (\partial \tilde{p} / \partial m)(m/\tilde{p})$ is the percentage increase in adjusted output price for a one percent increase in compliance cost.

From this situation, the impact of an increase in the compliance costs on supply (i.e., the change in supply due to the compliance costs change) from equations (38), (39) and (41) can thus be computed using a discrete change $\Delta m = m$ and recalling $z = w / e(m)$ as the following:

$$\frac{\Delta Y}{Y} = \frac{\Delta Y}{\Delta m} \frac{\Delta m}{Y} = - \frac{\partial Y}{\partial \tilde{p}} \frac{\tilde{p}}{Y} - \frac{\partial Y}{\partial z} \frac{w}{e(m)} \frac{1}{e(m)} \frac{\partial e}{\partial m} \frac{m}{p - m}$$

$$\frac{\Delta Y}{Y} = - \frac{\partial Y}{\partial \tilde{p}} \frac{\tilde{p}}{Y} \frac{m}{p - m} - \frac{\partial Y}{\partial e} \frac{z}{Y} \frac{\partial e}{\partial m} \frac{m}{p - m}$$

$$\frac{\Delta Y}{Y} = - \eta_{Yp} \frac{m}{p - m} - \eta_{Yp} \eta_{pm}$$

$$\frac{\Delta Y}{Y} = \eta_{Yp} \eta_{pm} - \eta_{Yp} \eta_{em} \tag{42}$$

(Total impact) \quad (Output price impact) \quad (Effective factor price impact)

In this case, the effective factor price impact due to efficiency improvements is expressed as a function of: $\eta_{e} = (\partial Y / \partial z)(z/Y)$ which is the elasticity of supply $Y$ with respect to the effective factor price $z$, i.e., “the input shadow price elasticity of supply” (Kuhn et al., 2011b:7, 2012a:9, 2012b:9), and of: $\eta_{em} = (\partial e / \partial m)(m/e)$ which is the elasticity of the compliance-induced efficiency rate $e$, to an increase of the compliance costs $m$ (see Kuhn et
al., 2010a, 2010b, 2011a:8), i.e., “the compliance costs elasticity of technical progress” (Kuhn et al., 2011b:7, 2012a:9, 2012b:9). Here, \( \eta_{cm} \) postulates that a big compliance cost increase will generate the use of a new processing modification technology of production.

We then have to compute \( \eta_{\text{c}} \) because the data for it is missing (Kuhn et al., 2011b:7, 2012a:9, 2012b:9). This elasticity depends on the effective factor cost shares and the market elasticities relating product factor to output. Thus, since the sets of data available do not allow a direct estimation, “the dual approach to profit maximization can be used to compute this elasticity” (Kuhn et al., 2011b:7, 2012a:9, 2012b:9). This manipulation will allow us to decompose this elasticity as the product of three terms that can be estimated from our sets of data. As a result, the standard duality relationships between the profit function and the cost function, the symmetry of the Hessian, and the envelope theorem can be used to compute \( \eta_{\text{c}} \) as the following (see Kuhn et al., 2011b:7, 2012a:9, 2012b:9).

Firstly, from equation (38) we can easily show that, applying Hotelling’s lemma to the symmetry of the Hessian (i.e., the matrix of second derivatives) of the profit function \( \pi \) (Young’s Theorem) yields (see Kuhn et al., 2011b:22, 2012a:24, 2012b:24)

\[
\frac{\partial Y}{\partial z} = \frac{\partial^2 \pi}{\partial p \partial z} = \frac{\partial^2 \pi}{\partial z \partial \tilde{p}} = -\frac{\partial X}{\partial \tilde{p}} \tag{43}
\]

Thus, the variation of the supply \( Y \) following a rise in the effective factor price \( z \) is equal to the negative of a change of factor demand \( X \) in response to a rising of the adjusted output price \( \tilde{p} \). These two expressions are equal \( (\partial Y / \partial z = -\partial X / \partial \tilde{p}) \) because the Hessian matrix of second-partial derivatives of the profit function is symmetric in prices.

Secondly, we use the dual approach to compute the partial derivative of factor (input) demand with respect to the adjusted output price in equation (43) based on profit maximization (Kuhn et al., 2011b:22, 2012a:24, 2012b:24). For that reason, we therefore “define the cost function for the producer \( C = C(w/e, r, y) \) by solving the cost minimization problem as” (Kuhn et al., 2011b:22, 2012a:24, 2012b:24):

\[
C(w/e, r, y) = \text{Min}_{x, \lambda} \left[ wx + rk + mf \left( e(m) x, k \right) \right] \quad \text{Subject to} \quad f\left( e(m) x, k \right) \geq y \tag{44}
\]
Thus, “by applying the envelope theorem (Sheppard’s Lemma) for an optimization problem, we can then determine the cost-minimizing level of compensated factor demand function $X^c$ for the producer as” (see Kuhn et al., 2011b:22, 2012a:25, 2012b:25 and Appendix 4 for further details):

$$X^c = \frac{\partial C}{\partial (w/e)}$$

(45)

Then, “at the profit-maximizing level of optimal production $Y$, the profit-maximizing level of factor demand $X$ is equal to the cost-minimizing level of compensated factor demand $X^c$ as” (Kuhn et al., 2011b:22, 2012a:25, 2012b:25):

$$X(\bar{p}, w/e(m), r) = X^c[w/e, r, Y(\bar{p}, w/e(m), r)]$$

(46)

From equation (46), deriving $X(\bar{p}, w/e(m), r)$ with respect to $\bar{p}$ yields (see Kuhn et al., 2011b:22, 2012a:25, 2012b:25):

$$\frac{\partial X}{\partial \bar{p}} = \frac{\partial X^c}{\partial \bar{p}} \frac{\partial Y}{\partial \bar{p}}$$

(47)

Thus, the impact of the adjusted output price’ increase on the factor demand $\partial X / \partial \bar{p}$ can be determined as the function of two terms. The first term $\partial X^c / \partial Y$ measures the impact of the increase in the supply level on the cost-minimizing level of factor demand. The second term $\partial Y / \partial \bar{p}$ evaluates the change of the output supply with respect to its own adjusted price. Then, if we use the result of the equation (43), we can rewrite (see Kuhn et al., 2011b:22, 2012a:25, 2012b:25):

$$\frac{\partial Y}{\partial z} = \frac{\partial X}{\partial \bar{p}} = -\frac{\partial X^c}{\partial \bar{p}} \frac{\partial Y}{\partial \bar{p}}$$

(48)

From this initial situation, “recalling $\partial Y / \partial \bar{p} = \partial Y / \partial p$, the impact of the effective factor price $z$ on supply $Y$ in elasticity form then yields” (Kuhn et al., 2011b:22, 2012a:25, 2012b:25):
\[ \eta_{zc} = \frac{\partial Y_z}{\partial z Y} = -\frac{\partial X_p}{\partial Y_p} \frac{\partial X}{\partial Y} \frac{\partial X_z}{\partial X} = -\left[ \frac{zX}{pY} \left( \frac{\partial Y_p}{\partial p Y} \right) \left( \frac{\partial X_z}{\partial Y} \right) \right] \]

\[ \eta_{zc} = -\frac{zX}{pY} \eta_{yp} \eta_{xy} \]  

(49)

Where \( \eta_{zc} \) is the percentage change in output supply for a one percent increase in the effective factor price; ‘‘ \( zX / pY \) is the proportion of the effective factor cost as a share of total revenues’’ (Kuhn et al., 2011b:7, 2012a:9, 2012b:9) and with \( 0 < zX / pY < 1 \); \( \eta_{yp} \) is discussed above in the basic model case; and ‘‘ \( \eta_{xy} = (\partial X / \partial Y)(Y / X) \) is representing the compensated dual factor demand elasticity of output supply’’ (Kuhn et al., 2011b:22, 2012a:9&25, 2012b:9&25), \( (1 \leq \eta_{xy} \leq 1) \) and it indicates to the percentage change in cost-minimizing level of compensated factor demand for a one percent increase in output level.

Thus, the percentage change in production (\( \Delta Y / Y \)) with efficiency improvements in the case of technical progress can be computed from equations (40), (41) and (42) as follows (see Kuhn et al., 2011b:7, 2012a:8, 2012b:8):

\[ \Delta Y / Y = -\eta_{yp} \frac{p-m}{p} \frac{m}{p-m} - \eta_{zc} \eta_{em} \]

\[ \Delta Y / Y = -\frac{m}{p} \eta_{yp} - \eta_{zc} \eta_{em} \]  

(50)

Here, compared to the result in the basic model case the additional term \( (\eta_{zc} \eta_{em}) \) in equation (50) shows how much of the initial shift back in supply (i.e., ‘‘the negative impact of environmental compliance on output level’’) from equation (35) is mitigated and offset through including efficiency improvements case (see Kuhn et al., 2011b:7, 2012a:9, 2012b:9). ‘‘This term reflects the impact of the compliance costs’ increase on the effective price of the polluting factor and moreover on the production level which is negative’’ (Kuhn et al., 2011b:7, 2012a:9, 2012b:9).

Then, continuing to assume that the output price remains constant, the local demand is not changing and the change in exports is \( (\Delta E = \Delta Y) \). The induced percentage change in exports
(\(\Delta E/E\)) with efficiency improvements can therefore be computed from equation (50) as follows (see Kuhn et al., 2011b:7, 2012a:9, 2012b:9):

\[
\frac{\Delta E}{E} = \Delta \frac{Y}{Y} \frac{1}{(E/Y)} = \left(-\frac{m}{p}\right) \eta_{\text{np}} - \eta_{\text{e}} \eta_{\text{em}} \frac{1}{(E/Y)}
\]

(51)

Here, “the result in equation (51) with regard to the induced technical progress is just a modified version of the result given in equation (36) of the basic model case” (Kuhn et al., 2011b:7, 2012a:9, 2012b:9). Again, “the induced technological progress would help offset the negative impact of environmental compliance at least partially” (see Kuhn et al., 2011b:7, 2012a:8-9, 2012b:8-9). As a result, the effective factor price impact due to efficiency improvements induced by environmental compliance causes an increase in both output supply and exports levels (see Kuhn et al., 2010a, 2010b, 2011a:9). In other words, the decrease in the production and exports levels, following the rise in the compliance costs, will be much less significant if we use more efficient production technologies.

3. Large Country Case: As a final step, the estimation of the environmental compliance impact needs to implement the inclusion of output market price adjustments due to “the large country case assumption, which is characterized by an endogenous world market price of olive oil products” (Kuhn et al., 2011b:7, 2012a:9, 2012b:9). Here, “given the size of the Syrian olive-mill industry and its world market share as described before, a part of the burden of the environmental compliance costs may be shifted along onto consumers in international markets by the way of higher export prices” (see, e.g., Dervis, de Melo & Robinson, 1989:225; Kuhn et al., 2011a:9, 2011b:7, 2012a:9, 2012b:9).

This case shows how to adjust the fundamental equations (50) and (51) to allow the possibility of incorporating equilibrium price adjustments into the basic model. Therefore, we have to calculate the impact with output market price adjustments on the production and exports levels (\(\Delta Y/Y\) and \(\Delta E/E\)).

In the case of including output market price adjustments’ effects, the environmental compliance costs’ increase \(m\) is shifting export supply and thus shifting the world market price of olive oil products. In order “to analyze the worldwide impact of the environmental compliance costs, we therefore need to incorporate the price shift on the world market” (Kuhn
et al., 2011b:7, 2012a:9, 2012b:9). Hence, “we expect to find a positive impact on the production and exports levels due to price increase, which may further mitigate the burden of compliance with environmental policies” (Kuhn et al., 2011b:7, 2012a:9, 2012b:9). Accordingly, additional notation related to the domestic and foreign demand functions are needed to incorporate output market price adjustments. For reference, “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” (Kuhn et al., 2010a, 2010b, 2011a:9). In addition, as reported above in equation (38), the form of the supply function \( Y \) is determined as (see Kuhn et al., 2011b:6, 2012a:8, 2012b:8):

\[
Y = Y(\bar{p}, w/ e(m), r) = \frac{\partial \pi}{\partial \bar{p}}
\]  

Where \( \bar{p} \) is external (given) in firms’ view (\( \bar{p} = p - m \)). However, “the output price \( p \) must be endogenously determined through the market equilibrium condition as follows” (Kuhn et al., 2011b:7, 2012a:9, 2012b:9). Firstly, it can be assumed that the export market clears where export demand equals export supply (see Kuhn et al., 2010a, 2010b, 2011a:9), and thus, the market equilibrium condition is determined as (see Kuhn et al., 2011b:7, 2012a:9, 2012b:9):

\[
E(p) = Y(\bar{p}, w/ e(m), r) - B(p)
\]  

Here, “the impact of an endogenous change of price \( p \) on supply \( Y \), exports \( E \) and domestic consumption \( B \) has to be taken into account” (Kuhn et al., 2011b:8, 2012a:9, 2012b:9). In this case, there is being a consideration of an equation as:

\[
F(\bar{p}, w/ e(m), r) = Y(\bar{p}, w/ e(m), r) - B(p) - E(p) = 0
\]  

Then, a comparative statics analysis through the implicit-function theorem rule yields the partial derivative of this equation for the equilibrium price \( p \) with respect to the compliance cost \( m \) using \( \partial Y / \partial \bar{p} = \partial Y / \partial p \) as the following (see Chiang, 1984:208; Kuhn et al., 2011b:8, 2012a:10, 2012b:10):
Secondly, the impact of an increase in the compliance costs \( m \) due to environmental policies on the output market price \( p \) can thus be computed from equation (55) using \( z = w / e(m) \) as the following (see Kuhn et al., 2011b:8, 2012a:10, 2012b:10):

\[
\eta_{pm} = \frac{\partial p}{\partial m} \left( \frac{p}{Y} \right) \left( \frac{\partial Y}{\partial m} \right) \left( \frac{1}{e(m)} \right) \left( \frac{1}{w} \right) \left( \frac{\partial e}{\partial m} \right) = \frac{m}{p} \left( \frac{\partial Y}{\partial p} + \frac{\partial Y}{\partial z} \right) \left( \frac{w}{e(m)} \right) \left( \frac{\partial e}{\partial m} \right) \left( \frac{1}{e(m)} \right) \left( \frac{1}{w} \right)
\]

(55)

Where \( \eta_{pm} = (\partial p / \partial m)(m / p) \) is the elasticity of the output market price \( p \) to an increase of the compliance costs \( m \), and it indicates the percentage increase in output price for a one percent increase in compliance cost; \( \eta_{yp} \), \( \eta_{yz} \), and \( \eta_{em} \) are discussed above in the efficiency improvements case; \( \eta_{yp} = (\partial E / \partial p)(p / E) \) is the elasticity of foreign demand with respect to the output price, \( (\eta_{yp} < 0) \) and it gives the percentage change in foreign demand in response to a one percent change in output price; \( \eta_{yp} = (\partial B / \partial p)(p / B) \) is the elasticity of domestic demand with respect to the output price, \( (\eta_{yp} < 0) \) and it gives the percentage change in domestic demand in response to a one percent change in output price; and \( B / Y \) is the share of domestic consumption in total production” (see Kuhn et al., 2011a:9, 2011b:8, 2012a:10, 2012b:10).

“In fact, the relationship in equation (56) shows how much of the increase in the average production costs for the producer due to environmental compliance is passed along to the consumers in both domestic and export markets in the form of higher output market prices” (Kuhn et al., 2010a, 2010b, 2011a:9).
Hence, “given that the output market price is changing” (Kuhn et al., 2010a, 2010b, 2011a:9), “the adjusted form of the supply function $Y$ not only must incorporate the impact of compliance cost on the effective product price $\widetilde{p} = \widetilde{p}(p(m), m)$ but also on the input’s shadow price $w/e(m)$ and will be written as” (Kuhn et al., 2011b:8, 2012a:9, 2012b:9):

$$Y = Y(\widetilde{p}(p(m), m), w/e(m), r)$$ (57)

For a discrete change $\Delta m = m$ and recalling $z = w/e(m)$, the impact of an increase in the compliance costs on supply (i.e., the change in supply due to the compliance costs change) can then be computed from equation (57) using the derivative of $Y$ with respect to $m$ as the following:

$$\frac{\Delta Y}{Y} = \frac{\partial Y}{\partial m} \frac{\Delta m}{Y} = m \left( \frac{\partial \widetilde{p}}{\partial p} \frac{\partial p}{\partial m} \frac{\partial p}{\partial m} + \frac{\partial \widetilde{p}}{\partial z} \frac{\partial z}{\partial e} \frac{\partial e}{\partial m} \right)$$

$$\frac{\Delta Y}{Y} = \left( \frac{\partial Y}{\partial p} \frac{p - m}{p} \frac{1}{p - m} \left( \frac{\partial \widetilde{p}}{\partial p} \frac{m}{p} \frac{\partial p}{\partial m} \frac{p + \partial \widetilde{p}}{\partial m} \frac{1}{p} \right) + \frac{\partial Y}{\partial z} \frac{\partial z}{\partial e} \frac{\partial e}{\partial m} \frac{m}{Y} \right)$$

$$\frac{\Delta Y}{Y} = \eta_{\tilde{p}} \left( \frac{\partial \widetilde{p}}{\partial p} \frac{p - m}{p} \eta_{\tilde{m}} + \frac{\partial \widetilde{p}}{\partial m} \frac{m}{p - m} \right) + \frac{\partial Y}{\partial z} \frac{z}{\partial e} \frac{m}{\partial m} (-1)$$

$$\frac{\Delta Y}{Y} = \eta_{\tilde{p}} (\eta_{\tilde{p}} \eta_{\tilde{m}} + \eta_{\tilde{z}} \eta_{\tilde{e}}) - \eta_{\tilde{e}} \eta_{\tilde{m}} \eta_{\tilde{e}} \eta_{\tilde{m}} \eta_{\tilde{e}} \eta_{\tilde{m}}$$ (58)

From this situation recalling $\tilde{p} = p - m$, where $\eta_{\tilde{p}} = (\partial \tilde{p}/\partial p)(p/\tilde{p})$ is the percentage increase in adjusted output price for a one percent increase in output price and determined as:

$$\eta_{\tilde{p}} = \frac{-p}{p - m}; \text{ and where } \eta_{\tilde{p}} \text{ and } \eta_{\tilde{m}} \text{ are determined as: } \eta_{\tilde{p}} = \frac{p - m}{p} \text{ and } \eta_{\tilde{m}} = -\frac{m}{p - m} \text{ as reported above in equations (40) and (41). Thus, the implications of all three cases are nested to show that the overall percentage change in production ($\Delta Y/Y$) with output market price adjustments can be computed from equation (58) as the following (see Kuhn et al., 2011b:8, 2012a:10, 2012b:10):

$$\Delta Y/Y = \eta_{\tilde{p}} \left( \frac{p - m}{p} - \eta_{\tilde{m}} \right) - \eta_{\tilde{e}} \eta_{\tilde{m}}$$

$$\Delta Y/Y = \eta_{\tilde{p}} (\eta_{\tilde{m}} - \frac{m}{p}) - \eta_{\tilde{e}} \eta_{\tilde{m}}$$

$$\Delta Y/Y = -\frac{m}{p} \eta_{\tilde{p}} + \eta_{\tilde{p}} \eta_{\tilde{m}} - \eta_{\tilde{e}} \eta_{\tilde{m}} \eta_{\tilde{e}} \eta_{\tilde{m}} \eta_{\tilde{e}} \eta_{\tilde{m}}$$ (59)
Here, “compared to the small country case assumption the additional term composed of \((\eta_{pp}\eta_{pm})\) in equation (59) is accounting for the induced compliance impact of price on the production level” (Kuhn et al., 2011b:8, 2012a:10, 2012b:10). This term is positive because “the output price elasticity is positive of course due to the monotony of the supply function \((\eta_p > 0)\), and the price elasticity of compliance cost is found positive too \((\eta_{pm} > 0)\)” (Kuhn et al., 2011b:8, 2012a:10, 2012b:10). In addition, this term \((\eta_{pp}\eta_{pm})\) shows how much of the initial change in supply (i.e., the negative impact on output level) from either equation (35) or (50) is mitigated through market price adjustments (i.e., the large country case assumption).

Finally, given that the output market price change will also affect domestic consumers, and since exports are the difference between production and domestic consumption \((E = Y - B)\), by “taking the according procedure for the shift in the exports level, the price adjusted form of the export supply function \(E\) can thus be rewritten as the following” (Kuhn et al., 2011b:8, 2012a:10, 2012b:10):

\[
E(p) = Y(\tilde{p}(p(m),m),w/e(m),r) - B(p)
\]  
(60)

Then, while the change in exports is \((\Delta E = \Delta Y - \Delta B)\), the implications of all three cases show that the overall percentage change in exports \((\Delta E/E)\) with output market price adjustments can be computed from equation (60) as follows (Kuhn et al., 2011a:10, 2011b:8, 2012a:10, 2012b:10):

\[
\frac{\Delta E}{E} = \frac{\Delta Y}{Y} \frac{1}{(E/Y) - \frac{\Delta B}{B(\frac{B}{Y})}} \frac{(B/Y)(E/Y)}{\frac{\Delta E}{E} = \left(-\frac{m}{p} \eta_{pp} + \eta_{pp} \eta_{pm} - \eta_{pe} \eta_{em}\right) \frac{1}{(E/Y) - \eta_{pp} \eta_{pm}(B/Y)}}
\]  
(61)

In this case, the overall percentage change in exports \((\Delta E/E)\) is now taking into account both supply changes and consumption changes induced by compliance with environmental policies. That is, “the shift in the exports level can be just seen as a residual of the induced shift in the domestic production and consumption levels, such that the world market equilibrium is restored after the olive-mill industry has adopted new technology as a response to compliance with environmental policies” (Kuhn et al., 2011b:8, 2012a:10, 2012b:10).
As a final result, “the large country case shows that a part of the burden of the environmental compliance is shifted along to the consumers in export markets in the form of higher international prices” (Kuhn et al., 2011b:8, 2012a:10, 2012b:10). Hence, “from a theoretical point of view, the negative impacts of environmental compliance on the production and exports levels in equations (59) and (61) of this case are mitigated much more than that in equations (35) and (36) or equations (50) and (51) of the small country case” (Kuhn et al., 2011a:10, 2011b:8, 2012a:10, 2012b:10). In other words, the increase in the production and exports levels, regardless of the assumption on/about the size of the compliance costs, will be much more significant due to output price increase. Ultimately, “which directions the overall percentage changes in the production and exports levels finally take is an issue of empirical estimations, which we pursue in the next chapter” (Kuhn et al., 2011b:8, 2012a:10, 2012b:10).

Thus, “the theoretical model outlined above provides three possible ways to calculate possible impacts on the Syrian olive oil production and exports levels due to compliance with environmental policies. In other words, the first way provides the calculation of the direct impact of the environmental compliance on the production and exports levels. This is mainly achieved by assuming exogenous output market prices and no efficiency improvements modification. The second way is about the calculation of the indirect impact of the environmental compliance on choosing more efficient production techniques and technologies. This indirect impact will be combined with the direct one to define the efficient impact of the environmental compliance on the production and exports levels. The third way provides the calculation of the indirect impact of the environmental compliance on the output market price. This indirect impact will be combined with the direct and indirect ones to define the final impact of the environmental compliance on the production and exports levels. This final impact integrates efficiency improvements modification and output market price adjustments due to compliance with environmental policies” (see, e.g., Ayadi & Matoussi, 2007:9; Kuhn et al., 2010a, 2010b, 2011a:10).

In this analysis, the possible impact of compliance with environmental policies on the Syrian olive oil production and exports levels is examined. This analysis is based on a partial-equilibrium trade model, which allows for calculating the percentage level of changes in the production and exports levels due to compliance with environmental policies. It is clear from the application of the model that the impact of compliance with environmental policies on the
production and export levels depends on the details of the case study. This analysis is of particular importance as it addresses some of the questions that refer to possible changes in environmental policies proposed for the olive oil agro-industrial sector in Syria, where there is lack of analytical capabilities, and the time has prevented the use of more sophisticated theoretical and experimental analysis. For example, the questions include the impact of compliance with environmental policies related to specific inputs and “end-of-the-pipe” on international trade competitiveness for the Syrian olive oil production and exports levels.

The most difficult challenge to achieve is probably the ability to make improvements in production efficiency with respect to the inputs used and production costs increase due to compliance with environmental policies. In this case, the olive oil agro-industrial sector in Syria needs to be able to innovate and research in alternative low-cost inputs and in implementing efficiency gains and productivity improvements in the production processes otherwise the impact of compliance with these policies on the Syrian olive oil production and exports levels will be insignificant or marginal (and vice versa).

In short, this model provides a sound theoretical background for understanding under which conditions environmental compliance costs can be expected to have large or small impacts on both production and export levels. Larger compliance impacts on the Syrian olive oil production and exports levels are possible in many cases when: (a) the costs of the complied input or the costs of environmental compliance are large relative to revenues; (b) the exports share of total production is large; (c) the sector is working with decreasing returns to scale; (d) the elasticity of output supply with respect to output prices is high; (e) efficiency improvements are not induced by this environmental compliance; and (f) some portion of the compliance costs cannot be transferred to the domestic and international consumers in the form of higher output market prices. On the other hand, compliance with environmental policies will have smaller impacts on the Syrian olive oil production and exports levels when the opposite is true (see, e.g., Larson, 2000a: 547; Larson et al, 2002: 1070).
6. The Econometric Regression and Environmental Policy Estimations

“This Chapter applies the theoretical model developed in the previous Chapter. This is mainly in order to estimate empirically the impacts of compliance with environmental policies on the Syrian olive oil production and exports levels” (see Kuhn et al., 2011a:11, 2012a:11, 2012b:11).

6.1. The Econometric Regression

“Estimating impacts of compliance with environmental policies on the production and export levels in percentage terms (ΔY/Y and ΔE/E) is based on the theoretical model described in the previous Chapter, and requires the values of the elasticities for the Syrian olive oil market (ηp, ηXY, ηp and ηp), which are outlined and explained in equations (9, 22, 27, 35, 49 and 56) in the previous Chapter. Estimations start by performing an econometric regression analysis and by using (through the use of) a multiple double log-linear regression equation (see, e.g., Ramanathan, 2002:255-256; Asteriou & Hall, 2007:161,310), which enables us to directly estimate the elasticities based on the key statistics of the olive oil agro-industrial sector in Syria for the period 1990-2006 presented in Table 2.2, which outlined in Chapter 2 (see Appendices 5, 6 and 7 for more details). Appendix 7 reports the complete regression results” (see Kuhn et al., 2010a:13, 2011a:11, 2012a:11, 2012b:11).

The multiple double log-linear regression equations are as the following (see Kuhn et al., 2012a:20, 2012b:20):

\[
\log(Y) = \alpha_1 + \alpha_2 \log(P) + \alpha_3 \log(X) + \alpha_4 \log(B) + \alpha_5 \log(E)
\]

\[
\log(X) = \beta_1 + \beta_2 \log(Y) + \beta_3 \log(P) + \beta_4 \log(B) + \beta_5 \log(E)
\]

\[
\log(B) = \delta_1 + \delta_2 \log(P) + \delta_3 \log(Y) + \delta_4 \log(X) + \delta_5 \log(E)
\]

\[
\log(E) = \gamma_1 + \gamma_2 \log(P) + \gamma_3 \log(Y) + \gamma_4 \log(X) + \gamma_5 \log(B)
\]

Where:

Y : The level of output;

P : The output market price;

X : The quantity of the complied input used;

\footnote{This section has been taken identically from Kuhn et al. (2010a, 2010b, 2011a, 2011b, 2012a, 2012b).}
$B$ : The level of domestic demand;
$E$ : The level of export (foreign) demand;
$\alpha, \beta, \delta, \gamma_i$ (with the index $i = 1,2,3,4,5$): Parameters (regression coefficients) to be estimated.

The econometric regression results indicate that by dropping the regression coefficients that are not statistically significant, the regression equations yield three statistically significant values of the elasticities $\eta_{yp}, \eta_{xy}$ and $\eta_{bp}$ (see Kuhn et al., 2012a:11, 2012b:11):

$$\log(Y) = -2.46 + 0.16\log(P) + 0.93\log(X)$$
$$\log(X) = 2.60 + 1.06\log(Y) - 0.16\log(P)$$
$$\log(B) = 15.06 - 0.63\log(P) + 0.29\log(Y) + 0.07\log(E)$$

Based on these equations, “the output own-price elasticity $\eta_{yp}$ for the Syrian olive oil market is therefore estimated to be 0.16” (Kuhn et al., 2010a:13, 2011a:12, 2012a:12). In competitive markets where producers are trying to maximize profits, this value is considered reasonably consistent with a general perception of inelastic supply response in agriculture for the olive oil market. This elasticity is assumed to be even lower because of the special climatic requirements and the long time period required before young olives trees bear fruit (Grethe, 2003:129). Moreover, this is mainly due to the high proportion of fixed capital in agriculture which is subject to natural forces, and difficulties in transport, storage and marketing.

Additionally, a sensitivity analysis using other possible scenarios for the possible estimations and assumptions of the output own-price elasticity for the olive oil market is carried out. This sensitivity analysis contains other four exploratory scenarios and exercises demonstrating the effects of various value changes of the output own-price elasticity on the result behavior of the analysis (see Appendix 8 for more details).

“The (cost-minimizing) input or factor demand elasticity in relation to output level $\eta_{xy}$ is estimated to be 1.06” (Kuhn et al., 2012a:12). This value is considered reasonably consistent with a general perception of a decreasing returns to scale cost function response in the olive oil market.
“The elasticity of domestic demand in relation to output price \( \eta_{bp} \) is estimated to be -0.63” (Kuhn et al., 2010a:13, 2011a:12, 2012a:12). The domestic demand is relatively inelastic, so that not all of the increase of the compliance cost can be passed along to the consumers, and the producers will have to bear some of the cost increase. In addition, a higher input price and the average costs increase will be accompanied by a reduction in both output and export levels. Generally, a lower demand response allows more of the compliance costs to be passed along to consumers in both domestic and international markets. While a higher and larger demand response allows less of the compliance costs to be passed along to consumers in both domestic and international markets (Larson et al., 2002:1067).

“The regression estimation of the elasticity of export demand with respect to output price \( \eta_{Ep} \) yields a coefficient which is statistically insignificant” (Kuhn et al., 2010a:13, 2011a:12, 2012a:12) for the Syrian olive oil market (as reported by the econometric regression in Appendix 7). But it is common practice in international trade studies to borrow elasticities from the existing trade-environment literature to develop elasticity estimates for simulation and policy analyses (see, e.g., Sullivan et al., 1989; Larson et al., 2002:1064). “This elasticity was currently available in the related literature; therefore the value for such elasticity from Ayadi and Matoussi (2007:4) who estimated to be around -3.05 in a case study for Tunisia is adapted” (Kuhn et al., 2010a:13-14, 2011a:12, 2012a:12).

### 6.2. The Environmental Policy Estimations

As a result of the efforts and investment that have been put in the olive oil agro-industrial sector during the last 15 years, Syria has witnessed a remarkable increase in the production and exports of olive oil products, where the production and exports have almost more than doubled as shown in Table 2.2 (outlined in Chapter 2). According to the Ministry of Agriculture & Agrarian Reform/General Commission for Scientific Agricultural Research, olive oil production in 2000 reached about 165 thousand tons. The local Syrian market usually consumes about 60% of produced olive oil and leaving the rest for export. The Ministry of Agriculture & Agrarian Reform forecasts that in 2010 the production of olive oil in Syria will reach about 250 thousand tons of which 150 thousand tons are to be consumed locally and leaving about 100 thousand tons surplus of olive oil for export (Dimashki & Al Rawas, 2006:12).
In fact, olive oil production in 2006 reached about 250 thousand tons, and the local Syrian market consumed about 100 thousand tons and leaving about 150 thousand tons surplus of olive oil for export. However, assuming that Syria stops planting olive trees, which are not in the government policy, Syria by the year 2015 will have 82 million fruitful olive trees. In calculation, assuming that each tree will produce an average of 20 Kg/year, this means that the annual olive production will be about 1.640 thousand tons, 164 thousand tons of which is used for table olive which leaves 1.476 thousand tons for oil milling. Assuming that the average olive oil production is 20% of the produced olives which means that a total of 295.2 thousand tons of olive oil is produced annually, and if the local consumption developed from 100 to 150 thousand tons/year which leaves about 145 thousand tons surplus needs to deal with (Asfari, 2007:5). Thereby, the local Syrian market consumes about 60% of produced olive oil and leaving the rest for export (Dimashki and Al Rawas, 2006:12).

Based on the discussion above, it can be noted that in the presence of an increased growth and improvement at all levels of production, consumption and exports of olive oil products, there will be a large surplus of olive oil production for export. Thus, it is quite reasonable “based on the statistics of the olive oil agro-industrial sector in Syria for the years 1990-2006 presented in Table 2.2 (outlined in Chapter 2) and experts expectations, if we compute or assume that the initial share of exports to total production \( E/Y \) is equal to 0.40, and that the initial share of domestic consumption to total production \( B/Y \) is 0.60” (Dimashki and Al Rawas, 2006:12; Asfari, 2007:5; Kuhn et al., 2010a:14, 2011a:12, 2012a:12).

### 6.2.1. The Integrated Pest Management Policy Estimations

Based on the structure of the average costs for the olive oil product presented in Table 4.2 (outlined in Chapter 4), we compute that the share of olives costs in total olive oil revenues \( wX / pY \) is equal to 0.41 (44969/109120). The percentage increase in the price of the complied input for the producer \( \Delta w/w \) was computed to be between 3.3% and 6.7% based on a study conducted by the Ministry of Agriculture and Agrarian Reform (2006b:9), as reported in the first regulatory policy scenario in section 4.2 of the study. Furthermore, it should be noted that the environmental costs are not negligible given that the costs of the complied input relative to total revenues \( wX / pY \) is considerable (41%).

Tables 6.1, 6.2 and 6.3 below report the values of parameters and elasticities which are used in the estimate of the impacts of compliance with the policy of Integrated Pest Management.
on the production and exports of Syrian olive oil products. They also provide the results of the estimates.

1. **The Basic Model Case:** The impact of higher olives prices for the producer on the production and exports of olive oil products.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Small impact</th>
<th>Large impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>The proportional increase in the olives price for the producer $\Delta w / w$</td>
<td>0.033</td>
<td>0.067</td>
</tr>
<tr>
<td>Output own-price elasticity $\eta_{yp}$</td>
<td>0.16</td>
<td>0.16</td>
</tr>
<tr>
<td>Input demand elasticity with respect to output $\eta_{xy}$</td>
<td>1.06</td>
<td>1.06</td>
</tr>
<tr>
<td>Share of olives costs in total olive oil revenues $wX / pY$</td>
<td>0.41</td>
<td>0.41</td>
</tr>
<tr>
<td>Output cross price elasticity w.r.t. input price $\eta_{yw}$</td>
<td>-0.07</td>
<td>-0.07</td>
</tr>
<tr>
<td>$\eta_{yw} = -\frac{wX}{pY} \eta_{yp} \eta_{xy}$</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The proportional change in production $\Delta Y / Y$:

- $\Delta Y / Y = \eta_{yw} \frac{\Delta w}{w}$

| Exports share of total production $E / Y$                                 | 0.40         | 0.40         |
| The proportional change in exports $\Delta E / E$                         | -0.0058      | -0.0118      |

\[ \Delta E / E = \Delta Y / Y \left(1 - \frac{1}{E / Y}\right) \]

**Table 6.1:** The basic model case (Equations 9, 10 and 11)

Table 6.1 indicates that in the basic model case, i.e., assuming that Syria is a price-taker in the world market and that there is no efficiency improvement, a 3.3% increase in the price of olives caused by environmental compliance would lead to a 0.23% reduction in olive oil production and a 0.58% reduction in olive oil exports. The larger impact, i.e., a 6.7% increase in the price of olives, would lead to a 0.47% reduction in olive oil production and a 1.18% reduction in olive oil exports.

Therefore, given that the olive oil exports get to €207 million in 2006 as reported in Table 2.4 (outlined in Chapter 2), a small impact option (i.e., a 3.3% increase in the price of olives) would cause a drop in export revenues of €1.20 million, and a large impact option (i.e., a 6.7% increase in the price of olives) would lead to €2.44 million drop in export revenues. In both cases, the loss is significant. However, the results are quite different after introducing the assumptions of efficiency improvements and output price adjustment, as reported below in Table 6.2 and Table 6.3.
Thus, the calculation of the impact of the increase in price of olives for the producer on the production and exports levels overstates the true impact, because potential efficiency improvements and output market price adjustments’ effects have not yet been taken into account. The role of including efficiency improvements into the basic model case will be considered.

2. Including Efficiency Improvements into the Basic Model Case: Efficiency improvements due to higher olives prices.

In this case, the impact of environmental compliance in the efficiency improvements assumption due to productivity level changes (described in the previous Chapter) will be estimated. The calculation therefore requires the evaluating of the efficiency of input use elasticity to his price ($\eta_{qw}$), which is outlined and explained in equation (15) in the previous Chapter. This estimation can be achieved using available data.

Agricultural experts evaluate that the compliance with the policy of IPM for the olive oil agro-industrial sector would lead to a significant reduction in the cost of chemical controlling pesticides by 40% (Regional Conference XXVIII for the Near East, 2006). Based on the structure of the average costs for the olive oil product presented in Table 4.2 (outlined in Chapter 4), we compute that the reduction in the cost of chemical controlling is equal to 850 SP ($2125 \times 40\%$). Therefore, if this cost is passed along in the olives prices, the implied price decreases of about 1.9% ($850/44969 = 0.019$), i.e., this gives $dq/q = 0.019$.

This can be reflected in compliance-induced efficiency improvements of the effective input used as a reduction in the increase of the effective complied input price of 58% ($0.019/0.033 = 0.58$) with the small impact compliance option, and of 28% ($0.019/0.067 = 0.28$) with the large impact compliance option, which result from compliance with this policy. In other words, the efficiency of input use elasticity to his price ($\eta_{qw} = (dq/q)/(dw/w)$) is computed to be between 0.58 and 0.28.
Table 6.2: Efficiency improvements due to productivity level changes

(Equations 15, 16 and 17)

<table>
<thead>
<tr>
<th>The proportional increase in the olives price for the producer</th>
<th>Small impact</th>
<th>Large impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \Delta w / w )</td>
<td>0.033</td>
<td>0.067</td>
</tr>
<tr>
<td>Output cross price elasticity wrt input price ( \eta_{yw} )</td>
<td>-0.07</td>
<td>-0.07</td>
</tr>
<tr>
<td>The efficiency of input use elasticity to his price ( \eta_{qw} )</td>
<td>0.58</td>
<td>0.28</td>
</tr>
<tr>
<td>Output cross price elasticity wrt input price ( \Psi_{yw} )</td>
<td>-0.03</td>
<td>-0.05</td>
</tr>
<tr>
<td>( \Psi_{yw} = \eta_{yw} (1 - \eta_{qw}) )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The proportional change in production ( \Delta Y / Y : )</td>
<td>-0.0010</td>
<td>-0.0034</td>
</tr>
<tr>
<td>( \Delta Y / Y = \Psi_{yw} \frac{\Delta w}{w} )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exports share of total production ( E / Y )</td>
<td>0.40</td>
<td>0.40</td>
</tr>
<tr>
<td>The proportional change in exports ( \Delta E / E : )</td>
<td>-0.0024</td>
<td>-0.0085</td>
</tr>
<tr>
<td>( \Delta E / E = \Delta Y / Y \frac{1}{E / Y} )</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 6.2 offers the above findings in the case of efficiency improvements due to productivity level changes based on efficiency of input use elasticity to his price of between 0.58 and 0.28. As indicated in Table 6.2, the assumption of efficiency improvement, i.e., a reduction in the effective input costs of compliance, leads to less negative effects on both output and export levels. In other words, Table 6.2 indicates that, under the small impact option of 3.3% increase in the price of olives, the reduction in olive oil production would be 0.10%, and the reduction in olive oil exports would be 0.24%. On the other hand, under the large impact option of 6.7% increase in the price of olives, the reduction in olive oil production would be 0.34%, and the reduction in olive oil exports would be 0.85%.

Based again on the 2006 benchmark level of exports equal to €207 million as reported in Table 2.4 (outlined in Chapter 2), compliance with the policy of IPM would consequently lead to a fall in the Syrian exports of olive oil equal to €0.50 million in the small impact case and to a fall equal to €1.76 million in the large impact case.

This calculated impact is less than the calculated impact on both the production level and the exports level obtained above in the basic model case. Therefore, the higher the efficiency improvement means that the lower the resultant cross elasticities of equations (16) and (17) will be. That is to say, an increase in the production and export levels of olive oil products will be in the efficiency improvements case. In other words, including efficiency
improvements will lead to offsetting a part of the increase in the olives price for the producer due to compliance with the policy of IPM for the olive oil agro-industrial sector.

This calculation still overstates the true impact because output market price adjustments have not yet been taken into account.

3. **Large Country Case:** Production and exports of olive oil products in the presence of output market price adjustments.

In this case, we have to estimate the impact of environmental compliance in the output market price adjustments case (i.e., the large economy assumption described in the previous Chapter). The calculation therefore requires the evaluating of the output market price elasticity with respect to input price ($\eta_{pw}$), which is outlined and explained in equation (22) in the previous Chapter. This elasticity is computed to be between 0.02 and 0.03 based on the values of the related elasticities ($\eta_{yw}^q$, $\eta_{qw}$, $\eta_{yp}$, $\eta_{bp}$, and $\eta_{ep}$) reported above.

Moreover, the calculation requires the evaluating of the price adjustment factor ($A$), which is outlined and explained in equation (27) in the previous Chapter. This factor is computed to be 0.91 based on the values of the related elasticities ($\eta_{yp}$, $\eta_{bp}$, and $\eta_{ep}$) reported above.
<table>
<thead>
<tr>
<th></th>
<th>Small impact</th>
<th>Large impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>The proportional increase in the olives price $\Delta w / w$</td>
<td>0.033</td>
<td>0.067</td>
</tr>
<tr>
<td>Output cross price elasticity wrt input price $\eta_{yw}$</td>
<td>-0.07</td>
<td>-0.07</td>
</tr>
<tr>
<td>The efficiency of input use elasticity to his price $\eta_{qw}$</td>
<td>0.58</td>
<td>0.28</td>
</tr>
<tr>
<td>Output own-price elasticity $\eta_{yp}$</td>
<td>0.16</td>
<td>0.16</td>
</tr>
<tr>
<td>Domestic demand elasticity wrt output price $\eta_{bp}$</td>
<td>-0.63</td>
<td>-0.63</td>
</tr>
<tr>
<td>Export demand elasticity wrt output price $\eta_{ep}$</td>
<td>-3.05</td>
<td>-3.05</td>
</tr>
<tr>
<td>Output cross price elasticity wrt input price $\Psi_{yw}$</td>
<td>-0.03</td>
<td>-0.05</td>
</tr>
<tr>
<td>Output market price elasticity wrt input price $\eta_{pw}$</td>
<td>0.02</td>
<td>0.03</td>
</tr>
</tbody>
</table>

\[ \eta_{pw} = \left(1 - \frac{\eta_{yw} B}{\eta_{bp} Y - \eta_{yp} + \eta_{ep} Y} \right) \]

Price adjustment factor $A$ : 0.91 0.91

Overall supply elasticity wrt input price $\Omega_{yw}$ : -0.03 -0.05

$\Omega_{yw} = \eta_{yw} (1 - \eta_{qw}) A$ or $\Omega_{yw} = \eta_{yw} (1 - \eta_{qw}) + \eta_{yp} \eta_{pw}$

Overall proportional change in production $\Delta Y / Y$ : -0.0009 -0.0031

Exports share of total production $E / Y$ | 0.40         | 0.40         |
| Domestic consumption share of total production $B / Y$ | 0.60         | 0.60         |
| Overall export supply elasticity wrt input price $\Omega_{ew}$ : | -0.05        | -0.09        |

\[ \Omega_{ew} = \Omega_{yw} \frac{1}{(E / Y)} - \eta_{bp} \eta_{pw} \frac{(B / Y)}{(E / Y)} \]

Overall proportional change in exports $\Delta E / E$ : -0.0017 -0.0059

\[ \Delta E / E = \Omega_{ew} \frac{\Delta w}{w} \]

Table 6.3: Output market price adjustments due to the large country case

(Equations 22, 25, 26, 27, 28 and 29)

Table 6.3 reports the results of the calculation of the impact on the production and exports of Syrian olive oil under the assumption of the output price adjustments case in which Syria is assumed to be a large economy in the international olive oil market. Table 6.3 also shows the above findings based on output market price elasticity with respect to an input price of between 0.02 and 0.03 and price adjustment factor of 0.91. As indicated in Table 6.3 above, under the small impact option, a 3.3% increase in the price of olives would lead to a decrease
of 0.09% in olive oil production and a decrease of 0.17% in olive oil exports. On the other hand, under the large impact option, a 6.7% increase in the price of olives would lead to a decrease of 0.31% in olive oil production and a decrease of 0.59% in olive oil exports.

This calculated impact is far less than the calculated impact on both the production level and the exports level that was previously obtained (in Table 6.2). This is mainly because a part of the increase in olive prices 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 product. In other words, an increase in the output market price of olive oil will lead to an offset in part of the increase in the olive prices for the producer due to compliance with the policy of IPM for the olive oil agro-industrial sector.

Therefore, the case of output price adjustments reflects a range of downward adjustment in production of olive oil from 0.09% to 0.31%, and in exports of olive oil from 0.17% to 0.59%, which is significantly smaller than the range demonstrated in the basic model case; a decrease from 0.23% to 0.47% in production of olive oil and a decrease from 0.58% to 1.18% in exports of olive oil.

Accordingly, this calculation suggests that the impact of the increase in the price of olives for the producer on the production and export levels of Syrian olive oil products is declined significantly. Thus, the decrease in the production and export levels will be much less significant by including the case of output price adjustments due to the large country assumption.

Then, given that the olive oil exports amounted to €207 million in 2006 as reported in Table 2.4 (outlined in Chapter 2), the range of reduction in export revenues in the output market price adjustments case is €0.35 million to €1.22 million, i.e., a small impact option (a 3.3% increase in the price of olives) would cause a drop in export revenues of €0.35 million, and a large impact option (a 6.7% increase in the price of olives) would lead to €1.22 million drop in export revenues. The yearly loss would thus be lower than in the basic model case by €0.85 million (1.20-0.35) to €1.22 million (2.44-1.22). In other words, in either case the lower loss is significant.
Thus, the burden of the increase of the environmental compliance costs on the sector due to the adoption and enforcement of the IPM policy will be reduced significantly. This mostly happen when efficiency improvements due to productivity level changes in the production processes are induced by compliance with this policy, and a part of the compliance costs increase can be passed on to international consumers as an output market price increase due to the large country case.

In sum, in this section it can be concluded that the impacts on both the production level and the exports level of Syrian olive oil products was calculated. This was mainly as a result of the increase in the price of olives for the producer caused by compliance with the policy of IPM for the olive oil agro-industrial sector. The impact was initially calculated by holding the output market price of olive oil products constant and ignoring efficiency improvements.

As a result, the impact of compliance with the policy of IPM on the production and exports levels was initially calculated to be a decrease of between 0.23% to 0.47% and 0.58% to 1.18% respectively. After taking minor efficiency improvements into account, the impact of compliance with the policy of IPM on the production and exports levels was calculated to be a decrease of between 0.10% to 0.34% and 0.24% to 0.85% respectively. As a final step, output market price adjustments have been included into the model, and the impact of compliance with the policy of IPM on the production and exports levels was calculated to be a decrease of between 0.09% to 0.31% and 0.17% to 0.59% respectively.

Hence, the overall calculations suggest that the impact on Syrian olive oil products, which is resulting from compliance with the policy of Integrated Pest Management, is within the range of between 0.09% to 0.31% and 0.17% to 0.59% decrease in the production and exports levels respectively. This will be mainly in the case of output price adjustments due to the large country assumption. Nonetheless, in percentage terms, this range of impacts certainly indicates some future concerns and more strategic thinking with regard to trade competitiveness for the olive oil agro-industrial sector in Syria. After all, as Michael Porter says, “Strategic thinking rarely occurs spontaneously” (Porter, 1980).
Figure 6.1: The impact of the increase in the cost of olives for the producer due to compliance with the policy of IPM for the olive oil agro-industrial sector on the production and exports of Syrian olive oil products

(Small impact)

Figure 6.2: The impact of the increase in the cost of olives for the producer due to compliance with the policy of IPM for the olive oil agro-industrial sector on the production and exports of

Syrian olive oil products

(Large impact)
6.2.2. The Integrated Waste Management Policy Estimations

In Chapter 4, it was pointed that “the average compliance costs per ton of olive oil production due to olive oil processing modifications and wastewater treatment process $m$ was evaluated to be between 120-250 €. The therefore percentage increase in the compliance unit cost share of price per ton of olive oil for the producer $m / p$ was computed to be between 5% and 10% based on the olive oil price of 2558€ per ton and the graph reported in Figure 4.1 (Kuhn et al., 2010a, 2010b, 2011a:13, 2012:12), as stated previously in the second regulatory policy scenario in section 4.2 of the study.

Tables 6.4, 6.5 and 6.6 below “report the values of parameters and elasticities which are used in the estimate of the impacts of compliance with the policy of Integrated Waste Management on the production and exports of Syrian olive oil products” (Kuhn et al., 2012a:12). They also provide the results of the estimates (see Kuhn et al., 2010a, 2010b, 2011a:13, 2012a:12).

1. The Basic Model Case: The impact of the increase in the average cost of olive oil production for the producer on the production and exports of olive oil products.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Small impact</th>
<th>Large impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>The average compliance costs per ton of olive oil $m$</td>
<td>120 €</td>
<td>250 €</td>
</tr>
<tr>
<td>The proportional increase in the compliance unit cost share of olive oil price for the producer $m / p$</td>
<td>0.05</td>
<td>0.10</td>
</tr>
<tr>
<td>Output own-price elasticity $\eta_{yp}$</td>
<td>0.16</td>
<td>0.16</td>
</tr>
<tr>
<td><strong>The proportional change in production $\Delta Y / Y$</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta Y / Y = -m / p \eta_{yp}$</td>
<td>-0.0082</td>
<td>-0.0163</td>
</tr>
<tr>
<td>Exports share of total production $E / Y$</td>
<td>0.40</td>
<td>0.40</td>
</tr>
<tr>
<td><strong>The proportional change in exports $\Delta E / E$</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta E / E = -m / p \eta_{yp} (E / Y)$</td>
<td>-0.0204</td>
<td>-0.0408</td>
</tr>
</tbody>
</table>

Table 6.4: The basic model case (Equations 35 and 36)

"Table 6.4 shows that in the basic model case, i.e., assuming that Syria is a price-taker in the world market and that there is no efficiency improvement, a 5% increase in the compliance unit cost share of olive oil price due to compliance with the policy of Integrated Waste

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1This section has been taken identically from Kuhn et al. (2010a, 2010b, 2011a, 2011b, 2012a, 2012b).
Management would lead to a 0.82% reduction in olive oil production, and a 2.04% reduction in olive oil exports for the smaller impact. The larger impact, i.e., a 10% increase in the compliance unit cost share of olive oil price due to environmental compliance, would lead to a 1.63% reduction in olive oil production, and a 4.08% reduction in olive oil exports” (Kuhn et al., 2010a, 2010b, 2011a:13, 2012a:13).

“Therefore, given that the Syrian olive oil exports amounted to €207 million in 2006 as reported in Table 2.4 (outlined in Chapter 2), a small impact option (a 5% increase in the compliance unit cost share of olive oil price) would cause a drop in export revenues of €4.22 million, and a large impact option (a 10% increase in the compliance unit cost share of olive oil price) would lead to €8.45 million drop in export revenues. In either case, the loss is significant” (Kuhn et al., 2010a, 2010b, 2011a:13, 2012a:13). “However, the results are quite different after introducing the assumptions of efficiency improvements and output price adjustments, as reported below in Table 6.5 and Table 6.6” (Kuhn et al., 2012a:13).

Thus, the calculation of the impact of increase in the compliance unit cost share of olive oil price for the producer on the production and exports levels overstates the true impact, because potential efficiency improvements and output price adjustments’ effects have not yet been taken into account. We will first consider the role of including efficiency improvements into the basic model case.

2. Including Efficiency Improvements into the Basic Model Case: Efficiency improvements due to the increase in the average cost of olive oil production.

In this case, “we have to compute the impact of environmental compliance in the efficiency improvements assumption due to productivity level changes (described in the previous Chapter). The calculation, therefore, requires the evaluating of further two elasticities (\( \eta_{IZ} \) and \( \eta_{em} \)), which are outlined and explained in equations (49) and (50) in the previous Chapter. We can compute them by making use of the available data and figures” (Kuhn et al., 2012a:13).

“In Syria, the olive oil product is extracted mainly according to three methods, as already described in section 4.2: the traditional olive press technology that consists of 47.8% of all olive oil mills, the three-phase technology, which is used in 51% of all mills, and the two-phase technology, which is 1.2% (Dimashki et al., 2007:11). According to the study by
Vlyssides et al. (2004:608), “the 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 three-phase and two-phase processes” (Kuhn et al., 2010a, 2010b, 2011a:13). By making use of these pieces of information and taking the weighted average of all olive oil mills, the production will be multiplied by 1.52 ((1*47.8+2*52.2)/100), i.e., the compliance-induced efficiency parameter “e” is computed to be 1.52” (Kuhn et al., 2012a:12-13).

“The total amount of olive oil mills using new technologies is 52.2%. Therefore, a 52.2% of the olive oil mills would have effective compliance costs reduced by 50%. That is to say, a 52.2% of the olive oil mills would pay less of the compliance costs by 50% in producing the same level of output. This can be translated into compliance-induced efficiency improvements as a reduction in the effective compliance costs of 26% resulting from compliance with this policy. That is to say, a 52.2% of the olive oil mills gives efficiency improvements (de/e) of 26% (see, e.g., Ayadi and Matoussi, 2007:11). Thus, the compliance costs efficiency elasticity \( \eta_{en} = (de/e)/(dm/m) \) is computed to be 0.26” (Kuhn et al., 2012a:13).

On “the basis of the structure of the average costs for the olive oil product presented in Table 4.2 (outlined in Chapter 4), we compute the share of the factor cost in total revenues \( (wX/pY) \) to be equal to 0.41. The share of the effective factor cost in total revenues \( (zX/pY) \) is therefore computed to be equal to 0.27 based on the values of \( (wX/pY \) and “e”) reported above” (see Kuhn et al., 2012a:13).

Thus, “the elasticity of supply with respect to the effective factor price \( \eta_{IZ} \), determined at equation (49) in the previous Chapter is computed to be -0.05 based on the value of the share of the effective factor cost in total revenues \( (zX/pY) \) and the values of the elasticities \( (\eta_{hp} \) and \( \eta_{XY} \) ) reported before” (see Kuhn et al., 2012a:13).
### Table 6.5: Efficiency improvements due to productivity level changes
(Equations 49, 50 and 51)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Small impact</th>
<th>Large impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>The average compliance costs per ton of olive oil</td>
<td>$m$</td>
<td>$250 , \text{€}$</td>
</tr>
<tr>
<td>The proportional increase in the compliance unit cost share of olive oil price for the producer</td>
<td>$m/p$</td>
<td>$0.10$</td>
</tr>
<tr>
<td>Output own-price elasticity</td>
<td>$\eta_{ip}$</td>
<td>$0.16$</td>
</tr>
<tr>
<td>Factor demand elasticity wrt output level</td>
<td>$\eta_{xy}$</td>
<td>$1.06$</td>
</tr>
<tr>
<td>Share of factor cost in total revenues</td>
<td>$wX/pY$</td>
<td>$0.41$</td>
</tr>
<tr>
<td>Compliance-induced efficiency parameter</td>
<td>$e$</td>
<td>$1.52$</td>
</tr>
<tr>
<td>Share of the effective factor cost in total revenues</td>
<td>$ZX/pY$</td>
<td>$0.27$</td>
</tr>
<tr>
<td>Supply elasticity wrt effective factor price</td>
<td>$\eta_{Z}$</td>
<td>$-0.05$</td>
</tr>
<tr>
<td>The compliance costs efficiency elasticity</td>
<td>$\eta_{em}$</td>
<td>$0.26$</td>
</tr>
<tr>
<td>The proportional change in production</td>
<td>$\Delta Y/Y$</td>
<td>$+0.0040$</td>
</tr>
<tr>
<td>Exports share of total production</td>
<td>$E/Y$</td>
<td>$0.40$</td>
</tr>
<tr>
<td>The proportional change in exports</td>
<td>$\Delta E/E$</td>
<td>$+0.0099$</td>
</tr>
</tbody>
</table>

As indicated in Table 6.5, “the assumption of efficiency improvement, i.e., a reduction in the effective average costs of compliance, leads to positive effects on production and exports in the small impact case, respectively 0.40% and 0.99%. The case in which the compliance costs are assumed to be large yields instead a negative impact on both production and exports levels. However, it is worth the note that the negative effects, i.e., 0.42% in the production level and 1.05% in exports, are smaller than in the basic model case. Based again on the 2006 benchmark level of exports equal to €207 million as reported in Table 2.4 (outlined in Chapter 2), compliance with the policy of Integrated Waste Management would therefore lead to an increase in the Syrian exports of olive oil equal to €2.05 million in the small impact case and to a fall equal to €2.17 million in the large impact case” (Kuhn et al., 2011a:14, 2012a:13-14).

Thus, the higher the efficiency improvement means that the lower the resultant of the changes in the production and exports levels of equations (50) and (51) will be. That is to say, an increase in the production and exports levels of olive oil products will be in the case of
efficiency improvements. In other words, including efficiency improvements will lead to offset a part of (under the large impact option) and all of (under the small impact option) the increase in the average cost of olive oil production for the producer. This is mainly due to compliance with the policy of Integrated Waste Management for the Olive Oil Pressing Industries. This calculation still overstates the true impact because output market price adjustments have not yet been taken into account.

3. Large Country Case: Production and exports of olive oil products in the presence of output market price adjustments.

In this case, we have to compute the impact of environmental compliance in the large country assumption (described in the previous Chapter). Thus, the calculation requires the evaluating of the output price elasticity with respect to the compliance costs increase \( \eta_{pm} \), which is outlined and explained in equation (56) in the previous Chapter. This elasticity is computed to be 0.09 based on the values of the elasticities \( \eta_{yp}, \eta_{yz}, \eta_{em}, \eta_{bp} \) and \( \eta_{ep} \) reported before (see Kuhn et al., 2012a:13).

<table>
<thead>
<tr>
<th>Small impact</th>
<th>Large impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>The average compliance costs per ton of olive oil ( m )</td>
<td>120 €</td>
</tr>
<tr>
<td>The proportional increase in the compliance unit cost share of olive oil price for the producer ( m/p )</td>
<td>0.05</td>
</tr>
<tr>
<td>Output own-price elasticity ( \eta_{yp} )</td>
<td>0.16</td>
</tr>
<tr>
<td>Domestic demand elasticity wrt output price ( \eta_{bp} )</td>
<td>-0.63</td>
</tr>
<tr>
<td>Export demand elasticity wrt output price ( \eta_{ep} )</td>
<td>-3.05</td>
</tr>
<tr>
<td>Supply elasticity wrt effective factor price ( \eta_{yz} )</td>
<td>-0.05</td>
</tr>
<tr>
<td>The compliance costs efficiency elasticity ( \eta_{em} )</td>
<td>0.26</td>
</tr>
<tr>
<td>Output price elasticity wrt compliance cost ( \eta_{pm} )</td>
<td>0.09</td>
</tr>
</tbody>
</table>

\[
\eta_{pm} = \left( \eta_{yp} + \eta_{yz} \eta_{em} \right) \left( \frac{\eta_{yp} - \eta_{bp} B Y - \eta_{ep} E Y}{Y} \right)
\]

**Overall proportional change in production** \( \Delta Y / Y \):

\[
\Delta Y / Y = - \frac{m}{p} \eta_{yp} + \eta_{yp} \eta_{pm} - \eta_{yz} \eta_{em}
\]

Exports share of total production \( E / Y \):

<table>
<thead>
<tr>
<th>Small impact</th>
<th>Large impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.40</td>
<td>0.40</td>
</tr>
</tbody>
</table>

Domestic consumption share of total production \( B / Y \):

<table>
<thead>
<tr>
<th>Small impact</th>
<th>Large impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.60</td>
<td>0.60</td>
</tr>
</tbody>
</table>

**Overall proportional change in exports** \( \Delta E / E \):

\[
\Delta E / E = \Delta Y / Y \left( 1 - \frac{\eta_{bp} \eta_{pm} (B / Y)}{(E / Y)} \right)
\]

<table>
<thead>
<tr>
<th>Small impact</th>
<th>Large impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>+0.1262</td>
<td>+0.1058</td>
</tr>
</tbody>
</table>

Table 6.6: Output market price adjustments due to the large country case (Equations 56, 59 and 61)
As indicated in Table 6.6 above, “the most important and relevant results concern the case of output price adjustments, that is the case in which Syria is assumed to be a large economy in the international olive oil market. The estimates lead to positive effects on both production and exports levels regardless of the assumption on the size of compliance costs, i.e., under both cases of small and large impacts. The increase in production lies between 0.98% and 1.80%. The size of exports rises very sharply by an amount between 10.58% and 12.62%” (Kuhn et al., 2012a:14).

This calculated impact is much more significant than the calculated impact on the production and exports that we previously obtained (in Table 6.5). This is mainly because all of the increase in average compliance costs per ton of olive oil production for the producer is passed on to consumers in the form of higher output market prices of olive oil products, something which can be achieved based on output market price adjustments due to the large country case. In other words, an increase in the output market price of olive oil will lead to offset all of the increase in the compliance unit cost share of olive oil price for the producer. This is mainly due to compliance with the policy of Integrated Waste Management for the Olive Oil Pressing Industries (see Kuhn et al., 2010a, 2010b, 2011a:13).

Then, the case of output price adjustments reflects a range of upward adjustment as an increase in production of olive oil from 0.98% to 1.80%, and an increase in exports of olive oil from 10.58% to 12.62%, which is significantly positive and much greater than the range demonstrated in the basic model case; 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 (see Kuhn et al., 2011a:14).

Accordingly, we conclude that the calculation of the impact of the increase in the average compliance costs of olive oil products for the producer on the production and exports levels of Syrian olive oil products is positive and increased significantly. Thus, the increase in the production and exports levels will be more notable and much significant by including output price adjustments due to the large country assumption (see Kuhn et al., 2011a:14).

Therefore, “given that benchmark value of the Syrian olive oil exports in 2006 is amounted to €207 million (as reported in Table 2.4 outlined in Chapter 2), compliance with the Integrated Waste Management policy under the assumption of output price adjustments would have positive impact on Syrian exports revenues in the range of €21.90-€26.12 million. The yearly
Thus, “the burden of the increase of the environmental compliance costs on the industry due to the adoption and enforcement of the policy of Integrated Waste Management will be reduced significantly, something which can be achieved when efficiency improvements due to productivity level changes in the production processes are induced by compliance with this policy, and a part of the compliance costs increase can be passed on to international consumers as an output market price increase due to the large country case” (see Kuhn et al., 2010a, 2010b, 2011a:14, 2012a:14).

In sum, in this section we calculated the impact on the production and exports levels of Syrian olive oil products. This was mainly as a result of the increase in the average costs of olive oil production for the producer caused by compliance with the policy of Integrated Waste Management for the Olive Oil Pressing Industries. The impact was initially calculated by holding the output market price of olive oil products constant and ignoring efficiency improvements. As a result, the impact of compliance with the policy of Integrated Waste Management on the production and exports levels was initially calculated to be a decrease of between 0.82% to 1.63% and 2.04% to 4.08% respectively. After we took minor efficiency improvements into account, the impact of compliance with the policy of Integrated Waste Management on the production and exports levels was calculated to be of between -0.42% to +0.40% and -1.05% to +0.99% respectively. As a final step, we included output market price adjustments into the model, and the therefore impact of compliance with the policy of Integrated Waste Management on the production and exports levels was calculated to be an increase of between 0.98% to 1.80% and 10.58% to 12.62% respectively.

Hence, the overall calculations suggest that the impact on the Syrian olive oil products, which is resulting from compliance with the policy of Integrated Waste Management, is within the range of between 0.98-1.80% and 10.58-12.62% increase in the production and exports levels respectively. This will be mainly in the case of output price adjustments due to the large country assumption. Nonetheless, in percentage terms, this range of impacts certainly indicates more future satisfactions and strategic thinking with regard to trade competitiveness for the olive oil agro-industrial sector in Syria (see Kuhn et al., 2010a, 2010b, 2011a:14-15).
Figure 6.3: 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

(Small impact)

Figure 6.4: 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

(Large impact)
As a final result, for the case of “input-specific” environmental policies, the enforcement of compliance with more stringent environmental policies would have some negative impact on the production and export levels of Syrian olive oil products. This is mainly due to the fact that the new environmental policies often express themselves through an increase in the compliance costs, which have negative effects on the overall production costs, export earnings and international trade competitiveness.

Nevertheless, for the case of “end-of-the-pipe” environmental policies, the enforcement of compliance with more stringent environmental policies would have a positive impact on the production and export levels of Syrian olive oil products. However, such a positive impact would be achieved in the large country case. In other words, the positive impacts would be achieved when efficiency improvements due to productivity level changes and output price adjustments due to the large country case are induced by compliance with these policies.

To sum up, the impacts of compliance with more stringent environmental policies on the production and exports levels tend to be complex and need to be analyzed on a case-by-case basis. Compliance with more stringent environmental policies typically has an impact on both consumers and producers. These policies may affect the willingness of consumers to pay for product varieties meeting these policies, because they change consumers’ perception or appreciation of these varieties. Moreover, these policies may affect producers’ costs in a number of ways. Firstly, they may imply a fixed cost when producers switch from producing one product variety to producing another higher quality variety. Secondly, they may involve a change in variable costs, for instance, if it is more expensive to produce a good meeting these policies than one not meeting these policies. Thirdly, the introduction of these policies affects production costs if it causes producers to run additional product lines. Finally, these policies will typically also generate additional costs related to conformity assessment procedures. Overall, the introduction of environmental policies is likely to affect the prices that consumers are willing to pay for certain product varieties and the prices at which producers are willing to supply those varieties. Thus, environmental policies will affect the production and exports levels differently, for instance, this may be the case if environmental policies affect the production costs for the producers differently (WTO, 2005:72).
Part Three: Environmental Policy Recommendations

7. The Trade and Competitiveness Opportunities for Syria

From an environmental perspective, the environmental policies are initially designed to protect domestic consumers from the environmental damages resulting from international trade liberalization. However, from a trade perspective, they might also be set up and take place to protect the domestic economic sectors from competitive foreign imports. In other words, from an environmental perspective, the environmental policies are developed to save the environment of a country and its consumers. Examples include processes and production methods policies, maximum pesticide residue policies in food products, emission policies, packing and packaging policies, eco-labeling systems etc. From a trade perspective, the fear is that these policies may be made and developed in ways that seek to protect poorly domestic economic sectors from competitive foreign imports. The question is therefore how these environmental policies can be made and developed in ways that are not or less harmful to the international trade competitiveness as far as possible. From the perspective of the Syrian government, the concern is that it will lose access to international export markets as a result of “green conditionalities” being imposed on its exports. In particular, this will be applicable to olive oil products that need to be exported and accepted globally. The question is then how the WTO-EU environmental policies for the international olive oil market can be designed, so that environmental objectives are not attained at the expense of international trade competitiveness for the olive oil agro-industrial sector in Syria.

The relationship between environmental policies and international trade competitiveness appears as a major issue in international trade in light of the global and regional economic changes which are taking place in the world today. There is a growing concern in the international community, regarding environmental frameworks, that the increase in economic growth due to the trade liberalization policies will lead to more pressures and negative effects on the environment. This in turn requires strengthening environmental policies and taking the necessary action to protect the environment. In contrast, at the same time, there is a growing concern in the business community that the adoption of environmental protection policies may adversely affect the international trade competitiveness of key economic sectors.

The globalization of the international economy has led to increasing competition and lower profit margins in several key economic sectors. The adaptation of new environmental policies would lead to the introduction of substantial additional costs in the production process,
particularly in developing economies where the cost of acquiring and adopting advanced technology is relatively high compared with developed economies. In general, it can be said that the ability of many developing economies to compete internationally may soften and decrease as a result of these constraints due to the lower profit margin from free trade.

The increase in international trade exchange is represented through significant growth in the volume and value of international trade over the years, and in turn, it has led to a raise in the internationalization and globalization of environmental problems. Despite the existence of effective systems to manage international economic relations, there is a lack of many environmental issues and problems in the international management. Moreover, the environmental policies adopted at the local level may conflict with the environmental policies adopted at the international level with regard to trade, investment and economic integration. Consequently, the domestic and international environmental policies need to be amended and coordinated, so that the environmental and economic objectives are compatible and supportive to each other.

Given that there is a growing discussion about the relationship between environmental policies and international trade competitiveness for the olive oil agro-industrial sector in Syria, it is important to bear in mind that the adoption and enforcement of compliance with environmental policies would result in raising the production costs for the producer in the short term. However, and in return, this would also reduce these costs over the long term. Generally, this occurs as a result of efficiency gains in productivity at the sector or industry level. While compliance with environmental policies often imposes direct costs on production with respect to the adopted investment and operation systems, the inclusion of environmental costs may lead to changes in prices, which may in turn affect the international trade competitiveness. Therefore, it is easy to understand that the differences in the stringent environmental policies approved at the domestic and international levels are the most important reasons for the differences in costs and competitive advantages in the international arena. The relevant policy question, however, is then where are the international trade competitiveness’ opportunities for the olive oil agro-industrial sector in Syria located as a result of implementing the WTO-EU environmental policies for the international olive oil market?
7.1. Potential Benefits of Trade Liberalization in Environmental Olive Oil Goods

Recently, the concepts of green economy and green development have been introduced in the rules of the new world order. The adoption and enforcement of compliance with environmental regulatory policies have become the most important conditions that must be met by goods and services to enter the global markets. Countries have the right to prevent the entry of certain goods and services to their markets if the country of origin does not take into consideration the environmental dimensions and aspects in their production processes, such as goods and services that pollute the environment, produce on the basis of over-exploitation of natural resources and affect the ecological balance. International institutions also give the international environmental management certifications systems for industries that take into account the environmental aspects such as the ISO 14000 (see, e.g., Viadiu et al., 2006:142).

At the international market level, there have been global business centers dealing in particular in the sale of green goods and services that are produced in environmentally friendly ways. The so-called “green shops markets” have become of great interest to consumers, who prefer “green” products, particularly in niche markets. In the last few years, many of the international and nationalism funding institutions in some countries have refrained from providing funding and support for projects that do not take into account the environmental aspects. The new banks, so-called “green banks”, which did not fund projects that contribute to the pollution of the environment, have emerged. More recently, the so-called “green funding” has also emerged. This green funding has become a new area of competition between banks to attract new customers; particularly those who prefer “green” products (see, e.g., UNEP, 2007:1-5).

1. Potential Benefits for Export Gains:

Syrian olive oil exporters may be able to compete in sub-regional or regional olive oil markets, where experience in similar environmental problems is key. They may be able to provide a wide range of olive oil products which that are universally accepted prices on the one hand and appropriate to the domestic and international environmental conditions on the other hand (see, e.g., Hamwey et al., 2003:13).

Syrian olive oil exporters have export potential and a positive trade balance in specific EGS related to the olive oil agro-industrial sector, where Syrian olive oil exporters have become significant suppliers to the global markets. In addition, some gains may be generated from
trade liberalization in environmentally preferable products, such as the olive oil products, especially those relating to certification requirements.

Moreover, Syrian olive oil exporters have export potential in the olive oil environment-friendly products, which are produced naturally. They can also play an active role in participating in the negotiations on the development of environmentally clean technologies related to the olive oil agro-industrial sector. Further, partnerships can provide environmental services suppliers in the Syrian olive oil agro-industrial sector with business opportunities, while at the same time allowing advanced technology transfer and local capacity building (see, e.g., Hamwey et al., 2003:13).

2. Potential Benefits for Environmental and Developmental Gains:

The Syrian economy can benefit from liberalizing trade in EGS related to the olive oil agro-industrial sector, since the provision of basic environmental services requires high levels of investment and expertise. The commercial presence of foreign enterprises in the Syrian olive oil agro-industrial sector could play a key role in increasing the environmental investments; improving the environmental services quality; transferring the environmentally sound technologies; and strengthening the international trade competitiveness for the Syrian economy (see, e.g., Hamwey et al., 2003:13; Less & McMillan, 2005:12; Yu, 2007:8).

The Syrian economy may gain from trade liberalization in EGS related to the olive oil agro-industrial sector, particularly when there are appropriate conditions for the transfer of environmental technologies and associated “know-how” on a favourable commercial base, as well as for the development of national capabilities both human and institutional in the olive oil agro-industrial sector. In addition, the Syrian government can get directly to the environment-friendly technologies and effectively participate in multilateral environmental agreements. This will be particularly through increasing investments and liberalizing international trade in EGS related to the olive oil agro-industrial sector.

The accession of Syrian government to the WTO can contribute effectively to increase the flow of advanced technologies to the Syrian economy, something which can be achieved through the effective participation of Syria in the WTO negotiations on the liberalization of trade in EGS related to the olive oil agro-industrial sector. However, the Syrian government has to strengthen its regulatory regime in relation to its own environmental and developmental
needs. The government is therefore being able to capture the benefits of trade liberalization in EGS related to the olive oil agro-industrial sector. This will lead to increasing investment in appropriate EGS related to the olive oil agro-industrial sector, and it will also lead to promoting opportunities for the transition to cleaner environment-friendly technologies. Ultimately, this would lead to effective technological solutions to environmental problems with regard to the management of local natural environmental resources related to the olive oil agro-industrial sector (see, e.g., Hamwey et al., 2003:14).

Thus, to ensure that the Syrian government can achieve immediate export, environmental and developmental gains, it must participate actively in the WTO negotiations on the liberalization of trade in EGS related to the olive oil agro-industrial sector. In addition, special and differential treatment provisions for developing countries must be taking into account. These provisions should be an integral part of all the WTO agreements. They will also need to be carefully elaborated and drafted in order to ensure that any eventual WTO agreement on environmental goods provides the Syrian government with flexibility in selecting goods related to the olive oil agro-industrial sector for liberalization. It also provides sufficient safeguards to protect the domestic olive oil agro-industrial sector in Syria. Moreover, it should facilitate the Syrian access to safeguard mechanisms, if liberalization delivers adverse results. Finally, with attracting foreign investments in the Syrian olive oil agro-industrial sector, environmental performance requirements by foreign investors should be strengthened. They can therefore be exploited to provide preferences for the use of domestically produced environmental goods in foreign investment operations related to the olive oil agro-industrial sector (see, e.g., Hamwey et al., 2003:52; Hamwey, 2005:20; Yu, 2007:5).

7.2. The Contribution of Good Environmental Policies to Promote the International Olive Oil Market

Good environmental regulatory policies can support a viable competitive economy and a clean natural environment in which to live and work (The Network of Heads of European Environment Protection Agencies, 2005). The adoption of effective environmental regulatory policies has grown to become a vital and integral part of achieving success in the international markets. It has also become an essential ingredient of a vibrant and modern economy. Unregulated markets effectively would be disorganized and not likely to provide what people desire with regard to reliable products and environmental qualities in which to live and work (see, e.g., The Network of Heads of European Environment Protection Agencies, 2005).
A modern approach of the adoption of effective environmental regulatory policies can help provide the necessary environmental services and improvements that people need. This must be in a form, which is commensurate with the promotion of a competitive global economy. The adoption of good environmental regulatory policies is likely to incorporate a mix of policy instruments, including measures based on market mechanisms such as emissions trading, a risk-based approach, and effective participation and dialogue with business and other stakeholders.

The community in general will benefit from the reduction of pollution, waste and environmental damage, as well as, the enhancement of the quality of environmental life. In addition, the business sector will be made more experienced and sophisticated with the effective implementation of environmental regulatory policies. The adoption of fair competition would positively affect all levels of economic, social and environmental sustainable development if the rules and provisions with respect to the adoption of effective environmental regulatory policies are taken into account.

In this context, given that there is a current focus on the international market for the olive oil agro-industrial sector in Syria, there is also now significant international attention towards achieving economic development and environmental preservation. Evidence and international research have evolved in this area, stressing that the adoption and enforcement of good environmental regulatory policies do not adversely affect international trade competitiveness and sustainable development. On the contrary, they can be beneficial by creating pressures that drive innovation and alert business about resource inefficiencies and new opportunities (For more details about the evidence, see The Network of Heads of European Environment Protection Agencies, 2005:1-8; OECD, 2006:9).

1. Competitiveness and good environmental policies are complementary; they seek to examine the market failures and to improve the social welfare for the olive oil agro-industrial sector. The objectives of competitiveness and good environmental regulatory policies are complementary. There is a general broad agreement that competitiveness and good environmental regulatory policies share common essential and fundamental objectives (OECD, 2006:9). The most important of these objectives are (a) achieving the maximum social welfare of the people; (b) achieving the common rational ground for the policy intervention in order to correct market failures; and (c) addressing the negative environmental
effects with regard to the protection of the natural environment. Thus, competitiveness and good environmental policies seek to enhance the international market for the olive oil agro-industrial sector in Syria.

2. **Good environmental policies help reduce costs for the olive oil agro-industrial sector.** The adoption of good environmental regulatory policies in the olive oil agro-industrial sector would bring lower costs. It would also help the development of environmentally-friendly products. The adoption of these policies would stimulate the consumption of clean energy and reduce pollution significantly. The decline in production costs would bring significant benefits and advantages to all at social, economic and environmental levels. Moreover, good environmental regulatory policies would help the olive oil agro-industrial sector’s stakeholders to understand how to capture productivity gains in production processes. Additionally, they would help promote innovative environmental practices, particularly those based on a core regulatory framework. Further, voluntary agreements between government and the olive oil agro-industrial sector stimulated by good environmental regulatory policies can improve the quality of environmental management and products, save resources, reduce costs and promote green markets (see, e.g., The Network of Heads of European Environment Protection Agencies, 2005:2).

3. **Higher environmental policies help create markets for the olive oil agro-industrial sector.** States that adopt and enforce high environmental regulatory policies are always characterized by the presence of leading effective industries in the markets. These States are also characterized by the best economic and environmental performances compared to those States that adopt and enforce low environmental regulatory policies. The process of adoption and enforcement of high environmental regulatory policies would play an important role in stimulating innovation and creativity, both in industries that develop these policies and in those industries that implement compliance with these policies (see, e.g., Porter, 1990; The Network of Heads of European Environment Protection Agencies, 2005:3).

4. **Good environmental policies drive innovation for the olive oil agro-industrial sector.** Industries which adopt the enforcement of effective environmental regulatory policies can achieve a hub commercial success at the international level. These industries are characterized by the adoption and use of clean technology in their production operations. In addition, the way in which these industries respond to effective environmental regulatory policies are
considered to be more important in the area of stimulating innovation. In the context of improving environmental quality, the effective environmental policies are always designed specifically to enhance the environmental performance of these industries. Michael Porter has recognized this dynamism, writing: “The data clearly show that the costs of addressing environmental policies can be minimized, if not eliminated, through innovation that delivers other benefits” (see, e.g., Porter & Van der Linde, 1995b:98; The Network of Heads of European Environment Protection Agencies, 2005:4).

Therefore, there is an urgent need to attract the attention of industries with regard to resource efficiencies and technological possibilities to improve and protect the environmental quality in the meantime. For instance, it is clear that industries that innovate in response to more stringent pollution policies, produce less pollution. These industries earn and save more money, and perhaps they have a chance to use this profit to improve the quality of their products. Moreover, these industries have absorbed climate change taxes through increased investments in environment-friendly technologies and clean energies. All this eventually would lead to cost reduction and environmental preservation at both local and international levels for the olive oil agro-industrial sector in Syria (see, e.g., The Network of Heads of European Environment Protection Agencies, 2005:4).

5. **Good environmental policies reduce business risk and increase confidence of the investment market and insurers for the olive oil agro-industrial sector.** Industries which have good management of environmental issues can reap financial advantages and benefits over other industries that do not take into account the environmental dimension. Moreover, the institutions working in the banking and insurance sectors, which are responsible for funding and ensuring all business industries and projects, pay particular attention and consider more positively the industries and projects that have good environmental philosophies and low environmental risks. Otherwise, these institutions give less attention and consider more negatively on industries and projects that have weak environmental philosophies and high environmental risks (see, e.g., The Network of Heads of European Environment Protection Agencies, 2005:4-5).

6. **Good environmental policies can assist competitive advantage and can help create competitive markets for the olive oil agro-industrial sector.** Good environmental regulatory policies can play a key role in stimulating innovation and encouraging
environment-friendly practices. They can thereby help strengthen the international competitiveness. The adoption and enforcement of good environmental policies in the industrialized countries have assist in strengthening their competitiveness at the international level (World Bank, 1994). In addition, there is no any evidence indicated that the industries that meet compliance with environmental regulatory policies experience weakness in their competitiveness in international markets (World Resources Institute, 1995). The evidence has also showed that industries, which have adopted international environmental regulatory policies, are not competitively disadvantaged and they are viable in the long term. This would suggest that industries implementing compliance with international environmental regulatory policies need to make full use of adaptation periods rather than choosing a strategy of resistance or inertia. Additionally, it is mistaken to consider good environmental regulatory policies as being internationally anti-competitive. Compliance with good environmental regulatory policies would bring many important benefits in particular such as the promotion of fair competition, less pollution, and environmental protection. Furthermore, it is unlikely that the costs of compliance with environmental regulatory policies would disappear if these policies were removed for the olive oil agro-industrial sector in Syria (see, e.g., The Network of Heads of European Environment Protection Agencies, 2005:6).

7. **Good environmental policies help create and sustain jobs for the olive oil agro-industrial sector.** The evidence tends to indicate that the net impact on employment of compliance with good environmental regulatory policies is either neutral or slightly positive. For example, the OECD’s review of environmental performance in 2004 provides evidence that in a country, which complies with international environmental regulatory policies, the country’s environmental industry (environmental manufacturing and services) has contributed significantly to the low unemployment rate (see, e.g., OECD, 2004a and 2004b; The Network of Heads of European Environment Protection Agencies, 2005:6-7).

8. **Good environmental policies improve the health of the workforce for the olive oil agro-industrial sector.** There is a strong relationship between protecting environment quality and maintaining people’s health. People who live in an environment of high quality, live longer and in good health. They are therefore able to play a fundamental and an effective role in promoting economic, social and environmental development. In addition, environmental policy-setters can make a significant contribution in improving the health of the workforce. This would be through their work to decrease pollution and enhance public access to a natural
and high quality environment. For example, the World Bank (2005a) underlined that the promotion of economic growth is one of the most important benefits resulting from good business management and regulatory policies. Human development indicators are higher as well. Business holders will spend less time and effort to enforce compliance with environmental regulatory policies and more time and effort facilitating their business in producing and marketing their products (see, e.g., World Bank, 2005a; The Network of Heads of European Environment Protection Agencies, 2005:7).

9. Good environmental policies protect the natural resources on which the olive oil agro-industrial sector depends. It should not be ignored that good environmental regulatory policies help protect and maintain the environmental goods and services provided for free by properly functioning eco-systems. These goods and services include appropriate environment climate, renewable natural resources such as water, air and soil, and the recycling of waste, among others. In spite of Syrian economy is mainly dependent on such goods and services, however in many cases the importance of maintaining them and take them for granted is ignored. Despite this, environmental protection agencies are often forced onto the defensive by claims that rigorous environmental management and policies inhibit economic development, reduce competitiveness and even force industry to move to regions where environmental regulatory policies are weaker (see, e.g., The Network of Heads of European Environment Protection Agencies, 2005:8).

Accordingly, the evidence outlined above shows that good environmental regulatory policies can promote the international market for the olive oil agro-industrial sector in Syria on the one hand. On the other hand, they can support a clean, competitive economy and a healthy environment in which to live and work.

As a result, the relationship between environmental regulatory policies and international trade competitiveness policies is a growing and important area of the regulatory and policy-setting activities, both domestically and internationally. In addition, regardless the difference has been found in the formulation forms of environmental regulatory policies as well as in the methods and techniques adopted by various countries and organizations to implement them locally and internationally. All this does not change the fact that the enforcement of compliance with environmental regulatory policies presents green opportunities for the olive oil agro-industrial sector in Syria.
The negative impact resulting from compliance with environmental regulatory policies can be minimized by ensuring a transparent and consultative process with the concerned parties from various developing and developed countries. Moreover, this can be minimized through “better coordination and a shared responsibility” among the key international actors, including governments, international organizations, policy-makers and Syrian olive oil exporters. Furthermore, this can be minimized by adopting a more comprehensive and proactive approach in adjusting to environmental regulatory policies by different stakeholders in the Syrian olive oil sector. In this case, by working together these different stakeholders can find ways to ensure that the transition to compliance with environmental regulatory policies creates as few unintended negative trade-related impacts as possible while maximizing the benefits for sustainable development in the Syrian olive oil sector. Ultimately, the burden of responsibility in this area lies primarily on the Syrian olive oil sector and the Syrian government alike, and no amount of activities, procedures and assistance by external forces can be a substitute for local awareness, commitment and cooperation within the Syrian olive oil sector and the Syrian government themselves.

7.3. Scenarios for Improving the International Olive Oil Market

It is clear that the Syrian government urgently needs to implement the effective international market for the olive oil agro-industrial sector at national, regional and international levels. However, the most effective international market for the olive oil agro-industrial sector in Syria requires the creation of enabling environments for regional collaboration and mechanisms. This is mainly in order to address the trade and environmental problems related to the international market for the olive oil sector. In this context, some possible trade-environment scenarios have been put forward. These scenarios aim to effectively improve the international market for the olive oil agro-industrial sector in Syria at national, regional and international levels (for a more complete introduction to the topic, see RIS, 2003:1-4).

A. Issues for Action at a National Level: It is quite clear that the Syrian government does have to play an important role to improve the international market for the olive oil agro-industrial sector. This is particularly when the olive oil exporters in Syria are the owners of the olive-mill small and medium-sized enterprises (SMEs). In addition, it may be beyond their capacities to meet the enforcement of compliance with the domestic and international environmental regulatory policies. This role would be through the effective implementation of many issues necessary in this area at the national level. These issues are as follows:
1. Gradual approach towards technical assistance and capacity building for the olive oil agro-industrial sector to meet environmental compliance: The process of meeting compliance with environmental regulatory policies would cause a rise in production costs, particularly for the olive oil SMEs. These costs can exceed the capacity of the owners of olive oil SMEs to bear and afford. Thus, it may be of critical importance for the establishment of common infrastructural facilities such as appropriate test and experience laboratories with international accreditation. In this context, the relevant government agencies can assist the owners of the olive oil SMEs in meeting compliance with environmental regulatory policies. This can be achieved through a gradual approach towards technical assistance and capacity building to meet compliance, which includes (a) the provision of the necessary raw materials and environmentally sound technologies; (b) the organization of outreach programs that include training of entrepreneurs, managers and different levels of employees on how to meet compliance with the required policies; and (c) the formation of cooperatives and self-help groups of concerned stakeholders. They could therefore share costs and create common facilities such as test laboratories and affluent treatment plants besides information dissemination offices about environmental regulatory policies (see, e.g., RIS, 2003:2; UN-ESCWA, 2005:67; UNCTAD, 2006a:2; OECD, 2008:9).

Additionally, the relevant government agencies have to take into account a regular exchange of information on ongoing technical assistance and capacity building activities. Gradually, this would also allow the transition to more effective and comprehensive approaches that combine the institutional capacity building with technical assistance and training systems. Moreover, the ongoing technical assistance and capacity building activities are required to be discussed with the development assistance departments in the major donor countries. This is mainly with a view to ensure the provision of an adequate funding base aimed at achieving full compliance with environmental regulatory policies in the olive oil SMEs (see, e.g., RIS, 2003:2).

2. Sharing of trade and environmental information related to the international olive oil market: The Syrian government should create effective mechanisms for disseminating information on the emerging environmental regulatory policies adopted by different countries to their producers and exporters. Therefore, the dissemination of such information would help reduce the proportion of rejections of export shipments. This would also help to avoid the
high costs of the process of repatriation of export shipments or the disposal of them abroad 
(see, e.g., RIS, 2003:2).

3. Evolving national environmental regulatory policies related to the international olive 
   oil market: A remarkable development has been seen in the adoption of international 
environmental regulatory policies. In addition, the Syrian economy has become increasingly 
more open to international markets, especially the markets of developed countries. Therefore, 
the Syrian government has to evolve their own environmental regulatory policies in 
accordance with international environmental regulatory policies. Thus, the government can 
make sure that its olive oil exports are appropriate for international markets and have been 
produced in environmentally friendly ways (see, e.g., UNEP, 2001:7; RIS, 2003:2; Parto & 
Herbert-Copley, 2007:14).

4. Effective participation in the setting process of international environmental 
   regulatory policies related to the international olive oil market: The experience of past 
   years suggests that the setting process of international environmental regulatory policies has 
evolved with limited participation of the Syrian government. Thus, what happens is that what 
is being proposed in foreign export markets gets approved as a default. The Syrian 
government should therefore increase its effective participation in the setting process of 
developing international environmental regulatory policies. This should be consistent with 
meeting its own environmental conditions and regulatory policies. The government should 
also provide its own suggestions with respect to other issues and concerns of alternative 
international environmental regulatory policies related to the olive oil market (see, e.g., RIS, 
2003:2; Rotherham, 2003:16).

5. Generating awareness about environmental concerns in the production processes 
   related to the olive oil agro-industrial sector: Increasing international attention has been 
given to the adoption of international environmental regulatory policies in the production 
processes related to the olive oil agro-industrial sector. In this framework, the Syrian 
government has to play an essential role in the field of generating knowledge, awareness and 
expertise regarding the environmental concerns in olive oil production processes. This can be 
achieved through media and other advertising means. In this case, the generated 
environmental awareness would lead to a significant increase in the market valuation of the 
olive oil agro-industrial sector that is labeled as relatively rich and green in terms of adopting
international environmental regulatory policies, and vice versa. Moreover, this would build considerable pressures on other sectors to become more aware environmentally (see, e.g., RIS, 2003:2).

6. **Compiling databases of international experiences about environmental regulatory policies related to the international olive oil market:** Most studies have highlighted a variety of international experiences concerning the imposition of environmental regulatory policies by the importing countries on the exporting countries of the countries that have been studied. These studies, however, have been sometimes made in an informal manner. The Syrian government has therefore to build a comprehensive database; in addition, the government has to collect all of the necessary information concerning these international experiences related to the olive oil agro-industrial sector, particularly within the framework of the WTO-EU agreements (see, e.g., RIS, 2003:2-3).

7. **Exploiting favorable opportunities for environmentally friendly goods and services related to the olive oil agro-industrial sector:** Increasing international interest has been given for the production of environment-friendly goods and services related to the olive oil agro-industrial sector. In this context, the Syrian government must take advantage of the emerging-growing environmental awareness in the markets of developed countries. This can be achieved through pushing exports of the environment-friendly olive oil products. In general, the Syrian government has a natural advantage in the olive oil agro-industrial sector, which should be exploited fully. Thus, it may be fruitful to create a brand in the markets of developed countries on the basis of use of environmentally friendly goods and services related to the olive oil agro-industrial sector (see, e.g., RIS, 2003:3).

8. **Diversification of major export markets related to the olive oil agro-industrial sector:** The Syrian economy is heavily dependent on exports of few commodities and on few specific export markets. Thus, the dependence on few primary commodities and markets for exports make the Syrian economy highly vulnerable. Therefore, in the medium to long term, the objective of Syrian government policies should be to diversify the composition of export commodities as well as the coverage of major export markets. In this context, to fulfill this objective, the Syrian government, for instance, should seek to diversify the coverage of major export markets related to the olive oil agro-industrial sector (see, e.g., RIS, 2003:3).
B. Issues for Action at a Regional Level: At a regional level, in particular, there are many areas where a regional cooperation strategy should be pursued. This could be fruitful and effective to improve the international market for the olive oil agro-industrial sector in Syria. These areas are listed below.

1. Regional coordination in international negotiations on the development of international environmental regulatory policies related to the international olive oil market: Syria and many of the Arab countries export many products and commodities that are common to all in the olive oil agro-industrial sector. Their concerns and interests are therefore quite similar. Thus, a regional-wide coordination has to be taken in the international environmental regulatory policies setting events, particularly in the WTO’s SPS and TBT Committees. Regional coordination in the development of international environmental regulatory policies would serve their concerns and interests related to the international market for the olive oil agro-industrial sector (see, e.g., RIS, 2003:4).

2. Regional cooperation in compliance with the emerging international environmental regulatory policies related to the international olive oil market: In general, regional cooperation in the Arab region could be significantly effective. This is particularly with regard sharing costs of compliance with the emerging international environmental regulatory policies related to the olive oil market. In such a case, the regional cooperation could cover the joint development activities of olive oil products, which meet the new emerging international environmental regulatory policies, and thus it could help share the costs of compliance with them. Moreover, regional cooperation could cover the establishment of regional institutional infrastructure such as test laboratories where the costs are high, and even it could even assist in the translations processes of the emerging international environmental regulatory policies to the local languages. In addition, the geographical contiguity in the Arab region would facilitate the optimal utilization of such institutional infrastructure. Furthermore, the joint training programs and other measures would also be fruitful to build local capacity activities in the region for meeting compliance with the emerging international environmental regulatory policies related to the international market for the olive oil agro-industrial sector (see, e.g., RIS, 2003:4; UNCTAD, 2004:148).

3. Regional cooperation in the development of eco-labels regulatory policies related to the international olive oil market: Syria and many of the Arab countries have tried to
launch their own eco-labels regulatory policies related to the international market for the olive oil agro-industrial sector. However, most of these eco-labels regulatory policies have had limited success. Therefore, another area of regional cooperation in the Arab region could be in the promotion of regional eco-labels regulatory policies, which might be more acceptable and popular than national eco-labels regulatory policies related to the international market for the olive oil agro-industrial sector (see, e.g., RIS, 2003:4; UNCTAD, 2004:43).

4. Evolving regional environmental regulatory policies for products and commodities of the Syrian export interest such as those related to the international olive oil market: There may be another area for fruitful and effective regional cooperation in the Arab region. This is in effect through the development of specific regional environmental regulatory policies, especially for products and commodities for export and they need to be accepted globally. Similarly, it would be fruitful for Syria and other countries in the Arab region to identify environmentally sensitive products and commodities from a regional perspective such as those related to the olive oil agro-industrial sector (see, e.g., RIS, 2003:4).

C. Issues for Action at an International Level: At an international level, there are many issues that have to be addressed and pursued at the WTO and other international forums. This could be fruitful and effective to improve the international market for the olive oil agro-industrial sector in Syria. These issues are listed below.

1. The creation of a global environmental regulatory policies forum related to the international olive oil market: A coherent framework has to be created in the context of activating the international market for the olive oil agro-industrial sector. A coherent framework might be the most important needed in the international environmental policies area from a comprehensive development perspective. In addition, such a coherent framework would help support the national capacity building and improve the design of international environmental policies. Moreover, an action plan has to be created to bridge the international environmental policies and address the problems confronting Syrian olive oil producers and exporters in adopting and enforcing these policies. The creation of such an action plan requires strong support for infrastructure modernization and enhanced access for the Syrian government to participate in the setting and developing of activities for these policies. Until the present time, there is no coordinated and effective international framework which aims at meeting and addressing the basic needs and requirements of sustainable development. This is
particularly in the area of the adoption of international environmental policies related to the international market for the olive oil agro-industrial sector in Syria (see, e.g., Esty & Ivanova, 2004:15; Motaal, 2007:22).

Accordingly, an international effort is required to create a global environmental policies forum related to the international market for the olive oil agro-industrial sector. A targeted financial assistance plan is also required for modernizing the international environmental policies infrastructures and enhancing capacity building in the Syrian region. The Syrian government is therefore able to participate in international setting and developing of activities of these policies. To achieve this goal, innovative ways such as the use of global information technology networks should be explored; in addition, the promotion of regulatory reform should be focused. Thus, the creation of such global environmental regulatory policies forum has to be in the long-term economic interest of the Syrian government. Ultimately, a concerted effort to accelerate the creation of appropriate global environmental policies forum would help implementing the effective international environmental regulatory policies related to the international market for the olive oil agro-industrial sector in Syria (see, e.g., Esty & Ivanova, 2004:16; Motaal, 2007:23).

2. The development of an integrated assessment framework related to the international olive oil market: An integrated assessment framework has to be taken in order to achieve a comprehensive sustainable development. Therefore, there is an urgent need for joint efforts to develop an integrated assessment framework related to the international market for the olive oil agro-industrial sector. Such a framework could be developed through the adoption of a broad consultative process at the international level; however, it needs to be subjected to a wide review process by relevant international institutions and organizations. Ultimately, such a framework could be adopted to ensure that the environmental regulatory policies are developed and implemented to achieve a comprehensive sustainable development at national, regional and international levels (see, e.g., Asian Development Bank, 2002:7).

In general, an integrated assessment framework would help the development of environmental regulatory polices related to the international market for the olive oil agro-industrial sector. An integrated assessment framework will be achieved through taken up the following steps. It has to ensure that the environmental regulatory policies are analyzed at all stages of the implementation of comprehensive sustainable development polices related to the international
market for the olive oil agro-industrial sector. It also has to analyze the implications of the implementation of future comprehensive sustainable development policies. This analysis must be done in accordance with all countries’ sustainable development objectives. In addition, it has to promote public dialogue and participation in all of the implementation processes from different groups and nations alike. Finally, it has to enhance the development of technical assistance and capacity building activities in the implementation of comprehensive sustainable development policies. Altogether, these steps would improve the development of an integrated assessment framework related to the international market for the olive oil agro-industrial sector in Syria (see, e.g., Corzine & Jackson, 2006:12).

3. Enhancing international coordination related to the international olive oil market:
There is no doubt that enhancing international coordination would contribute to eliminating trade and environmental problems related to the international market for the olive oil agro-industrial sector. In addition, enhancing international coordination would contribute to strengthening the international market for the olive oil agro-industrial sector in the international forums. Moreover, it is widely recognized that international coordination constitutes the best approach for resolving global trade and environmental concerns. International coordination provides a safeguard with multilateral attempts to address trade and environmental problems. Thus, it is clear that enhancing international coordination would help in finding cooperative solutions to global trade and environmental problems related to the international market for the olive oil agro-industrial sector. These cooperative solutions would help in reducing the growing problems related to the international market for the olive oil agro-industrial sector. Furthermore, they would help in reflecting the importance of the international community’s shared responsibilities and concerns in this area. Ultimately, all this would help in enhancing the international market for the olive oil agro-industrial sector in Syria (see, e.g., UNCTAD, 2006a:54).

4. Promote the WTO-EU and MEAs compatibility related to the international olive oil market: At an international level, several effective practical actions can be taken in order to increase the mutual support between the MEAs and the WTO-EU agreements related to the international market for the olive oil sector. Firstly, the environmental impact of trade liberalization has to be estimated for the olive oil market within the MEAs and the WTO-EU agreements. Second, the transfer and adoption of environmentally sound technologies have to be encouraged in the olive oil sector within the MEAs and the WTO-EU agreements. Third,
the technical assistance and capacity building initiatives have to be strengthened in this sector within the MEAs and the WTO-EU agreements. Fourth, the communication and cooperation activities have to be strengthened between the environmental compliance and enforcement officials in this sector within the formal MEAs, WTO and EU committees. Fifth, the environmental and developmental aspects of the MEAs-WTO negotiations have to be identified within this sector. Finally, the relationship between existing, new and future MEAs, WTO and EU regulatory policies related to the olive oil market has to be clarified in order to promote the international market for the olive oil agro-industrial sector (see, e.g., UNCTAD, 2006a:14; UNEP, 2006:210, 641).

5. Providing effective international technical assistance related to the international olive oil market: Both the WTO’s SPS Agreement and the WTO’s TBT Agreement contain some specific technical assistance provisions related to the olive oil market. These provisions emphasize the need for providing technical assistance by the importing countries to assist the exporting countries in meeting their compliance with environmental policies imposed by the importing countries. In this context, the SPS Agreement under Article (9) includes the provision of more effective and efficient technical assistance to other members, especially developing economies members (RIS, 2003:3; WTO, 2005:110). They are therefore able to comply with the SPS rules and measures that are necessary to achieve the appropriate level of the SPS protection in their international export markets. In addition, the SPS Agreement under Article (9.2) states that the importing countries should consider providing effective technical assistance as well as allowing developing economies members to maintain and expand their market access opportunities for the products of their export interest (WTO, 2005:134).

Similarly, the TBT Agreement under Article (11) provides for advice and technical assistance, if requested, on mutual agreed terms and conditions (RIS, 2003:3; WTO, 2005:132). Thus, it may be useful for the Syrian government to seek within the WTO’s SPS and TBT Agreements effective technical assistance related to the international market for the olive oil agro-industrial sector.

6. Reviews of the WTO’s SPS and TBT Agreements related to the international olive oil market: The Syrian government may consider seeking reviews of the SPS and TBT agreements. These reviews would be through the WTO working committee on SPS measures
and the WTO working committee on TBT rules. In addition, these reviews would lead to a reduction in the misuse of the discretion and flexibility available under these agreements. The purpose of these reviews is to achieve the effective comprehensive application of international environmental policies on the one hand. On the other hand, the purpose is to bring about greater transparency in the imposition of new environmental policies related to the international market for the olive oil agro-industrial sector (see, e.g., RIS, 2003:3).

7. Special and Differential Treatment for developing countries related to the international olive oil market: Like other WTO Agreements, the special and differential treatment in the case of SPS and TBT Agreements has also been increased to a longer transition period for developing economies members. However, the longer transition period provided under these Agreements is of hardly any use because the importing countries enterprises start insisting on the product-related environmental regulatory policies due to high consumer awareness for these environmental policies. Therefore, the issue of special and differential treatment for the Syrian government has to be of a more substantive type. For instance, it could be in the form of additional financing along with effective technical assistance to cover the costs of compliance with the environmental regulatory policies related to the international market for the olive oil agro-industrial sector (see, e.g., RIS, 2003:3; UN-ESCWA, 2005:67; WTO, 2005:134).

8. Promoting ESTs related to the international olive oil market: The adoption of ESTs is seen to be one of the key factors for achieving the overall economic and social development in the Syrian region. The transfer of ESTs is also a major focus in the framework of the worldwide efforts to enhance the protection of environmental quality and to raise the level of sustainable development in the region. In addition, ESTs have recently emerged and grown as a distinct category of advanced technologies. Moreover, the need for innovation, transfer and dissemination of them has been emphasized in the WTO-EU agreements. Therefore, promoting ESTs related to the international olive oil market has to be confirmed with a view to reinforce the international market for the olive oil agro-industrial sector in Syria (see, e.g., Less & McMillan, 2005:24).

9. Providing international assistance for effective participation of the Syrian government in the setting and developing processes of international environmental regulatory policies related to the international olive oil market: In general, the setting processes of
international environmental regulatory policies have been developed and evolved without much effective participation of the Syrian government. International assistance should therefore be provided for effective participation of the Syrian government in the setting and developing processes of international environmental regulatory policies related to the international market for the olive oil agro-industrial sector (see, e.g., RIS, 2003:4).

10. Evolving trilateral cooperation programs for providing the appropriate technical experiences and skills related to the international olive oil market: In many cases, the appropriate technical experiences and skills are not very often available in developed countries. However, such technical experiences and skills are more likely to be available in other Arab countries. Therefore, trilateral cooperation programs could be evolved to make technical experiences and skills effective. These programs involve resources from a developed (donor) country combined with skills of an Arab country to assist another Arab country such as Syria in providing the appropriate technical experiences and skills related to the international market for the olive oil agro-industrial sector (see, e.g., RIS, 2003:4).

Ultimately, the analysis shows that the international market for the olive oil agro-industrial sector in Syria is still characterized by a lack of greater clarity and transparency. This is mainly due to preferring strategic and economic interests to environmental ones. In addition, this is due to a lack of willingness to relinquish some gains for the welfare and benefit of all mankind. Accordingly, an inventory of policy lessons that cover some issues for action and cooperation at national, regional and international levels has been put forward. These issues are more likely to be fruitful in improving the international market for the olive oil agro-industrial sector in Syria. They are also more likely to be fruitful in preparing the Syrian olive oil producers and exporters to face emerging trade-environment challenges and problems related to the international olive oil market more effectively. These issues, however, need to be actively addressed at the WTO-EU level. They would therefore help mitigating the negative impacts of compliance with the new environmental regulatory policies related to the international olive oil market on trade competitiveness for the olive oil agro-industrial sector in Syria.
8. Summary and Conclusion

8.1. Policy Implications and Recommendations for Syria

“In this study it has been demonstrated that the solution to the environmental problems going along with the production of olive oil is essential for the future of the olive oil agro-industrial sector in Syria. Accordingly, this study raised a number of questions and concerns regarding the impacts of compliance with environmental policies on international trade competitiveness, i.e., on the production and exports levels for the olive oil agro-industrial sector in Syria” (Kuhn et al., 2010a, 2010b, 2011a:16, 2012a:15, 2012b:14).

“The main research questions include issues such as if the environmental policies being used as tools for discrimination are against the access of the Syrian olive oil products into the international markets, or if the implementation of compliance with environmental policies in Syria will lead to an increase in production costs and a reduction in export competitiveness from pollution intensive agro-industrial sectors, particularly for the olive oil agro-industrial sector where Syria has significant competitive advantages in olive oil products. Other questions revolve about how much will production and exports levels of the olive oil agro-industrial sector changes if compliance with environmental policies is adopted and enforced? Does the adoption and enforcement of compliance with environmental policies create new incentives and opportunities for the olive oil agro-industrial sector to reduce environmental compliance costs, i.e., would compliance with environmental policies lead to stronger incentives for the olive oil agro-industrial sector with a view to become more efficient in the production processes, and/or would the olive oil agro-industrial sector be able to convert some of the additional production costs of environmental compliance to the domestic and international consumers in the form of higher output market prices?” (see Kuhn et al., 2010a, 2010b, 2011a:15).

The questions and concerns mentioned above have been addressed qualitatively and quantitatively for the olive oil agro-industrial sector in Syria. “We addressed these issues by implementing a partial-equilibrium trade model and by estimating empirically the impacts of compliance with environmental policies under the assumptions of efficiency improvements and output price adjustments” (Kuhn et al., 2012a:15, 2012b:14).

1This section has been taken identically from Kuhn et al. (2010a, 2010b, 2011a, 2011b, 2012a, 2012b).
In particular, we put too much emphasis on the assumptions of a shift towards more environmentally friendly technologies as well as a potential shift of compliance cost onto the consumers in export markets. “The unique novelty in this model is the extended impact of the compliance cost’s increase on the input’s shadow price, and which finally drives the main results of the present study” (Kuhn et al., 2012b:14).

In this context, “the study discussed the status and provided the economic indicators by reviewing the international market for the olive oil agro-industrial sector. The study presented the environmental baseline by reviewing the domestic and international environmental regulatory policies affecting the olive oil agro-industrial sector in Syria. In addition, it explained the environmental problem and provided the potential environmental regulatory policies scenarios used in the analysis, and it introduced the partial equilibrium framework as a methodology used in the empirical part to examine the impacts of environmental policies on the Syrian olive oil production and exports levels. Finally, the study presented the empirical application and analyzed the exploratory results by providing the econometric regression and environmental policy estimations. This is mainly in order to estimate empirically the impacts of compliance with environmental policies on the production and exports levels of Syrian olive oil products” (see, e.g., Kuhn et al., 2010a, 2010b, 2011a:15).

The findings are not conclusive and differ from one policy to another. On the one hand, for the “input-specific” environmental policies, the study confirms the legitimacy of the concerns that compliance with environmental policies in Syria has some negative impacts on its production and exports levels. However, the empirical results provide a strong support to the Porter hypothesis and the use of environmental policy in the international export markets, especially when there is the possibility for the introduction of efficiency improvements in the production processes and output market price adjustments in both domestic and export markets. For example, the exploratory analysis finds that compliance with environmental policies would lead to a decrease in the production and exports levels of Syrian olive oil products in the range of between 0.23-0.47% and 0.58-1.18% respectively in the basic model case. However, with efficiency improvements and output market price adjustments, the decrease in the production and exports levels would fall to the range of between 0.09-0.31% and 0.17-0.59% respectively. In other words, a decrease in the production and exports levels of Syrian olive oil products, i.e., in the international trade competitiveness, will be much less significant if efficiency improvements and output price adjustments are induced by
compliance with environmental policies. In fact, the empirical results suggest that, under the assumptions of efficiency improvements and output price adjustments, compliance with the policy of Integrated Pest Management can lead to small negative effects on the production and exports levels of Syrian olive oil products.

On the other hand, “for the “end-of-the-pipe” environmental policies, the empirical results provide a strong support to the Porter hypothesis and the use of environmental policy in the international markets. In other words, achieving compliance with environmental policies would stimulate innovation and the use of environmentally sound technologies, which in fact lead to a reduction in the effective environmental compliance costs and an increase in the international trade competitiveness at both domestic and international levels. Moreover, the study disproves the legitimacy of the concerns that stricter environmental policies in Syria have negative impacts on its production and exports levels. For instance, the exploratory analysis finds that compliance with environmental policies would lead to a decrease in the production and exports levels of Syrian olive oil products in the range of between 0.82-1.63% and 2.04-4.08% respectively in the basic model case. With efficiency improvements and output market price adjustments, an increase in the production and exports levels would be in the range of between 0.98-1.80% and 10.58-12.62% respectively. Therefore, the exploratory analysis reaches the conclusion that regardless of the assumption on the size of compliance costs, an increase in the production and exports levels of Syrian olive oil products will be much more significant if efficiency improvements and output market price adjustments are induced by compliance with environmental policies. In other words, the increase in the international trade competitiveness will be much more significant by compliance with environmental policies. In fact, the empirical results suggest that, under the assumptions of efficiency improvements and output market price adjustments, compliance with the policy of Integrated Waste Management leads to positive effects on the production and exports levels of Syrian olive oil products” (see, e.g., Kuhn et al., 2010a, 2010b, 2011a:15-16, 2012a:15).

Furthermore, it has emerged that both domestic and international environmental policies appear to pose some more difficult questions with regard to trade competitiveness in Syria, something which stresses the need for more serious research by the Syrian government to find out how to determine the most efficient methods for meeting compliance with the domestic environmental regulatory policies, and this is mainly in order to be consistent with the
presented and anticipated environmental regulatory policies in the international markets. This issue will be explained in more detail as part in the remainder of this study.

While there is an increasing importance of the adoption and enforcement of environmental regulatory policies and the tendency to harmonize these policies worldwide, the olive oil agro-industrial sector in Syria needs to become more market-oriented and emerge as a profit maximizing sector in order to accumulate profits in the long term. This sector also needs to forecast the impact of the constantly changing global economic circumstances and conditions. These circumstances and conditions will be imposed as a result of compliance with international environmental policies, especially those allowed under the WTO, the EU and the International Trade and Environmental Agreements. Enforcing compliance with these policies could significantly have some negative impact on the production and exports levels of Syrian olive oil products, i.e., on the international trade competitiveness levels of the olive oil agro-industrial sector in Syria.

Thus, given that the olive oil products have become one of the largest Syrian exports to the EU countries and other countries in the world, increased awareness of environmental policies in export markets paves the way for the Syrian olive oil producers to make the necessary adjustments to the production processes, and it enhances the ability of the Syrian decision-makers to begin the process of introducing effective environmental policies in the framework of a social market economy. The protection of the local environment and the promotion of exports are essential for the Syrian government in the long term in order to achieve sustainable development. This is particularly in the light of accession to the WTO-EU agreements and other trade and environmental agreements at both regional and international levels.

In this context, the main concern of the Syrian olive oil producers and exporters is the expected adverse impact as a result of the enforcement of compliance with new environmental policies. This will be particularly with regard to the adverse impact on the production costs and the international trade competitiveness at both domestic and international levels. This concern is often due to a lack of experience and application of advanced technology in the olive oil production processes, which could turn compliance into an expensive process of the experiments and errors. However, it should be clear to those producers and exporters, and despite the fact that compliance with environmental policies may involve additional
production costs, it could also lead to a rise in output prices and the expansion of export markets for olive oil products. These benefits would be achieved due to the introduction of efficiency gains and productivity improvements in the production processes as well as output price adjustments in both domestic and export markets. In other words, this can be secured from accessing to new advanced technologies and entering into niche markets for environmentally friendly products.

Meanwhile, compliance with international environmental regulatory policies can support fundamental changes regarding the capabilities of the Syrian olive oil producers and exporters to increase their export competitiveness and access to new foreign export markets. Moreover, improving environmental quality and performance in Syria can help reduce the additional associated costs, which result from addressing the environmental damage and degradation related to the olive oil agro-industrial sector in the Syrian region. These costs, however, are the responsibility of the society, and would otherwise be paid for by society as a whole (see, e.g., UN-ESCWA, 2005:66).

The questions that arise here are; “what are the relevant policy implications? ‘Does this mean that more stringent environmental policies are good or bad for the olive oil agro-industrial sector’s international trade competitiveness in Syria?’ It is very important to note that achieving compliance with environmental policies has both negative and positive impacts on the international trade competitiveness for the olive oil agro-industrial sector in Syria. While this study’s contribution is to estimate the total impact of compliance with environmental policies on the international trade competitiveness for the olive oil agro-industrial sector in Syria, and it is also to make relevant policy implication suggestions, all aspects of the environment and international trade competitiveness have to be taken into consideration for the olive oil agro-industrial sector in Syria” (Kuhn et al., 2010a, 2010b, 2011a:16).

“For the olive oil agro-industrial sector in Syria, the relevant policy questions are then: How to upgrade the Syrian olive oil agro-industrial sector’s structure? How to seize the environmental opportunities to innovate to get the ‘first move advantage’ and ‘innovation offset’? How to minimize the costs of compliance with new environmental policies at both domestic and international levels? How to improve the international trade competitiveness for the olive oil agro-industrial sector in Syria? To answer these questions, the following policy implications and recommendations are presented and offered for the olive oil agro-industrial
sector in Syria, as well as for other Arab countries in the Mediterranean region” (Kuhn et al., 2010a, 2010b, 2011a:16, 2012a:14).

First of all, achieving compliance with the local environmental policies is the first step towards accepting the importance of adopting international environmental policies to enhance trade competitiveness for the olive oil agro-industrial sector in Syria. Thus, compliance and enforcement of environmental policies should be strengthened with a view to increase net exports and to improve health and safety for the entire population. Enforcement should also be combined with awareness campaigns to provide Syrian olive oil producers and exporters with information and tools that are necessary to assist them in achieving compliance with the international environmental regulatory policies related to the olive oil market, especially those allowed under the WTO-EU Agreements.

Secondly, “an efficient and effective communication and/or consultation mechanism has to be established between all the Syrian olive oil stakeholders, policy-setters and decision makers involved in this field. The objective of this multilateral forum is to examine and address the impacts of compliance with environmental regulatory policies on international trade competitiveness for the olive oil agro-industrial sector in Syria. Such a multilateral forum might also be established to address these impacts and facilitate interaction amongst different key stakeholders, policy-setters and decision-makers in the Syrian olive oil agro-industrial sector” (see, e.g., Kuhn et al., 2010a, 2010b, 2011a:16).

Thirdly, “a financial support has to be provided to R & D institutions for research in the environmentally sound technologies that are necessary for the olive oil agro-industrial sector in Syria. The objective of this financial support is to enhance the efficiency and effectiveness of the production processes in the olive oil agro-industrial sector in Syria. On the other hand, the objective of such financial support is to enhance the efficiency and effectiveness of the production extraction processes in the olive oil mills and pressing industries in Syria” (see, e.g., Kuhn et al., 2010a, 2010b, 2011a:16, 2012a:14).

Fourthly, “incentives have to be offered to the Syrian olive oil agro-industrial sector, particularly the olive oil mills and pressing industries for investments in cleaner technologies that increase efficiency at various stages of production processes. This would also reduce both
“input-specific” and “end-of-the-pipe” compliance costs before the environmental damage occurs” (see, e.g., Kuhn et al., 2010a, 2010b, 2011a:16, 2012a:14).

Fifthly, “the Syrian olive oil producers and exporters have to be encouraged to adopt international environmental regulatory policies in labeling and packaging policies related to the international olive oil market. They have to be encouraged by increasing their awareness and understanding of international environmental management certifications systems such as the ISO 9000 for quality management systems, the ISO 14000 for environmental management systems, and the Hazard Analysis and Critical Control Points (HACCP) systems. This awareness process would increase the international trade competitiveness of their olive oil production and exports levels. At the same time, it would help them to achieve compliance with both local and international environmental regulatory policies related to the international olive oil market” (see, e.g., Kuhn et al., 2010a, 2010b, 2011a:16).

“The above results based on the theoretical model suggest that a wide range of policy implications and recommendations have and need to be considered by the Syrian government, as well as by other Arab countries in the Mediterranean region” (Kuhn et al., 2012a:14). The government is actively encouraged to assist the olive oil agro-industrial sector all the way through the adoption and implementation of the worldwide environmental regulatory policies related to the international olive oil market. It should encourage the olive oil agro-industrial sector to take into account the environmental aspect in the production processes and the commitment to environmental protection laws, which increases its competitiveness in the global trade regime. It also should motivate producers to comply with existing local environmental regulatory policies. This will be achieved through improved monitoring and reporting on compliance with environmental policies in the olive oil agro-industrial sector.

“The Syrian government needs to activate the domestic environmental regulatory policies that govern the work of the olive oil mills and pressing industries. It should implement controls on product quality as well as the application of international standard specifications for olive oil products. It is also important to establish a public communication network with regard to the information and issues on the international environmental regulatory policies related to the international olive oil market. This process would support the olive oil producers and exporters to know what environmental regulatory policies are and how to comply with them
at both local and international levels” (see, e.g., Kuhn et al., 2010a, 2010b, 2011a:16, 2012a:14).

“The Syrian government should provide technical support and advanced training systems on new environmental regulatory policies as well as method of implementing them and to ways of complying with them” (see, e.g., Kuhn et al., 2010a, 2010b, 2011a:16, 2012a:14). It is necessary to simplify the process of adopting and enforcing environmental regulatory policies by upgrading the level of standardization bodies to conduct testing and to issue environmental certifications. It also should arrange long-term credit facilities to assist the olive oil producers and exporters in achieving compliance with and enforcement of both domestic and international environmental regulatory policies related to the international olive oil market.

The Syrian government needs to transfer and adapt the olive oil processing technologies applied in countries which are considered as pioneers in the olive oil production such as Italy and Spain. It should take advantage of the WTO agreements and the Syrian-EU Association Agreement through the inclusion of olive oil products into the main export goods to the EU countries which consume about 75% of global consumption of olive oil products. It also should include the olive oil product within the international trade agreements, which would grant this product a preferential advantage in the markets of the countries that signed such agreements, and thus, this would help improving the competitive position of the Syrian olive oil agro-industrial sector.

Furthermore, the Syrian government should provide database marketing to the olive oil exporters including preferences of consumers in foreign markets in terms of size, type, color, taste, prices, export seasons and other important information related to these issues. It should encourage universities and specialized research institutes to carry out studies on foreign export markets. It also should apply the international quality policies on olive oil exports (taste, color, a measure of the acidity (pH), and the proportion of peroxide) which are issued by the International Olive Oil Council. This set of recommendations would help the olive oil producers and exporters to know what environmental policies related to the international olive oil market are and how to comply with them.

The Syrian government needs to address the environmental regulatory policies issues related to the olive oil market, something which can be achieved through paying close attention and
being actively involved in the international negotiations on the development of international environmental regulatory policies, particularly with other developing and developed countries’ governments. This is necessary to avoid the use of such policies as barriers to achieve the international trade competitiveness for the olive oil agro-industrial sector in particular by developed countries. This is also necessary to ensure that the Syrian region does not become a haven for pollution-intensive agro-industrial sectors.

The first step to achieve this objective is to promote communication, consultation and coordination between all the types of government agencies responsible for trade and the environment issues related to the international olive oil market. This will be achieved through pursuing cooperation and coordination strategy involving all key stakeholders, exporters, importers, policy-setters and policy-makers from the Syrian region involved in this field. This would enable the Syrian government to identify a coherent policy related to the international olive oil market that is viable in both areas of trade and the environment.

Hence, it is important to note that achieving compliance with international environmental regulatory policies in foreign export markets, especially those that are wastewater effluents or “end-of-the-pipe” regulatory policies based would have positive impacts on the Syrian olive oil production and exports levels. Thus, the basic recommendation is to enforce compliance with environmental regulatory policies within Syria, there is usually a way to do so at both local and international levels.

“Overall, 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 other International Trade and Environmental Agreements. The importance of this study lies in the fact that it is the “first” in the field of the olive oil agro-industrial sector in the Arab developing economies in the Mediterranean region. It also highlights areas where the introduction of compliance-induced efficiency improvements in the production processes and output market price adjustments in both domestic and international export markets can be made intuitively and self-evidently. This aims at rendering the Syrian olive oil agro-industrial sector less susceptible to the concerns of compliance with environmental regulatory policies. These concerns are the possibility of lowering the costs of compliance with these policies and controlling production to operate at capacity. This process would be achieved in the Syrian olive oil agro-industrial sector through
accessing to new environmentally sound technologies and entering into niche markets with consumers who prefer environmentally friendly products” (Kuhn et al., 2010a, 2010b, 2011a:16-17).

“Achieving compliance with stringent environmental policies related to the international olive oil market would be good for the improvement of the international trade competitiveness at all levels, the environmental quality and the economic performance in the Syrian region. For the olive oil agro-industrial sector in Syria, benefits brought by achieving compliance with environmental policies will very often offset and even exceed the costs initially imposed by achieving compliance with environmental policies related to the international olive oil market. Clearly, the nature of the environmental policies related to the international olive oil market here is critical. Those policies should not only be designed to trigger the olive oil agro-industrial sector to overhaul its production processes, but also they should be designed to offer the olive oil agro-industrial sector sufficient latitude regarding how to achieve the environmental compliance targets. These are questions that the entire olive oil agro-industrial sector’s stakeholders, policy-setters and decision-makers should be concerned about in the Syrian region” (see, e.g., Birdcall & Wheeler, 2001; Copeland & Taylor, 2004; The Network of Heads of European Environment Protection Agencies, 2005; Qing & Honglei, 2009:304; Kuhn et al., 2010a, 2010b, 2011a:17). Ultimately, the publication of this study aims to create greater awareness of the trade-environment issues related to the international olive oil market in Syria, and to be provided as an example for other studies covering other economic sectors in other Arab and developing economies in the Mediterranean region. Finally, it is important to point out the saying that: “The life you save may be your own, or more importantly, mine”.

8.2. Concluding Remarks

The adoption and enforcement of the WTO-EU environmental policies for the international olive oil market are still in their early infancy in the Syrian region. Researches and studies are still in an early exploratory stage and have not yet developed a coherent framework for estimating the impact of the adoption and enforcement of the WTO-EU environmental policies for the olive oil market on the Syrian economy. In view of this, the study has been mainly aimed at suggesting a comprehensive conceptual framework for the adoption and implementation of the WTO-EU environmental policies for the olive oil market in the Syrian region. In particular, the study attempts to contribute to filling the gap in the trade-environment literature related to the international market for the olive oil agro-industrial
sector on the one hand. On the other hand, the study attempts to give complete coverage in the vital theme of the WTO-EU environmental policies for the international olive oil market and their impact on trade competitiveness for the olive oil agro-industrial sector in Syria.

More specifically, the study aimed at assisting the Syrian government in addressing the environment and trade competitiveness links between the related to the olive oil market. The study also aimed at contributing to increase the awareness and knowledge in the Syrian region on issues dealing with the relationship between environmental policies and trade competitiveness policies related to the olive oil market. Furthermore, the study aimed at promoting the dialogue on the WTO-EU environmental policies between policy-setters and policy-makers from the Syrian region, something which can be achieved by effectively studying the main environment and trade competitiveness issues related to the olive oil market from a comprehensive development perspective.

In order to achieve these objectives, the study began to fill this gap in the trade-environment analysis related to the international market for the olive oil agro-industrial sector in Syria. The study therefore suggested a comprehensive conceptual framework of the WTO-EU environmental policies for the worldwide olive oil market and their impact on trade competitiveness for the olive oil agro-industrial sector in Syria. This framework is supported by a set of pillars. The proposed pillars of this framework were organized as follows: The first pillar was introducing the environmental background and problem related to the olive oil agro-industrial sector in Syria (Institutional Setting and Background). The second pillar was estimating the impact of compliance with the WTO-EU environmental policies on trade competitiveness for the olive oil agro-industrial sector (Theoretical Model and Empirical Analysis for Syria). The third pillar was implementing the WTO-EU environmental policies related to the international olive oil market: Where do the international trade competitiveness opportunities for Syria located? (Environmental Policy Recommendations).

In particular, “this study analyses the main features of the environmental economics of the olive oil agro-industrial sector in Syria, and identifies its constraints and potentials in relation to the domestic and international markets. Now, more than ever, the marketing issues are becoming increasingly important since the Syrian olive oil production has exceeded the olive oil domestic consumption (see, e.g., Malevolti, 1999:3). In the near future, the gap between the olive oil production on the one hand and the olive oil consumption and exports on the
other hand could again grow because of the adoption and enforcement of environmental policies in international markets. As a result, this study analyses the main issues in relation to these aspects and problems focusing on the development of international olive oil production, consumption and exports (see, e.g., Malevolti, 1999:3). Moreover, this study highlights the domestic and international environmental policies that affect the olive oil agro-industrial sector pointing out the international trade competitiveness issues for Syria” (Kuhn et al., 2011a:3).

In addition, given that the study includes important details of the olive oil agro-industrial sector in Syria, it explains its crucial purpose of the relationship between the environmental policies impacts and the sector’s international trade competitiveness. It is intended that “this study contributes to the current debate on the trade-environment issues related to the international olive oil market in three ways (see, e.g., Larson et al., 2002). Firstly, this study provides additional information on a wide range of actual trade-environment issues that the Syrian olive oil sector is facing. It shows that the trade-environment issues are ever-presents and ubiquitous, but often depend on reasonably specific and often technical trade-environment issues related to a particular agro-industrial sector of the economy. Secondly, this study points out how policy analysts in Syria can use a comparatively easy methodology to start analyzing these impacts quantitatively and in a timely manner to inform the trade-environment policy debates. Thirdly, considering the main results of this study as a whole can help to understand how the magnitude of the environmental policies impacts on trade competitiveness depends on the details of the case study” (Kuhn et al., 2012a:15).

The study concluded that compliance with the WTO-EU environmental regulatory policies has a clear positive impact on the international trade competitiveness for Syrian olive oil production and exports levels. However, such a positive impact would be achieved in the case of “end-of-the-pipe” regulatory policies. In other words, a positive impact would be achieved through the incorporation of compliance-induced efficiency gains in productivity at the sector level and price premiums for products in both local and export markets. These benefits and advantages can be secured through accessing new environmentally sound technologies and entering into niche markets with consumers who prefer environmentally friendly products.

However, the pursuit of sustainable development in the case of the Syrian olive oil sector requires balancing the objectives of the environment and trade competitiveness policies
related to the international olive oil market. Achieving a balance between these often conflicting priorities or policy objectives is difficult enough at both national and international levels. In other words, the environment and trade competitiveness questions are frequently controversial and complex for the Syrian olive oil market. Interrelationships between the environment and trade competitiveness policies make every one of them affect the other, and the attention paid to only one area would adversely affect the other area. It becomes vital to establish some balance between the environment and trade competitiveness policies. The attention should not thus be paid to trade competitiveness priorities without taking environmental considerations into account. When considering environmental factors, close attention is required and needs to be directed towards trade competitiveness priorities.

In general, it is believed that WTO-EU environmental regulatory policies do not conflict with the international environmental regulatory policies related to the international market for the olive oil agro-industrial sector in Syria. The WTO and EU will develop and take only some important controls to ensure that these policies will not be used as a method of trade protectionism that are non-related primarily to the environment.

Moreover, the participation of the Syrian government has to be improved in the development process of the new environmental regulatory policies related to the international market for the olive oil agro-industrial sector. This participation is a matter of extreme importance. This importance has been recognized and taken into account for several decades. Several initiatives have also been adopted and undertaken in this area, where they have aimed at improving and promoting the situation of the Syrian government participation in order to become more effectively. However, these initiatives have not achieved a significant improvement so far. In addition, the progress may be slow as the main difficulty facing the Syrian government seems to be the lack of expertise needed for participation in the work on the formulation of the new environmental regulatory policies related to the international market for the olive oil agro-industrial sector at a technical or technological level.

From the study, it is clear to us that the Syrian government should take a key role in the area of achieving compliance with the WTO-EU environmental policies related to the international market for the olive oil agro-industrial sector at the international level. This role starts from placing the environmental policies governing the olive oil market into force at home, which should be done according to its appropriate environmental grounds. The government is
therefore able to help olive oil producers and exporters achieve adaptability with the new situation, which takes from the environment as its main hub. In addition, the issue of environmental regulatory policies related the olive oil market should be directly raised at the WTO-EU level. Thus, the actions that are taken because of environmental regulatory policies are clear and direct having been agreed upon among the entire WTO-EU member countries.

Furthermore, the international actors’ efforts should be intensified in the area of the WTO-EU environmental policies related to the international market for the olive oil agro-industrial sector. In addition, the efforts of the UN General Assembly, Donors, the World Bank and the UNCTAD’s Consultative Task Force on environmental requirements and market access for developing countries should be along with the WTO-EU’s efforts to reconcile between the international trade agreements and the international environmental agreements. Thus, the logic of the environment is clearly put forward with the logic of trade on equal and integrated basis locally, regionally and internationally. In this context, within the framework of the international trade and environment negotiations, it is necessary to take into account some important questions in this regard. For instance, how effectively the olive oil agro-industrial sector in Syria is able to adapt to the new WTO-EU environmental policies related to the olive oil market.

Accordingly, an inventory of recommendations covering some issues for achieving the adoption and enforcement of the WTO-EU environmental policies related to the olive oil market in Syria has been put forward. These recommendations are more likely to be fruitful in improving the international market for the olive oil agro-industrial sector in Syria. In addition, they are more likely to be fruitful in preparing the Syrian olive oil exporters to effectively face the emerging trade-environment challenges and problems related to the olive oil market. Furthermore, these recommendations aim to enhance trade competitiveness for the olive oil agro-industrial sector in Syria. Making further progress in this domain is needed to:

- Increase public awareness of the importance of implementing the environmental policies and eco-labeling systems related to the olive oil agro-industrial sector in Syria.
- Assist the olive oil agro-industrial sector in Syria to adopt and enforce the appropriate environmental policies that are compatible with the international environmental policies on the one hand and are commensurate with its economic and social development conditions on the other hand.
• Encourage the Syrian government to assist the olive oil agro-industrial sector in terms of accessing and obtaining the new emerging information and technologies related to the international olive oil market.

• Enhance the olive oil agro-industrial sector in Syria to become more responsive to a changing global marketplace that places an equal emphasis on the environmentally friendly production processes as well as on the consumer’s preferences for environmentally friendly products.

• Encourage the olive oil producers and exporters in Syria to strive to the maximum extent possible to ensure that environmental policies related to the national and international market for olive oil are adopted for the purpose of protecting the global environment, rather than simply for the purpose of protecting the domestic environment.

• Review the domestic environmental policies related to the olive oil market pursued in Syria, as well as working on passing and adopting new environmental policies that fit the requirements of the new global trading system on the one hand, and contribute to maintaining a clean healthy environment on the other hand.

To sum up, the trade-environment literature lacks a comprehensive conceptual framework that gives complete coverage to the vital theme of the WTO-EU environmental policies for the international olive oil market and their impact on trade competitiveness for the olive oil agro-industrial sector in Syria. The Syrian government is therefore able to meet different operational challenges and opportunities that the olive oil agro-industrial sector encounters from time to time and at different stages of its development process. The suggested framework for estimating the impact of compliance with the WTO-EU environmental policies on the olive oil market in Syria may contribute to achieving this goal.

However, further research is needed to enhance this suggested framework in Syria. Future research should explore the organizational issues of the olive oil market in Syria. In addition, the suggested framework for the olive oil market in Syria can be operationalized, and thus used in other empirical and theoretical research. This requires future studies that provide empirical and theoretical evidence for the suggested framework for the olive oil market in Syria. Finally, continuous research efforts will contribute to further studies that develop a coherent framework of the WTO-EU environmental policies for the international olive oil market and their impact on trade competitiveness for the olive oil agro-industrial sector in Syria.
## Appendices

### Appendix 1: The Basic Data Base for the Syrian Olive Oil Agro-Industrial Sector

#### Table 1.1: The Basic Data of the World Olive Oil Production and Exports

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<td>18.0</td>
<td>21.5</td>
<td>5.0</td>
<td>20.0</td>
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<td>414.0</td>
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<td>611.5</td>
<td>485.5</td>
<td>503.1</td>
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<td><strong>European Union</strong></td>
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<td>1707.0</td>
<td>1878.5</td>
<td>1940.5</td>
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<tr>
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<td>114.0</td>
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<td>2565.5</td>
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<td>1.7</td>
<td>2.2</td>
<td>4.7</td>
<td>30.4</td>
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<td>44.6</td>
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<td>5.0</td>
<td>2.0</td>
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<td></td>
</tr>
<tr>
<td><strong>Lebanon</strong></td>
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<td>0.0</td>
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<td>1.5</td>
<td>1.5</td>
<td>1.0</td>
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<td><strong>Morocco</strong></td>
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<td>10.0</td>
<td>10.0</td>
<td>9.0</td>
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</tr>
<tr>
<td><strong>Palestine</strong></td>
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<td>119.0</td>
<td>109.0</td>
<td>29.0</td>
<td>80.0</td>
<td>270.0</td>
<td>182.0</td>
<td>198.0</td>
<td>219.0</td>
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<tr>
<td><strong>Arab Countries</strong></td>
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<td>291.0</td>
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<td>313.5</td>
<td>324.5</td>
<td>330.5</td>
<td>341.5</td>
<td>371.5</td>
</tr>
<tr>
<td><strong>European Union</strong></td>
<td>47.0</td>
<td>108.5</td>
<td>27.0</td>
<td>102.0</td>
<td>41.0</td>
<td>90.0</td>
<td>63.0</td>
<td>121.0</td>
<td>78.5</td>
<td>90.5</td>
</tr>
<tr>
<td><strong>Other Countries</strong></td>
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<td>444.5</td>
<td>502.0</td>
<td>394.5</td>
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<td>675.5</td>
<td>633.5</td>
<td>618.0</td>
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<tr>
<td><strong>Total</strong></td>
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<td>4.1</td>
<td>0.4</td>
<td>0.01</td>
<td>0.04</td>
<td>0.04</td>
<td>0.07</td>
<td>0.03</td>
<td>0.14</td>
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</table>

Figure 1.1: Mass Balances in Relation to the Olive Oil Extraction Method

Source: Vlyssides et al, 2004:605
Figure 1.2: An Integrated Pollution Prevention Method for Olive Oil Processing

Source: Vlyssides et al, 2004:607
Appendix 2: The EU Environmental Regulatory Policies Related to the Olive Oil Agro-Industrial Sector

Reviews of the most important EU environmental regulatory policies are listed below (TDC-OLIVE, 2004).

- Council Directive 96/61/EC laying down the integrated management of pollution prevention and control. It is known as the International Plant Protection Convention (IPPC) guide. It identifies measures to prevent, reduce and eliminate pollution at the source of contaminants in order to ensure a reasonable management of the natural resources. The overall objective of this guidance is to achieving accountability through the principle of “polluter pays”.
- Council Directive 91/692/EEC laying down the importance of the disposal of all types of waste oils in environment-friendly ways. It provides the specific rules and measures necessary to ensure that the waste oils are collected and disposed without causing any possible damage to the environmental quality.
- Council Directive 75/442/EEC determining the importance of laying down effective waste management strategy. It is a legal framework for Community policy on waste management strategy to reduce the waste production.
- Council Directive 2000/76/EC laying down the fifth Environment Action Programme: Towards Sustainability, concerning the importance of the incineration of waste in environment-friendly ways. It determines the target that levels of certain pollutants such as nitrogen oxides (NOx), sulphur dioxide (SO2) and dioxins should not be exceeded in order to protect all people against health risks from air pollution.
Council Directive (February, 2001) laying down a strategy aimed at achieving a high level of protection for human health and the environment while maintaining the industrial competitiveness, through: First, the call for global coordination of testing procedures, and thus testing obligations are extended to exporters and a recognition of non-EU tests is achieved, and secondly, in line with EU obligations under the WTO by ensuring equal treatment between imports and domestic products in terms of testing requirements and compliance with international environmental regulatory policies.

1. General European Environmental Regulatory Policies Affecting Food Industry

- Council Directive 93/43 EEC laying down the hygiene of foodstuffs, which establishes the rules of hygiene of foodstuffs and the procedures for the verification of compliance with these rules. The principles of the Hazard Analysis and Critical Control Points (HACCP) systems should be developed.
- Council Directive 95/2/EC laying down the need for food safety. It applies to additives other than colors and sweeteners, such as preservatives, acids, acidity regulators, and others.
- Council Directive 89/391 laying down the importance of the introduction of strict environmental rules and measures aims to promote improvements and services in the safety and health of workers at the work place. It also aims to ensure the highest degree of protection of the workers at the work place through the implementation of preventive rules and measures in anticipation of work accidents and occupational diseases.
- Council Directive 2000/13/EC laying down the coherence of international laws between all countries with regard to eco-labeling regulatory policies and systems.
- Council Regulation 178/2002 laying down the importance of developing an effective process of adopting the general principles and measures of food law in order to ensure a high level of the human health and environmental quality protection.

2. Specific European Environmental Regulatory Policies Affecting Olive-Mill Industry

- Commission Regulation 616/72/EEC laying down the detailed environmental regulations concerning the export of olive oil production.
- Council Regulation 154/75/EEC laying down the importance of establishing an environmental register of olive cultivation in all countries that produce olive oil.
- Commission Regulation 2960/77/EEC laying down the homogeneity of environmental rules concerning the production and sale of olive oil products.
- Commission Regulation 3136/78/EEC laying down the homogeneity of trade rules concerning the import levy on olive oil products.
- Council Regulation 2262/84/EEC laying down the importance of developing the detailed procedures and rules in order to insure the effective application of special measures in respect of olive oil products.
- Council Regulation 2658/87/EEC laying down the importance of establishing the Common Customs Tariff of the olive oil products.
- Commission Regulation 3472/85/EEC laying down the importance of organizing the purchase and storage processes of olive oil products by the intervention agencies.
- Commission Regulation 183/93/EEC laying down the existence of rules for determining the characteristics of olive oil products and on the homogeneity of the relevant methods of analysis.
- Commission Regulation 1476/95/EC laying down the importance of the homogeneity of the special rules for the application of import licensing system for olive oil products.
- Commission Regulation 2543/95/EC laying down the importance of the homogeneity of the special rules for the application of export licensing system for olive oil products.
- Commission Regulation 2138/97/EC laying down the existence of special rules for determining the common olive oil production areas.
- Commission Regulation 528/1999/EC laying down the need to develop common measures with regard to improving the quality of the olive oil production.
- Commission Regulation 327/2001/EC laying down the importance of the existence of special rules regarding the storage conditions of olive oil products.
- Commission Regulation 796/2002/EC laying down the importance of the existence of rules for determining the fundamental characteristics of the different types of olive oil products. As well, it is laying down the importance of the adoption of the relevant harmonized methods of analysis.
- Commission Regulation 1176/2003/EC laying down the marketing standards and policies for olive oil products.
- Council Regulation 865/2004/EC laying down the importance of establishing common scientific organization concerning the market in olive oil products.
Appendix 3: Marketing Channels of Olive Oil Product in the Arab Countries

Source: Arab Organization for Agricultural Development, 2003:122
Appendix 4: The Proof of Defining the Cost-Minimizing Factor Demand Function

We define the cost minimization problem \( C = C(w/e, r, y) \) as:

\[
C(w/e, r, y) = \min_{x,k} \left[ wx + rk + mf(e(m)x, k) \right] \quad \text{Subject to} \quad f(e(m)x, k) \geq y \quad (4.1)
\]

We then define the Lagrangian function as follows:

\[
L(x,k,\lambda) = wx + rk + mf(ex,k) + \lambda(y - f(ex,k)) \quad (4.2)
\]

Now we minimize the Lagrangian by choice of \( x, k \) and \( \lambda \). That is, we take the three partial derivatives (the first order conditions) and set these derivatives equal to zero as:

\[
\frac{\partial L}{\partial x} = w + m \frac{\partial f}{\partial ex} \frac{\partial ex}{\partial x} - \lambda \frac{\partial f}{\partial ex} \frac{\partial ex}{\partial x} = 0 \quad (4.3)
\]

\[
\frac{\partial L}{\partial k} = r + m \frac{\partial f}{\partial k} - \lambda \frac{\partial f}{\partial k} = 0 \quad (4.4)
\]

\[
\frac{\partial L}{\partial \lambda} = y - f(ex,k) = 0 \quad (4.5)
\]

By rearranging equations (4.3) and (4.4) we get:

\[
w + e(m - \lambda) \frac{\partial f}{\partial ex} = 0 \quad (4.6)
\]

\[
r + (m - \lambda) \frac{\partial f}{\partial k} = 0 \quad (4.7)
\]

To solve, we divide equation (4.6) by equation (4.7) to get one equation, and we then use this new equation in combination with the constraint equation (4.5). This gives us:

\[
\frac{\partial f}{\partial ex} = \frac{w}{e(m - \lambda)} = \frac{w/e}{r} \quad \frac{\partial f}{\partial k} = \frac{-r}{(m - \lambda)} \quad (4.8)
\]

\[
y = f(ex,k) \quad (4.9)
\]
That is, the ratio of the marginal product factors must equal the ratio of the factors prices, and that the amounts of the product factors must be sufficient to produce the given amount of output. The solution of these two equations (4.8) and (4.9) yields the cost-minimizing value of $X$. This is the conditional (derived) factor demand. It is conditional on $y$, and it can be written as:

$$X^c = X^c(w/e, r, y)$$  \hspace{1cm} (4.10)

That is, for each choice of $w/e$, $r$ and $y$, there should be an optimum $X^c$ that minimizes the cost of producing $y$. This is the cost-minimizing level of factor demand function and determined as follows: First, from the first order conditions in equations (4.3), (4.4) and (4.5), the solutions are implicitly determined as:

$$x^c = x^c(w/e, r, y)$$
$$k^c = k^c(w/e, r, y)$$
$$\lambda^c = \lambda^c(w/e, r, y)$$  \hspace{1cm} (4.11)

Second, substituting these solutions into the Lagrangian yields the minimum cost function as:

$$C(w/e, r, y) = wx^c + rk^c + mf(ex^c, k^c) + \lambda (y - f(ex^c, k^c))$$  \hspace{1cm} (4.12)

Then, the partial derivative of the cost function $C = C(w/e, r, y)$ with respect to $(w/e)$ yields:

$$\frac{\partial C(w/e, r, y)}{\partial (w/e)} = [w + e(m - \lambda) \frac{\partial f}{\partial x} \frac{\partial x^c}{\partial w} + \frac{r}{m - \lambda} \frac{\partial f}{\partial k} \frac{\partial k^c}{\partial w}] + [y - f(ex^c, k^c)] \frac{\partial \lambda^c}{\partial w} + x^c$$  \hspace{1cm} (4.13)

Note that, the three terms in brackets are nothing more than the first order conditions, and at the optimal values of $x, k$ and $\lambda$ these three bracketed terms are equal to zero. Therefore, the expression in equation (4.13) simplifies to be written as:

$$\frac{\partial C(w/e, r, y)}{\partial (w/e)} = X^c = X^c(w/e, r, y)$$  \hspace{1cm} (4.14)

This is the envelope theorem (Sheppard’s Lemma) for constrained optimization.
### Appendix 5: Forms and Features of Different Functional Forms

<table>
<thead>
<tr>
<th>Name</th>
<th>Functional form</th>
<th>Marginal effect ((dY / dX))</th>
<th>Elasticity ((dY / dX)(X / Y))</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Linear</strong></td>
<td>(Y = \beta_1 + \beta_2 X)</td>
<td>(\beta_2)</td>
<td>(\beta_2 X / Y)</td>
</tr>
<tr>
<td><strong>Linear-Log</strong></td>
<td>(Y = \beta_1 + \beta_2 \ln X)</td>
<td>(\beta_2 / X)</td>
<td>(\beta_2 / Y)</td>
</tr>
<tr>
<td><strong>Log-Linear</strong></td>
<td>(\ln Y = \beta_1 + \beta_2 X)</td>
<td>(\beta_2 Y)</td>
<td>(\beta_2 X)</td>
</tr>
<tr>
<td><strong>Double-Log Linear</strong></td>
<td>(\ln Y = \beta_1 + \beta_2 \ln X)</td>
<td>(\beta_2 Y / X)</td>
<td>(\beta_2)</td>
</tr>
</tbody>
</table>

Source: Asteriou and Hall, 2007:161

### Appendix 6: Interpretation of Marginal Effects in Logarithmic Models

<table>
<thead>
<tr>
<th>Name</th>
<th>Functional form</th>
<th>Marginal effect</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Linear</strong></td>
<td>(Y = \beta_1 + \beta_2 X)</td>
<td>(\Delta Y = \beta_2 \Delta X)</td>
<td>1 unit change in (X) will induce a (\beta_2) unit change in (Y)</td>
</tr>
<tr>
<td><strong>Linear-Log</strong></td>
<td>(Y = \beta_1 + \beta_2 \ln X)</td>
<td>(\Delta Y = \beta_2 / 100[100 \Delta X / X])</td>
<td>1 per cent change in (X) will induce a (\beta_2 / 100) unit change in (Y)</td>
</tr>
<tr>
<td><strong>Log-Linear</strong></td>
<td>(\ln Y = \beta_1 + \beta_2 X)</td>
<td>(100 \Delta Y / Y = 100 \beta_2 \Delta X)</td>
<td>1 unit change in (X) will induce a (100 \beta_2) per cent change in (Y)</td>
</tr>
<tr>
<td><strong>Double-Log Linear</strong></td>
<td>(\ln Y = \beta_1 + \beta_2 \ln X)</td>
<td>(100 \Delta Y / Y = \beta_2 [100 \Delta X / X])</td>
<td>1 per cent change in (X) will induce a (\beta_2) per cent change in (Y)</td>
</tr>
</tbody>
</table>

Source: Asteriou and Hall, 2007:165
Appendix 7: The Econometric Regression of the Elasticities for the Olive Oil Agro-Industrial Sector in Syria

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

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

**. 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 $\eta_{yp}$:

$$Log(Y) = -1.97 + 0.15Log(P) + 0.92Log(X) - 0.03Log(B) + 0.01Log(E)$$

Dependent Variable: LOG(Y)
Method: Least Squares
Date: 11/13/11   Time: 14:21
Sample(adjusted): 1993 2006
Included observations: 14 after adjusting endpoints

<table>
<thead>
<tr>
<th></th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
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<td>-1.974448</td>
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<td>-0.951289</td>
<td>0.3663</td>
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<td>C(2)</td>
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<td>1.322445</td>
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<td>C(4)</td>
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<td>C(5)</td>
<td>0.005665</td>
<td>0.013725</td>
<td>0.412738</td>
<td>0.6895</td>
</tr>
</tbody>
</table>

R-squared   | 0.987624    | Mean dependent var | 11.68870 |
Adjusted R-squared | 0.982124 | S.D. dependent var | 0.416031 |
S.E. of regression | 0.055624 | Akaike info criterion | -2.667950 |
Sum squared resid  | 0.027846 | Schwarz criterion | -2.439716 |
Log likelihood    | 23.67565 | Durbin-Watson stat | 2.118783 |
\[ \log(Y) = -2.32 + 0.16 \log(P) + 0.94 \log(X) - 0.02 \log(B) \]

**Dependent Variable: LOG(Y)**

**Method: Least Squares**

**Date: 11/13/11**

**Time: 14:27**

**Sample: 1990 2006**

**Included observations: 17**

\[
\log(Y) = C(1) + C(2) \log(P) + C(3) \log(X) + C(4) \log(B)
\]

<table>
<thead>
<tr>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C(1)</td>
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<td>-3.073164</td>
<td>0.0089</td>
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<tr>
<td>C(2)</td>
<td>0.163631</td>
<td>2.627926</td>
<td>0.0209</td>
</tr>
<tr>
<td>C(3)</td>
<td>0.940312</td>
<td>24.51781</td>
<td>0.0000</td>
</tr>
<tr>
<td>C(4)</td>
<td>-0.021031</td>
<td>-0.328805</td>
<td>0.7475</td>
</tr>
</tbody>
</table>

R-squared: 0.990665
Mean dependent var: 11.59511
Adjusted R-squared: 0.988510
S.D. dependent var: 0.466158
S.E. of regression: 0.049968
Akaike info criterion: -2.952559
Sum squared resid: 0.032458
Schwarz criterion: -2.756509
Log likelihood: 29.09675
Durbin-Watson stat: 2.137472

\[ \log(Y) = -2.46 + 0.16 \log(P) + 0.93 \log(X) \]

**Dependent Variable: LOG(Y)**

**Method: Least Squares**

**Date: 11/13/11**

**Time: 14:33**

**Sample: 1990 2006**

**Included observations: 17**

\[
\log(Y) = C(1) + C(2) \log(P) + C(3) \log(X)
\]

<table>
<thead>
<tr>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C(1)</td>
<td>-2.458304</td>
<td>-4.104645</td>
<td>0.0011</td>
</tr>
<tr>
<td>C(2)</td>
<td>0.163270</td>
<td>2.710296</td>
<td>0.0169</td>
</tr>
<tr>
<td>C(3)</td>
<td>0.933065</td>
<td>30.72304</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared: 0.990587
Mean dependent var: 11.59511
Adjusted R-squared: 0.989242
S.D. dependent var: 0.466158
S.E. of regression: 0.048350
Akaike info criterion: -3.061924
Sum squared resid: 0.032728
Schwarz criterion: -2.914887
Log likelihood: 29.02636
Durbin-Watson stat: 2.095395

\[ \log(Y) = -2.18 + 1.16 \log(P) \]

**Dependent Variable: LOG(Y)**

**Method: Least Squares**

**Date: 11/13/11**

**Time: 14:37**

**Sample: 1990 2006**

**Included observations: 17**

\[
\log(Y) = C(1) + C(2) \log(P)
\]

<table>
<thead>
<tr>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C(1)</td>
<td>-2.180672</td>
<td>-0.455684</td>
<td>0.6551</td>
</tr>
<tr>
<td>C(2)</td>
<td>1.165324</td>
<td>2.879210</td>
<td>0.0115</td>
</tr>
</tbody>
</table>

R-squared: 0.355943
Mean dependent var: 11.59511
Adjusted R-squared: 0.313005
S.D. dependent var: 0.466158
S.E. of regression: 0.386376
Akaike info criterion: 1.046120
Sum squared resid: 2.239297
Schwarz criterion: 1.144145
Log likelihood: -6.892018
Durbin-Watson stat: 2.572596
As depicted above, the estimates of the production supply response for olive oil using a multiple double log-linear regression equation are comprising the regression coefficients and testing results. The coefficient of determination (R-Square) denotes that 99% of the production variations are explained by the supply equation of the production. All regression coefficients are statistically significant at the 5% level of significance. The signs and magnitudes of the regression coefficients coincide with economic theory. The regression coefficient (C(2) or the elasticity) indicates a positive relationship between the production supplied and the price of olive oil. Also, this regression coefficient points out to a rigid (inelastic) supply with the price of olive oil. The Figure also shows an upward sloping trend line and a positive relationship between the production supplied and the price of olive oil products.

Thus, 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 an input demand elasticity (cost-minimizing) with respect to output level

\[ \eta_{XY}^c = 1.57 + 1.05 \log(Y) - 0.13 \log(P) + 0.07 \log(B) - 0.01 \log(E) \]

Dependent Variable: LOG(X)
Method: Least Squares
Date: 11/13/11   Time: 14:51
Sample(adjusted): 1993 2006
Included observations: 14 after adjusting endpoints

\[ \text{LOG}(X) = C(1) + C(2) \cdot \text{LOG}(Y) + C(3) \cdot \text{LOG}(P) + C(4) \cdot \text{LOG}(B) + C(5) \cdot \text{LOG}(E) \]

<table>
<thead>
<tr>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C(1)</td>
<td>1.572030</td>
<td>2.259037</td>
<td>0.695885</td>
</tr>
<tr>
<td>C(2)</td>
<td>1.048909</td>
<td>0.061553</td>
<td>17.04084</td>
</tr>
<tr>
<td>C(3)</td>
<td>-0.125781</td>
<td>0.127288</td>
<td>-0.988155</td>
</tr>
<tr>
<td>C(4)</td>
<td>0.070288</td>
<td>0.131925</td>
<td>0.532787</td>
</tr>
<tr>
<td>C(5)</td>
<td>-0.007300</td>
<td>0.014553</td>
<td>-0.501576</td>
</tr>
</tbody>
</table>

R-squared 0.986928
Mean dependent var 13.08318

\[ \text{LOG}(X) = 2.28 + 1.04 \log(Y) - 0.16 \log(P) + 0.04 \log(B) \]

Dependent Variable: LOG(X)
Method: Least Squares
Date: 11/13/11   Time: 14:57
Sample: 1990 2006
Included observations: 17

\[ \text{LOG}(X) = C(1) + C(2) \cdot \text{LOG}(Y) + C(3) \cdot \text{LOG}(P) + C(4) \cdot \text{LOG}(B) \]

<table>
<thead>
<tr>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C(1)</td>
<td>2.279396</td>
<td>0.828603</td>
<td>2.750890</td>
</tr>
<tr>
<td>C(2)</td>
<td>1.040964</td>
<td>0.042457</td>
<td>24.51781</td>
</tr>
<tr>
<td>C(3)</td>
<td>-0.155456</td>
<td>0.068653</td>
<td>-2.264385</td>
</tr>
<tr>
<td>C(4)</td>
<td>0.042181</td>
<td>0.066556</td>
<td>0.633758</td>
</tr>
</tbody>
</table>

R-squared 0.989979
Mean dependent var 12.99301

Adjusted R-squared 0.987666
S.D. dependent var 0.473391
S.E. of regression 0.052574
Akaike info criterion -2.850868
Sum squared resid 0.035932
Schwarz criterion -2.654818
Log likelihood 28.23238
Durbin-Watson stat 2.242300
\[ \log(X) = 2.60 + 1.06\log(Y) - 0.16\log(P) \]

Dependent Variable: LOG(X)
Method: Least Squares
Date: 11/13/11   Time: 15:02
Sample: 1990 2006
Included observations: 17

\[ \text{LOG}(X) = C(1) + C(2) \cdot \text{LOG}(Y) + C(3) \cdot \text{LOG}(P) \]

<table>
<thead>
<tr>
<th></th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C(1)</td>
<td>2.600497</td>
<td>0.641486</td>
<td>4.053866</td>
<td>0.0012</td>
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<tr>
<td>C(2)</td>
<td>1.056073</td>
<td>0.034374</td>
<td>30.72304</td>
<td>0.0000</td>
</tr>
<tr>
<td>C(3)</td>
<td>-0.156730</td>
<td>0.067141</td>
<td>-2.334342</td>
<td>0.0350</td>
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</table>

R-squared 0.989669
Mean dependent var 12.99301
Adjusted R-squared 0.988193
S.D. dependent var 0.473391
S.E. of regression 0.051438
Akaike info criterion -2.938087
Sum squared resid 0.037042
Schwarz criterion -2.791049
Log likelihood 27.97374
Durbin-Watson stat 2.122507

\[ \log(X) = 1.30 + 1.01\log(Y) \]

Dependent Variable: LOG(X)
Method: Least Squares
Date: 11/13/11   Time: 15:05
Sample: 1990 2006
Included observations: 17

\[ \text{LOG}(X) = C(1) + C(2) \cdot \text{LOG}(Y) \]

<table>
<thead>
<tr>
<th></th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C(1)</td>
<td>1.302816</td>
<td>0.364503</td>
<td>3.574222</td>
<td>0.0028</td>
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<tr>
<td>C(2)</td>
<td>1.008201</td>
<td>0.031412</td>
<td>32.09595</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared 0.985648
Mean dependent var 12.99301
Adjusted R-squared 0.984691
S.D. dependent var 0.473391
S.E. of regression 0.058572
Akaike info criterion -2.726988
Sum squared resid 0.051460
Schwarz criterion -2.628963
Log likelihood 25.17940
Durbin-Watson stat 1.905455
As depicted above, the estimates of the input demand response with respect to the output level of olive oil using a multiple double log-linear regression equation are comprising the regression coefficients and testing results. The coefficient of determination (R-Square) denotes that 99% of the input demand variations are explained by the input demand equation. All regression coefficients are statistically significant at the 5% level of significance. The signs and magnitudes of the regression coefficients coincide with economic theory. The regression coefficient (C(2) or the elasticity) indicates a positive relationship between the input demand and the output level of olive oil. Also, this regression coefficient points out to decreasing returns to scale cost function response between the input demand and the output level of olive oil. The Figure also shows an upward sloping trend line and a positive relationship between the input demand and the output level of olive oil products.

Thus, the regression equation is statistically significant with respect to the relationship between $X$ and $Y$ 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 (0.00) is smaller than the level of significance (0.05).
4. Estimates of the elasticity of domestic demand with respect to output price $\eta_{dy}$:

$$
\log(B) = 13.91 - 0.56\log(P) - 0.18\log(Y) + 0.44\log(X) + 0.07\log(E)
$$

Dependent Variable: LOG(B)
Method: Least Squares
Date: 11/13/11   Time: 15:11
Sample(adjusted): 1993 2006
Included observations: 14 after adjusting endpoints

<table>
<thead>
<tr>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C(1)</td>
<td>13.91381</td>
<td>3.431146</td>
<td>4.055150</td>
</tr>
<tr>
<td>C(2)</td>
<td>-0.557986</td>
<td>0.276696</td>
<td>-2.016602</td>
</tr>
<tr>
<td>C(3)</td>
<td>-0.178891</td>
<td>0.881173</td>
<td>-0.203015</td>
</tr>
<tr>
<td>C(4)</td>
<td>0.435009</td>
<td>0.816478</td>
<td>0.532787</td>
</tr>
<tr>
<td>C(5)</td>
<td>0.072456</td>
<td>0.027643</td>
<td>2.621096</td>
</tr>
</tbody>
</table>

R-squared 0.701300  Mean dependent var 11.47892
Adjusted R-squared 0.568545  S.D. dependent var 0.224372
S.E. of regression 0.147379  Akaike info criterion -0.719160
Sum squared resid 0.195486  Schwarz criterion -0.490925
Log likelihood 10.03412  Durbin-Watson stat 1.491846

$$
\log(B) = 5.76 + 0.08\log(P) - 0.39\log(Y) + 0.71\log(X)
$$

Dependent Variable: LOG(B)
Method: Least Squares
Date: 11/13/11   Time: 15:21
Sample: 1990 2006
Included observations: 17

<table>
<thead>
<tr>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C(1)</td>
<td>5.764825</td>
<td>3.967504</td>
<td>1.453010</td>
</tr>
<tr>
<td>C(2)</td>
<td>0.081169</td>
<td>0.331963</td>
<td>0.244513</td>
</tr>
<tr>
<td>C(3)</td>
<td>-0.392177</td>
<td>1.192733</td>
<td>-0.328805</td>
</tr>
<tr>
<td>C(4)</td>
<td>0.710519</td>
<td>1.121120</td>
<td>0.633758</td>
</tr>
</tbody>
</table>

R-squared 0.422396  Mean dependent var 11.40880
Adjusted R-squared 0.289103  S.D. dependent var 0.255917
S.E. of regression 0.215775  Akaike info criterion -0.026834
Sum squared resid 0.605267  Schwarz criterion 0.169216
Log likelihood 4.228088  Durbin-Watson stat 1.495961
Log(B) = 15.06 − 0.63Log(P) + 0.29Log(Y) + 0.07Log(E)

Dependent Variable: LOG(B)
Method: Least Squares
Date: 11/13/11   Time: 15:26
Sample(adjusted): 1993 2006
Included observations: 14 after adjusting endpoints
LOG(B)=C(1)+C(2)*LOG(P)+C(3)*LOG(Y)+C(4)*LOG(E)

<table>
<thead>
<tr>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C(1) 15.05807</td>
<td>2.578260</td>
<td>5.840401</td>
<td>0.0002</td>
</tr>
<tr>
<td>C(2) -0.632026</td>
<td>0.230540</td>
<td>-2.741502</td>
<td>0.0208</td>
</tr>
<tr>
<td>C(3) 0.286143</td>
<td>0.116539</td>
<td>2.455338</td>
<td>0.0339</td>
</tr>
<tr>
<td>C(4) 0.071465</td>
<td>0.026575</td>
<td>2.689218</td>
<td>0.0227</td>
</tr>
</tbody>
</table>

R-squared 0.691879  Mean dependent var 11.47892
Adjusted R-squared 0.599443  S.D. dependent var 0.224372
S.E. of regression 0.142004  Akaike info criterion -0.830964
Sum squared resid 0.201652  Schwarz criterion -0.648376
Log likelihood 9.816748  Durbin-Watson stat 1.356568

Log(B) = 7.61 − 0.03Log(P) + 0.36Log(Y)

Dependent Variable: LOG(B)
Method: Least Squares
Date: 11/13/11   Time: 15:33
Sample: 1990 2006
Included observations: 17
LOG(B)=C(1)+C(2)*LOG(P)+C(3)*LOG(Y)

<table>
<thead>
<tr>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C(1) 7.612526</td>
<td>2.632802</td>
<td>2.891416</td>
<td>0.0118</td>
</tr>
<tr>
<td>C(2) -0.030190</td>
<td>0.275561</td>
<td>-0.109559</td>
<td>0.9143</td>
</tr>
<tr>
<td>C(3) 0.358183</td>
<td>0.141079</td>
<td>2.538889</td>
<td>0.0236</td>
</tr>
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</table>

R-squared 0.404551  Mean dependent var 11.40880
Adjusted R-squared 0.319467  S.D. dependent var 0.255917
S.E. of regression 0.211114  Akaike info criterion -0.114053
Sum squared resid 0.623967  Schwarz criterion -0.648376
Log likelihood 3.969447  Durbin-Watson stat 1.376168

Log(B) = 6.83 + 0.39Log(P)

Dependent Variable: LOG(B)
Method: Least Squares
Date: 11/13/11   Time: 15:36
Sample: 1990 2006
Included observations: 17
LOG(B)=C(1)+C(2)*LOG(P)

<table>
<thead>
<tr>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C(1) 6.831447</td>
<td>3.052747</td>
<td>2.237803</td>
<td>0.0408</td>
</tr>
<tr>
<td>C(2) 0.387209</td>
<td>0.258189</td>
<td>1.499709</td>
<td>0.1544</td>
</tr>
</tbody>
</table>

R-squared 0.130391  Mean dependent var 11.40880
Adjusted R-squared 0.072417  S.D. dependent var 0.255917
S.E. of regression 0.246476  Akaike info criterion 0.147028
Sum squared resid 0.912585  Schwarz criterion 0.245053
Log likelihood 0.750261  Durbin-Watson stat 0.690198
As depicted above, the estimates of the domestic demand response for olive oil using a multiple double log-linear regression equation are comprising the regression coefficients and testing results. The coefficient of determination (R-Square) denotes that 80% of the domestic demand variations are explained by the domestic demand equation. All regression coefficients are statistically significant at the 5% level of significance. The signs and magnitudes of the regression coefficients coincide with economic theory. The regression coefficient (C(2) or the elasticity) indicates an inverse relationship between the domestic demand and the price of olive oil. Also, this regression coefficient points out also to a rigid (inelastic) domestic demand with the price of olive oil. The Figure also shows an upward and a downward sloping trend line as well as an inverse and a positive relationship between the domestic demand and the price of olive oil products.

Thus, the regression equation is statistically significant with respect to the relationship between B and P because the multiple correlation coefficient is 0.83 and the multiple coefficient of determination is 0.69 (the relationship is significant), and the probability of significance (0.02) is smaller than the level of significance (0.05).
5. Estimates of the elasticity of export demand with respect to output price $\eta_{Ep}$:

\[ \log(E) = -102.63 + 4.43 \log(P) + 3.28 \log(Y) - 3.73 \log(X) + 5.97 \log(B) \]

Dependent Variable: LOG(E)
Method: Least Squares
Date: 11/13/11   Time: 15:48
Sample(adjusted): 1993 2006
Included observations: 14 after adjusting endpoints

\[ \log(E) = C(1) + C(2) \log(P) + C(3) \log(Y) + C(4) \log(X) + C(5) \log(B) \]

<table>
<thead>
<tr>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C(1)</td>
<td>-102.6273</td>
<td>-2.586572</td>
<td>0.0294</td>
</tr>
<tr>
<td>C(2)</td>
<td>4.434509</td>
<td>1.678389</td>
<td>0.1276</td>
</tr>
<tr>
<td>C(3)</td>
<td>3.279268</td>
<td>0.412738</td>
<td>0.6895</td>
</tr>
<tr>
<td>C(4)</td>
<td>-3.725278</td>
<td>-0.501576</td>
<td>0.6280</td>
</tr>
<tr>
<td>C(5)</td>
<td>5.974660</td>
<td>2.621096</td>
<td>0.0278</td>
</tr>
</tbody>
</table>

R-squared 0.620125  Mean dependent var 8.277405
Adjusted R-squared 0.451292  S.D. dependent var 1.806703
S.E. of regression 2.279451  Akaike info criterion 3.693149
Sum squared resid 16.11972  Schwarz criterion 3.921384
Log likelihood -20.85204  Durbin-Watson stat 1.561668

\[ \log(E) = -34.38 + 1.94 \log(P) + 3.90 \log(Y) - 1.99 \log(X) \]

Dependent Variable: LOG(E)
Method: Least Squares
Date: 11/13/11   Time: 15:53
Sample(adjusted): 1993 2006
Included observations: 14 after adjusting endpoints

\[ \log(E) = C(1) + C(2) \log(P) + C(3) \log(Y) + C(4) \log(X) \]

<table>
<thead>
<tr>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C(1)</td>
<td>-34.38000</td>
<td>-0.911568</td>
<td>0.3834</td>
</tr>
<tr>
<td>C(2)</td>
<td>1.940979</td>
<td>0.625071</td>
<td>0.5459</td>
</tr>
<tr>
<td>C(3)</td>
<td>3.897801</td>
<td>0.389600</td>
<td>0.7050</td>
</tr>
<tr>
<td>C(4)</td>
<td>-1.985965</td>
<td>-0.213108</td>
<td>0.8355</td>
</tr>
</tbody>
</table>

R-squared 0.330147  Mean dependent var 8.277405
Adjusted R-squared 0.129192  S.D. dependent var 1.806703
S.E. of regression 1.338312  Akaike info criterion 4.117507
Sum squared resid 28.42471  Schwarz criterion 4.300095
Log likelihood -24.82255  Durbin-Watson stat 1.719452
\[ \log(E) = -39.78 + 2.89\log(P) + 1.78\log(Y) \]

Dependent Variable: LOG(E)
Method: Least Squares
Date: 11/13/11   Time: 15:57
Sample(adjusted): 1993 2006
Included observations: 14 after adjusting endpoints

\[ \log(E) = C(1) + C(2)\log(P) + C(3)\log(Y) \]

<table>
<thead>
<tr>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C(1)</td>
<td>-39.78380</td>
<td>26.67986</td>
<td>-1.491154 0.1640</td>
</tr>
<tr>
<td>C(2)</td>
<td>2.289349</td>
<td>2.522935</td>
<td>0.907415 0.3836</td>
</tr>
<tr>
<td>C(3)</td>
<td>1.782823</td>
<td>1.208027</td>
<td>1.475814 0.1680</td>
</tr>
</tbody>
</table>

R-squared 0.327105   Mean dependent var 8.277405
Adjusted R-squared 0.204761  S.D. dependent var 1.806703
S.E. of regression 1.611149  Akaike info criterion 3.979181
Sum squared resid 28.55380  Schwarz criterion 4.116122
Log likelihood -24.85427  Durbin-Watson stat 1.746464

\[ \log(E) = -39.21 + 3.99\log(P) \]

Dependent Variable: LOG(E)
Method: Least Squares
Date: 11/13/11   Time: 16:00
Sample(adjusted): 1993 2006
Included observations: 14 after adjusting endpoints

\[ \log(E) = C(1) + C(2)\log(P) \]

<table>
<thead>
<tr>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C(1)</td>
<td>-39.20792</td>
<td>27.95579</td>
<td>-1.402497 0.1861</td>
</tr>
<tr>
<td>C(2)</td>
<td>3.993431</td>
<td>2.350725</td>
<td>1.698808 0.1151</td>
</tr>
</tbody>
</table>

R-squared 0.193871  Mean dependent var 8.277405
Adjusted R-squared 0.126693  S.D. dependent var 1.806703
S.E. of regression 1.688380  Akaike info criterion 4.016979
Sum squared resid 34.20751  Schwarz criterion 4.108273
Log likelihood -26.11886  Durbin-Watson stat 0.779635
As depicted above, the estimates of the export demand response for olive oil using a multiple double log-linear regression equation are comprising the regression coefficients and testing results. The coefficient of determination (R-Square) denotes that 80% of the export demand variations are explained by the export demand equation. All regression coefficients are statistically insignificant at the 5% level of significance with the exception of lagged (past) values of the level of output (C(6)). The signs and magnitudes of the regression coefficients do not coincide with economic theory. The regression coefficient (C(2) or the elasticity) indicates a positive relationship between the export demand and the price of olive oil. Also, this regression coefficient points out to a rigid (inelastic) export demand with the price of olive oil. The Figure also shows an upward sloping trend line and a negative relationship between the export demand and the price of olive oil products.

Thus, the regression equation is statistically insignificant with respect to the relationship between $E$ and $P$ because the multiple correlation coefficient is 0.44 and the multiple coefficient of determination is 0.19 (the relationship is not significant), and the probability of significance (0.12) is greater than the level of significance (0.05).
Appendix 8: Performing Sensitivity Analysis: Scenarios Put Forward for the Possible Estimations and Assumptions of the Output Own-Price Elasticity for the Syrian Olive Oil Agro-Industrial Sector

Sensitivity analysis is used to determine how “sensitive” a result behavior of the analysis is to changes in the value of the parameters of the model used. Sensitivity analysis is usually performed as a test in which the analyst sets dissimilar parameter values to examine how a change in the parameter values causes a change in the result behavior of the analysis. By showing how the result behavior of the analysis responds to changes in the parameter values, sensitivity analysis is a useful and an important tool in the analysis result building process as well as in the analysis result evaluation process.

Moreover, sensitivity analysis helps to build confidence in the result behavior of the analysis by studying the uncertainties that are often associated with the parameter values in the model used. Sensitivity analysis can also indicate which the parameter value is reasonable to use in the analysis result evaluation process.

Further, sensitivity analysis helps the analyst to understand dynamics of the analysis result. Experimenting with a wide range of the parameter values can offer insights into behavior of the analysis result in extreme situations. Discovering that the result behavior of the analysis greatly changes for a change in the parameter value can identify a leverage point in the analysis result, and the parameter value whose specific value can significantly influence the result behavior mode of the analysis (Breierova & Choudhari, 2001:47).

In this section we present four scenarios or tests for the possible estimations and assumptions of the output own-price elasticity for the olive oil agro-industrial sector. In addition, we explore how sensitive a result behavior of the analysis is to changes in the parameter values of a price elasticity of supply.

The calculations of the impacts of our regulatory policies scenarios on the production and exports levels of Syrian olive oil products are reported below.
Scenario 1: The output own-price elasticity for the olive oil agro-industrial sector in Turkey was estimated to be: \( \eta_{ip} = 0.56 \) (Grethe, 2003:127).

1. The impact of the increase in the cost of olives for the producer due to compliance with the policy of IPM for the olive oil agro-industrial sector on the production and exports of Syrian olive oil products (the case of “input-specific” environmental policies)

1.1. The basic model case: The impact of higher olives prices for the producer on the production and exports of olive oil products (Equations 9, 10 and 11).

<table>
<thead>
<tr>
<th></th>
<th>Small impact</th>
<th>Large impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>The proportional increase in the olives price for the producer ( \Delta w/w )</td>
<td>0.033</td>
<td>0.067</td>
</tr>
<tr>
<td>Output own-price elasticity ( \eta_{ip} )</td>
<td>0.56</td>
<td>0.56</td>
</tr>
<tr>
<td>Input demand elasticity with respect to output ( \eta_{xy} )</td>
<td>1.06</td>
<td>1.06</td>
</tr>
<tr>
<td>Share of olives costs in total olive oil revenues ( wX/pY )</td>
<td>0.41</td>
<td>0.41</td>
</tr>
<tr>
<td>Output cross price elasticity wrt input price ( \eta_{w} )</td>
<td>-0.24</td>
<td>-0.24</td>
</tr>
<tr>
<td>The proportional change in production ( \Delta Y/Y )</td>
<td>-0.0080</td>
<td>-0.0162</td>
</tr>
<tr>
<td>Exports share of total production ( E/Y )</td>
<td>0.40</td>
<td>0.40</td>
</tr>
<tr>
<td>The proportional change in exports ( \Delta E/E )</td>
<td>-0.0200</td>
<td>-0.0406</td>
</tr>
</tbody>
</table>

1.2. Including efficiency improvements into the basic model case: Efficiency improvements due to higher olives prices (Equations 15, 16 and 17).

<table>
<thead>
<tr>
<th></th>
<th>Small impact</th>
<th>Large impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>The proportional increase in the olives price for the producer ( \Delta w/w )</td>
<td>0.033</td>
<td>0.067</td>
</tr>
<tr>
<td>Output cross price elasticity wrt input price ( \eta_{w} )</td>
<td>-0.24</td>
<td>-0.24</td>
</tr>
<tr>
<td>The efficiency of input use elasticity to his price ( \eta_{qw} )</td>
<td>0.58</td>
<td>0.28</td>
</tr>
<tr>
<td>Output cross price elasticity wrt input price ( \Psi_{iw} )</td>
<td>-0.10</td>
<td>-0.17</td>
</tr>
<tr>
<td>The proportional change in production ( \Delta Y/Y )</td>
<td>-0.0034</td>
<td>-0.0117</td>
</tr>
<tr>
<td>Exports share of total production ( E/Y )</td>
<td>0.40</td>
<td>0.40</td>
</tr>
<tr>
<td>The proportional change in exports ( \Delta E/E )</td>
<td>-0.0084</td>
<td>-0.0292</td>
</tr>
</tbody>
</table>
1.3. Large country case: Production and exports of olive oil products in the presence of output market price adjustments (Equations 22, 25, 26, 27, 28 and 29).

<table>
<thead>
<tr>
<th></th>
<th>Small impact</th>
<th>Large impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>The proportional increase in the olives price for the producer $\Delta w/w$</td>
<td>0.033</td>
<td>0.067</td>
</tr>
<tr>
<td>Output cross price elasticity wrt input price $\eta_{yw}$</td>
<td>-0.24</td>
<td>-0.24</td>
</tr>
<tr>
<td>The efficiency of input use elasticity to his price $\eta_{qw}$</td>
<td>0.58</td>
<td>0.28</td>
</tr>
<tr>
<td>Output own-price elasticity $\eta_{yp}$</td>
<td>0.56</td>
<td>0.56</td>
</tr>
<tr>
<td>Domestic demand elasticity wrt output price $\eta_{yp}$</td>
<td>-0.63</td>
<td>-0.63</td>
</tr>
<tr>
<td>Export demand elasticity wrt output price $\eta_{yp}$</td>
<td>-3.05</td>
<td>-3.05</td>
</tr>
<tr>
<td>Output cross price elasticity wrt input price $\Psi_{yw}$</td>
<td>-0.10</td>
<td>-0.17</td>
</tr>
<tr>
<td>Output market price elasticity wrt input price $\eta_{pw}$</td>
<td>0.05</td>
<td>0.08</td>
</tr>
<tr>
<td>Price adjustment factor $A$</td>
<td>0.74</td>
<td>0.74</td>
</tr>
<tr>
<td>Overall supply elasticity wrt input price $\Omega_{yw}$</td>
<td>-0.08</td>
<td>-0.13</td>
</tr>
<tr>
<td>Overall proportional change in production $\Delta Y/Y$</td>
<td>-0.0025</td>
<td>-0.0087</td>
</tr>
<tr>
<td>Exports share of total production $E/Y$</td>
<td>0.40</td>
<td>0.40</td>
</tr>
<tr>
<td>Domestic consumption share of total production $B/Y$</td>
<td>0.60</td>
<td>0.60</td>
</tr>
<tr>
<td>Overall export supply elasticity wrt input price $\Omega_{Ew}$</td>
<td>-0.14</td>
<td>-0.25</td>
</tr>
<tr>
<td>Overall proportional change in exports $\Delta E/E$</td>
<td>-0.0047</td>
<td>-0.0165</td>
</tr>
</tbody>
</table>

In sum, in this scenario we calculated the impact on the production and exports levels of olive oil products as a result of the increase in the cost of olives for the producer caused by compliance with the policy of IPM for the olive oil agro-industrial sector. The impact on the production and exports levels was initially calculated to be a decrease of between 0.80-1.62% and 2.00-4.06% respectively. After taking minor efficiency improvements into account, the impact on the production and exports levels was calculated to be a decrease of between 0.34-1.17% and 0.84-2.92% respectively. After including output market price adjustments in the model, the impact on the production and exports levels was calculated to be a decrease of between 0.25-0.87% and 0.47-1.65% respectively.

Hence, the overall calculations suggest that the impacts of compliance with the policy of IPM on the Syrian olive oil products is within the range of between 0.25-0.87% and 0.47-1.65% decrease in the production and exports levels respectively in the case of output price adjustments. Nonetheless, in percentage terms, the range of impacts certainly indicates some future concerns and more strategic thinking with regard to trade competitiveness for the olive oil agro-industrial sector in Syria.
The impact of the increase in the cost of olives for the producer due to compliance with the policy of IPM for the olive oil agro-industrial sector on the production and exports of Syrian olive oil products

(Small impact)

The impact of the increase in the cost of olives for the producer due to compliance with the policy of IPM for the olive oil agro-industrial sector on the production and exports of Syrian olive oil products

(Large impact)
2. 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 case of wastewater effluents or “end-of-the-pipe” environmental policies)

2.1. The basic model case: The impact of the increase in the average cost of olive oil production for the producer on the production and exports of olive oil products (Equations 35 and 36).

<table>
<thead>
<tr>
<th></th>
<th>Small impact</th>
<th>Large impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>The average compliance costs per ton of olive oil $m$</td>
<td>120 €</td>
<td>250 €</td>
</tr>
<tr>
<td>The proportional increase in the compliance unit cost share of olive oil price for the producer $m/p$</td>
<td>0.05</td>
<td>0.10</td>
</tr>
<tr>
<td>Output own-price elasticity $\eta_{iy}$</td>
<td>0.56</td>
<td>0.56</td>
</tr>
<tr>
<td>The proportional change in production $\Delta Y/Y$</td>
<td>-0.0280</td>
<td>-0.0560</td>
</tr>
<tr>
<td>Exports share of total production $E/Y$</td>
<td>0.40</td>
<td>0.40</td>
</tr>
<tr>
<td>The proportional change in exports $\Delta E/E$</td>
<td>-0.0700</td>
<td>-0.1400</td>
</tr>
</tbody>
</table>

2.2. Including efficiency improvements into the basic model case: Efficiency improvements due to the increase in the average cost of olive oil production (Equations 49, 50 and 51).

<table>
<thead>
<tr>
<th></th>
<th>Small impact</th>
<th>Large impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>The average compliance costs per ton of olive oil $m$</td>
<td>120 €</td>
<td>250 €</td>
</tr>
<tr>
<td>The proportional increase in the compliance unit cost share of olive oil price $m/p$</td>
<td>0.05</td>
<td>0.10</td>
</tr>
<tr>
<td>Output own-price elasticity $\eta_{iy}$</td>
<td>0.56</td>
<td>0.56</td>
</tr>
<tr>
<td>Factor demand elasticity wrt output level $\eta_{yx}$</td>
<td>1.06</td>
<td>1.06</td>
</tr>
<tr>
<td>Share of factor cost in total revenues $wY/pY$</td>
<td>0.41</td>
<td>0.41</td>
</tr>
<tr>
<td>Compliance-induced efficiency parameter $e$</td>
<td>1.52</td>
<td>1.52</td>
</tr>
<tr>
<td>Share of the effective factor cost in total revenues $ZX/pY$</td>
<td>0.27</td>
<td>0.27</td>
</tr>
<tr>
<td>Supply elasticity wrt effective factor price $\eta_{yz}$</td>
<td>-0.05</td>
<td>-0.05</td>
</tr>
<tr>
<td>The compliance costs efficiency elasticity $\eta_{em}$</td>
<td>0.26</td>
<td>0.26</td>
</tr>
<tr>
<td>The proportional change in production $\Delta Y/Y$</td>
<td>-0.0159</td>
<td>-0.0439</td>
</tr>
<tr>
<td>Exports share of total production $E/Y$</td>
<td>0.40</td>
<td>0.40</td>
</tr>
<tr>
<td>The proportional change in exports $\Delta E/E$</td>
<td>-0.0397</td>
<td>-0.1097</td>
</tr>
</tbody>
</table>
2.3. Large country case: Production and exports of olive oil products in the presence of output market price adjustments (Equations 56, 59 and 61).

<table>
<thead>
<tr>
<th><strong>Small impact</strong></th>
<th><strong>Large impact</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>The average compliance costs per ton of olive oil $m$</td>
<td>120 €</td>
</tr>
<tr>
<td>The proportional increase in the compliance unit cost share of olive oil price $m/p$</td>
<td>0.05</td>
</tr>
<tr>
<td>Output own-price elasticity $\eta_{bp}$</td>
<td>0.56</td>
</tr>
<tr>
<td>Domestic demand elasticity wrt output price $\eta_{bp}$</td>
<td>-0.63</td>
</tr>
<tr>
<td>Export demand elasticity wrt output price $\eta_{ep}$</td>
<td>-3.05</td>
</tr>
<tr>
<td>Supply elasticity wrt effective factor price $\eta_{iz}$</td>
<td>-0.05</td>
</tr>
<tr>
<td>The compliance costs efficiency elasticity $\eta_{em}$</td>
<td>0.26</td>
</tr>
<tr>
<td>Output price elasticity wrt compliance cost $\eta_{pm}$</td>
<td>0.25</td>
</tr>
</tbody>
</table>

**Overall proportional change in production** $\Delta Y / Y$ | +0.1262 | +0.0982 |

| Exports share of total production $E/Y$ | 0.40 | 0.40 |
| Domestic consumption share of total production $B/Y$ | 0.60 | 0.60 |

**Overall proportional change in exports** $\Delta E / E$ | +0.5561 | +0.4861 |

In sum, in this scenario we calculated the impact on the production and exports levels of olive oil products as a result of the increase in the average costs per ton of olive oil production for the producer caused by compliance with the policy of Integrated Waste Management for the Olive Oil Pressing Industries. The impact of the increase in the average costs per ton of olive oil production on the production and exports levels was initially calculated to be a decrease of between 2.80-5.60% and 7.00-14.00% respectively. After taking minor efficiency improvements into account, the impact on the production and exports levels was calculated to be a decrease of between 1.59-4.39% and 3.97-10.97% respectively. After including output market price adjustments in the model, the impact on the production and exports levels was calculated to be an increase of between 9.82-12.62% and 48.61-55.61% respectively.

Hence, the overall calculations suggest that the impacts on the Syrian olive oil products, which is 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 9.82-12.62% and 48.61-55.61% increase in the production and exports levels respectively in the case of output price adjustments. Nonetheless, in percentage terms, the range of impacts on the production and exports levels of olive oil products certainly indicates more future satisfactions and strategic thinking with regard to trade competitiveness for the olive oil agro-industrial sector in Syria.
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

(Small impact)

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

(Large impact)
Scenario 2: The output own-price elasticity is assumed to be: $\eta_{yp} = 0.47$.

1. The impact of the increase in the cost of olives for the producer due to compliance with the policy of IPM for the olive oil agro-industrial sector on the production and exports of Syrian olive oil products (the case of “input-specific” environmental policies)

1.1. The basic model case: The impact of higher olives prices for the producer on the production and exports of olive oil products (Equations 9, 10 and 11).

<table>
<thead>
<tr>
<th></th>
<th>Small impact</th>
<th>Large impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>The proportional increase in the olives price for the producer $\Delta w / w$</td>
<td>0.033</td>
<td>0.067</td>
</tr>
<tr>
<td>Output own-price elasticity $\eta_{yp}$</td>
<td>0.47</td>
<td>0.47</td>
</tr>
<tr>
<td>Input demand elasticity with respect to output $\eta_{xy}$</td>
<td>1.06</td>
<td>1.06</td>
</tr>
<tr>
<td>Share of olives costs in total olive oil revenues $wX / pY$</td>
<td>0.41</td>
<td>0.41</td>
</tr>
<tr>
<td>Output cross price elasticity wrt input price $\eta_{yw}$</td>
<td>-0.20</td>
<td>-0.20</td>
</tr>
<tr>
<td>The proportional change in production $\Delta Y / Y$</td>
<td>-0.0067</td>
<td>-0.0136</td>
</tr>
<tr>
<td>Exports share of total production $E / Y$</td>
<td>0.40</td>
<td>0.40</td>
</tr>
<tr>
<td>The proportional change in exports $\Delta E / E$</td>
<td>-0.0168</td>
<td>-0.0341</td>
</tr>
</tbody>
</table>

1.2. Including efficiency improvements into the basic model case: Efficiency improvements due to higher olives prices (Equations 15, 16 and 17).

<table>
<thead>
<tr>
<th></th>
<th>Small impact</th>
<th>Large impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>The proportional increase in the olives price for the producer $\Delta w / w$</td>
<td>0.033</td>
<td>0.067</td>
</tr>
<tr>
<td>Output cross price elasticity wrt input price $\eta_{yw}$</td>
<td>-0.20</td>
<td>-0.20</td>
</tr>
<tr>
<td>The efficiency of input use elasticity to his price $\eta_{qw}$</td>
<td>0.58</td>
<td>0.28</td>
</tr>
<tr>
<td>Output cross price elasticity wrt input price $\Psi_{yw}$</td>
<td>-0.09</td>
<td>-0.15</td>
</tr>
<tr>
<td>The proportional change in production $\Delta Y / Y$</td>
<td>-0.0028</td>
<td>-0.0098</td>
</tr>
<tr>
<td>Exports share of total production $E / Y$</td>
<td>0.40</td>
<td>0.40</td>
</tr>
<tr>
<td>The proportional change in exports $\Delta E / E$</td>
<td>-0.0071</td>
<td>-0.0245</td>
</tr>
</tbody>
</table>
1.3. Large country case: Production and exports of olive oil products in the presence of output market price adjustments (Equations 22, 25, 26, 27, 28 and 29).

<table>
<thead>
<tr>
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<th>Small impact</th>
<th>Large impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>The proportional increase in the olives price for the producer $\Delta w/w$</td>
<td>0.033</td>
<td>0.067</td>
</tr>
<tr>
<td>Output cross price elasticity wrt input price $\eta_{yw}$</td>
<td>-0.20</td>
<td>-0.20</td>
</tr>
<tr>
<td>The efficiency of input use elasticity to his price $\eta_{qw}$</td>
<td>0.58</td>
<td>0.28</td>
</tr>
<tr>
<td>Output own-price elasticity $\eta_{yp}$</td>
<td>0.47</td>
<td>0.47</td>
</tr>
<tr>
<td>Domestic demand elasticity wrt output price $\eta_{yp}$</td>
<td>-0.63</td>
<td>-0.63</td>
</tr>
<tr>
<td>Export demand elasticity wrt output price $\eta_{yp}$</td>
<td>-3.05</td>
<td>-3.05</td>
</tr>
<tr>
<td>Output cross price elasticity wrt input price $\Psi_{yw}$</td>
<td>-0.09</td>
<td>-0.15</td>
</tr>
<tr>
<td>Output market price elasticity wrt input price $\eta_{pw}$</td>
<td>0.04</td>
<td>0.07</td>
</tr>
<tr>
<td>Price adjustment factor $A$</td>
<td>0.77</td>
<td>0.77</td>
</tr>
<tr>
<td>Overall supply elasticity wrt input price $\Omega_{yw}$</td>
<td>-0.07</td>
<td>-0.11</td>
</tr>
<tr>
<td><strong>Overall proportional change in production</strong> $\Delta Y/Y$</td>
<td><strong>-0.0022</strong></td>
<td><strong>-0.0076</strong></td>
</tr>
<tr>
<td>Exports share of total production $E/Y$</td>
<td>0.40</td>
<td>0.40</td>
</tr>
<tr>
<td>Domestic consumption share of total production $B/Y$</td>
<td>0.60</td>
<td>0.60</td>
</tr>
<tr>
<td>Overall export supply elasticity wrt input price $\Omega_{Ew}$</td>
<td>-0.13</td>
<td>-0.22</td>
</tr>
<tr>
<td><strong>Overall proportional change in exports</strong> $\Delta E/E$</td>
<td><strong>-0.0042</strong></td>
<td><strong>-0.0145</strong></td>
</tr>
</tbody>
</table>

In sum, in this scenario we calculated the impact on the production and exports levels of olive oil products as a result of the increase in the cost of olives for the producer caused by compliance with the policy of IPM for the olive oil agro-industrial sector. The impact of the increase in the cost of olives on the production and exports levels was initially calculated to be a decrease of between 0.67-1.36% and 1.68-3.41% respectively. After taking minor efficiency improvements into account, the impact on the production and exports levels was calculated to be a decrease of between 0.28-0.98% and 0.71-2.45% respectively. After including output market price adjustments in the model, the impact on the production and exports levels was calculated to be a decrease of between 0.22-0.76% and 0.42-1.45% respectively.

Hence, the overall calculations suggest that the impacts of compliance with the policy of IPM on the Syrian olive oil products is within the range of between 0.22-0.76% and 0.42-1.45% decrease in the production and exports levels respectively in the case of output price adjustments. Nonetheless, in percentage terms, the range of impacts certainly indicates some future concerns and more strategic thinking with regard to trade competitiveness for the olive oil agro-industrial sector in Syria.
The impact of the increase in the cost of olives for the producer due to compliance with the policy of IPM for the olive oil agro-industrial sector on the production and exports of Syrian olive oil products

(Small impact)

The basic model With efficiency improvements With output market price adjustments

The impact of the increase in the cost of olives for the producer due to compliance with the policy of IPM for the olive oil agro-industrial sector on the production and exports of Syrian olive oil products

(Large impact)
2. 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 case of wastewater effluents or “end-of-the-pipe” environmental policies)

2.1. The basic model case: The impact of the increase in the average cost of olive oil production for the producer on the production and exports of olive oil products (Equations 35 and 36).

<table>
<thead>
<tr>
<th></th>
<th>Small impact</th>
<th>Large impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>The average compliance costs per ton of olive oil</td>
<td>120 €</td>
<td>250 €</td>
</tr>
<tr>
<td>The proportional increase in the compliance unit cost share of olive oil price for the producer</td>
<td>0.05</td>
<td>0.10</td>
</tr>
<tr>
<td>Output own-price elasticity $\eta_{op}$</td>
<td>0.47</td>
<td>0.47</td>
</tr>
<tr>
<td>The proportional change in production $\Delta Y / Y$</td>
<td>-0.0235</td>
<td>-0.0470</td>
</tr>
<tr>
<td>Exports share of total production $E / Y$</td>
<td>0.40</td>
<td>0.40</td>
</tr>
<tr>
<td>The proportional change in exports $\Delta E / E$</td>
<td>-0.0588</td>
<td>-0.1175</td>
</tr>
</tbody>
</table>

2.2. Including efficiency improvements into the basic model case: Efficiency improvements due to the increase in the average cost of olive oil production (Equations 49, 50 and 51).

<table>
<thead>
<tr>
<th></th>
<th>Small impact</th>
<th>Large impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>The average compliance costs per ton of olive oil</td>
<td>120 €</td>
<td>250 €</td>
</tr>
<tr>
<td>The proportional increase in the compliance unit cost share of olive oil price</td>
<td>0.05</td>
<td>0.10</td>
</tr>
<tr>
<td>Output own-price elasticity $\eta_{op}$</td>
<td>0.47</td>
<td>0.47</td>
</tr>
<tr>
<td>Factor demand elasticity wrt output level $\eta_{xy}$</td>
<td>1.06</td>
<td>1.06</td>
</tr>
<tr>
<td>Share of factor cost in total revenues $wX / pY$</td>
<td>0.41</td>
<td>0.41</td>
</tr>
<tr>
<td>Compliance-induced efficiency parameter $e$</td>
<td>1.52</td>
<td>1.52</td>
</tr>
<tr>
<td>Share of the effective factor cost in total revenues $ZX / pY$</td>
<td>0.27</td>
<td>0.27</td>
</tr>
<tr>
<td>Supply elasticity wrt effective factor price $\eta_{yz}$</td>
<td>-0.05</td>
<td>-0.05</td>
</tr>
<tr>
<td>The compliance costs efficiency elasticity $\eta_{em}$</td>
<td>0.26</td>
<td>0.26</td>
</tr>
<tr>
<td>The proportional change in production $\Delta Y / Y$</td>
<td>-0.0114</td>
<td>-0.0349</td>
</tr>
<tr>
<td>Exports share of total production $E / Y$</td>
<td>0.40</td>
<td>0.40</td>
</tr>
<tr>
<td>The proportional change in exports $\Delta E / E$</td>
<td>-0.0284</td>
<td>-0.0872</td>
</tr>
</tbody>
</table>
2.3. Large country case: Production and exports of olive oil products in the presence of output market price adjustments (Equations 56, 59 and 61).

<table>
<thead>
<tr>
<th></th>
<th>Small impact</th>
<th>Large impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>The average compliance costs per ton of olive oil ( m )</td>
<td>120 €</td>
<td>250 €</td>
</tr>
<tr>
<td>The proportional increase in the compliance unit cost share of olive oil price ( m / p )</td>
<td>0.05</td>
<td>0.10</td>
</tr>
<tr>
<td>Output own-price elasticity ( \eta_{bp} )</td>
<td>0.47</td>
<td>0.47</td>
</tr>
<tr>
<td>Domestic demand elasticity ( \eta_{bp} )</td>
<td>-0.63</td>
<td>-0.63</td>
</tr>
<tr>
<td>Export demand elasticity ( \eta_{bp} )</td>
<td>-3.05</td>
<td>-3.05</td>
</tr>
<tr>
<td>Supply elasticity ( \eta_{Hz} )</td>
<td>-0.05</td>
<td>-0.05</td>
</tr>
<tr>
<td>The compliance costs efficiency elasticity ( \eta_{em} )</td>
<td>0.26</td>
<td>0.26</td>
</tr>
<tr>
<td>Output price elasticity ( \eta_{pm} )</td>
<td>0.22</td>
<td>0.22</td>
</tr>
<tr>
<td><strong>Overall proportional change in production</strong> ( \Delta Y / Y )</td>
<td>+0.0926</td>
<td>+0.0691</td>
</tr>
<tr>
<td>Exports share of total production ( E / Y )</td>
<td>0.40</td>
<td>0.40</td>
</tr>
<tr>
<td>Domestic consumption share of total production ( B / Y )</td>
<td>0.60</td>
<td>0.60</td>
</tr>
<tr>
<td><strong>Overall proportional change in exports</strong> ( \Delta E / E )</td>
<td>+0.4414</td>
<td>+0.3826</td>
</tr>
</tbody>
</table>

In sum, in this scenario we calculated the impact on the production and exports levels of olive oil products as a result of the increase in the average costs per ton of olive oil production for the producer caused by compliance with the policy of Integrated Waste Management for the Olive Oil Pressing Industries. The impact of the increase in the average costs per ton of olive oil production on the production and exports levels was initially calculated to be a decrease of between 2.35-4.70% and 5.88-11.75% respectively. After taking minor efficiency improvements into account, the impact on the production and exports levels was calculated to be a decrease of between 1.14-3.49% and 2.84-8.72% respectively. After including output market price adjustments in the model, the impact on the production and exports levels was calculated to be an increase of between 6.91-9.26% and 38.26-44.14% respectively.

Hence, the overall calculations suggest that the impacts on the Syrian olive oil products, which is 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 6.91-9.26% and 38.26-44.14% increase in the production and exports levels respectively in the case of output price adjustments. Nonetheless, in percentage terms, the range of impacts on the production and exports levels of olive oil products certainly indicates more future satisfactions and strategic thinking with regard to trade competitiveness for the olive oil agro-industrial sector in Syria.
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

(Small impact)

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

(Large impact)
Scenario 3: The output own-price elasticity for the olive oil agro-industrial sector in Syria was estimated to be: $\eta_{yp} = 0.37$ (Grad & Mansour, 2008:34).

1. The impact of the increase in the cost of olives for the producer due to compliance with the policy of IPM for the olive oil agro-industrial sector on the production and exports of Syrian olive oil products (the case of “input-specific” environmental policies)

1.1. The basic model case: The impact of higher olives prices for the producer on the production and exports of olive oil products (Equations 9, 10 and 11).

<table>
<thead>
<tr>
<th></th>
<th>Small impact</th>
<th>Large impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>The proportional increase in the olives price for the producer $\Delta w / w$</td>
<td>0.033</td>
<td>0.067</td>
</tr>
<tr>
<td>Output own-price elasticity $\eta_{yp}$</td>
<td>0.37</td>
<td>0.37</td>
</tr>
<tr>
<td>Input demand elasticity with respect to output $\eta_{xy}$</td>
<td>1.06</td>
<td>1.06</td>
</tr>
<tr>
<td>Share of olives costs in total olive oil revenues $wX / pY$</td>
<td>0.41</td>
<td>0.41</td>
</tr>
<tr>
<td>Output cross price elasticity wrt input price $\eta_{yw}$</td>
<td>-0.16</td>
<td>-0.16</td>
</tr>
<tr>
<td>The proportional change in production $\Delta Y / Y$</td>
<td>-0.0053</td>
<td>-0.0107</td>
</tr>
<tr>
<td>Exports share of total production $E / Y$</td>
<td>0.40</td>
<td>0.40</td>
</tr>
<tr>
<td>The proportional change in exports $\Delta E / E$</td>
<td>-0.0132</td>
<td>-0.0268</td>
</tr>
</tbody>
</table>

1.2. Including efficiency improvements into the basic model case: Efficiency improvements due to higher olives prices (Equations 15, 16 and 17).

<table>
<thead>
<tr>
<th></th>
<th>Small impact</th>
<th>Large impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>The proportional increase in the olives price for the producer $\Delta w / w$</td>
<td>0.033</td>
<td>0.067</td>
</tr>
<tr>
<td>Output cross price elasticity wrt input price $\eta_{yw}$</td>
<td>-0.16</td>
<td>-0.16</td>
</tr>
<tr>
<td>The efficiency of input use elasticity to his price $\eta_{qwe}$</td>
<td>0.58</td>
<td>0.28</td>
</tr>
<tr>
<td>Output cross price elasticity wrt input price $\Psi_{yw}$</td>
<td>-0.07</td>
<td>-0.12</td>
</tr>
<tr>
<td>The proportional change in production $\Delta Y / Y$</td>
<td>-0.0022</td>
<td>-0.0077</td>
</tr>
<tr>
<td>Exports share of total production $E / Y$</td>
<td>0.40</td>
<td>0.40</td>
</tr>
<tr>
<td>The proportional change in exports $\Delta E / E$</td>
<td>-0.0056</td>
<td>-0.0193</td>
</tr>
</tbody>
</table>
1.3. Large country case: Production and exports of olive oil products in the presence of output market price adjustments (Equations 22, 25, 26, 27, 28 and 29).

<table>
<thead>
<tr>
<th></th>
<th>Small impact</th>
<th>Large impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>The proportional increase in the olives price for the producer $\Delta w/w$</td>
<td>0.033</td>
<td>0.067</td>
</tr>
<tr>
<td>Output cross price elasticity wrt input price $\eta_{yw}$</td>
<td>-0.16</td>
<td>-0.16</td>
</tr>
<tr>
<td>The efficiency of input use elasticity to his price $\eta_{qw}$</td>
<td>0.58</td>
<td>0.28</td>
</tr>
<tr>
<td>Output own-price elasticity $\eta_{yp}$</td>
<td>0.37</td>
<td>0.37</td>
</tr>
<tr>
<td>Domestic demand elasticity wrt output price $\eta_{yp}$</td>
<td>-0.63</td>
<td>-0.63</td>
</tr>
<tr>
<td>Export demand elasticity wrt output price $\eta_{yp}$</td>
<td>-3.05</td>
<td>-3.05</td>
</tr>
<tr>
<td>Output cross price elasticity wrt input price $\Psi_{yw}$</td>
<td>-0.07</td>
<td>-0.12</td>
</tr>
<tr>
<td>Output market price elasticity wrt input price $\eta_{pw}$</td>
<td>0.03</td>
<td>0.06</td>
</tr>
<tr>
<td>Price adjustment factor A</td>
<td>0.81</td>
<td>0.81</td>
</tr>
<tr>
<td>Overall supply elasticity wrt input price $\Omega_{yw}$</td>
<td>-0.05</td>
<td>-0.09</td>
</tr>
<tr>
<td>Overall proportional change in production $\Delta Y/Y$</td>
<td>-0.0018</td>
<td>-0.0063</td>
</tr>
<tr>
<td>Exports share of total production $E/Y$</td>
<td>0.40</td>
<td>0.40</td>
</tr>
<tr>
<td>Domestic consumption share of total production $B/Y$</td>
<td>0.60</td>
<td>0.60</td>
</tr>
<tr>
<td>Overall export supply elasticity wrt input price $\Omega_{Ew}$</td>
<td>-0.10</td>
<td>-0.18</td>
</tr>
<tr>
<td>Overall proportional change in exports $\Delta E/E$</td>
<td>-0.0034</td>
<td>-0.0120</td>
</tr>
</tbody>
</table>

In sum, in this scenario we calculated the impact on the production and exports levels of olive oil products as a result of the increase in the cost of olives for the producer caused by compliance with the policy of IPM for the olive oil agro-industrial sector. The impact on the production and exports levels was initially calculated to be a decrease of between 0.53-1.07% and 1.32-2.68% respectively. After taking minor efficiency improvements into account, the impact on the production and exports levels was calculated to be a decrease of between 0.22-0.77% and 0.56-1.93% respectively. After including output market price adjustments in the model, the impact on the production and exports levels was calculated to be a decrease of between 0.18-0.63% and 0.34-1.20% respectively.

Hence, the overall calculations suggest that the impacts of compliance with the policy of IPM on the Syrian olive oil products is within the range of between 0.18-0.63% and 0.34-1.20% decrease in the production and exports levels respectively in the case of output price adjustments. Nonetheless, in percentage terms, the range of impacts certainly indicates some future concerns and more strategic thinking with regard to trade competitiveness for the olive oil agro-industrial sector in Syria.
The impact of the increase in the cost of olives for the producer due to compliance with the policy of IPM for the olive oil agro-industrial sector on the production and exports of Syrian olive oil products

(Small impact)

The impact of the increase in the cost of olives for the producer due to compliance with the policy of IPM for the olive oil agro-industrial sector on the production and exports of Syrian olive oil products

(Large impact)
2. 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 case of wastewater effluents or “end-of-the-pipe” environmental policies)

2.1. The basic model case: The impact of the increase in the average cost of olive oil production for the producer on the production and exports of olive oil products (Equations 35 and 36).

<table>
<thead>
<tr>
<th></th>
<th>Small impact</th>
<th>Large impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>The average compliance costs per ton of olive oil ( m )</td>
<td>120 €</td>
<td>250 €</td>
</tr>
<tr>
<td>The proportional increase in the compliance unit cost share of olive oil price for the producer ( m / p )</td>
<td>0.05</td>
<td>0.10</td>
</tr>
<tr>
<td>Output own-price elasticity ( \eta_{yp} )</td>
<td>0.37</td>
<td>0.37</td>
</tr>
<tr>
<td>The proportional change in production ( \Delta Y / Y )</td>
<td>-0.0185</td>
<td>-0.0370</td>
</tr>
<tr>
<td>Exports share of total production ( E / Y )</td>
<td>0.40</td>
<td>0.40</td>
</tr>
<tr>
<td>The proportional change in exports ( \Delta E / E )</td>
<td>-0.0463</td>
<td>-0.0925</td>
</tr>
</tbody>
</table>

2.2. Including efficiency improvements into the basic model case: Efficiency improvements due to the increase in the average cost of olive oil production (Equations 49, 50 and 51).

<table>
<thead>
<tr>
<th></th>
<th>Small impact</th>
<th>Large impact</th>
</tr>
</thead>
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<tr>
<td>The average compliance costs per ton of olive oil ( m )</td>
<td>120 €</td>
<td>250 €</td>
</tr>
<tr>
<td>The proportional increase in the compliance unit cost share of olive oil price ( m / p )</td>
<td>0.05</td>
<td>0.10</td>
</tr>
<tr>
<td>Output own-price elasticity ( \eta_{yp} )</td>
<td>0.37</td>
<td>0.37</td>
</tr>
<tr>
<td>Factor demand elasticity wrt output level ( \eta_{xy} )</td>
<td>1.06</td>
<td>1.06</td>
</tr>
<tr>
<td>Share of factor cost in total revenues ( wX / pY )</td>
<td>0.41</td>
<td>0.41</td>
</tr>
<tr>
<td>Compliance-induced efficiency parameter ( e )</td>
<td>1.52</td>
<td>1.52</td>
</tr>
<tr>
<td>Share of the effective factor cost in total revenues ( ZX / pY )</td>
<td>0.27</td>
<td>0.27</td>
</tr>
<tr>
<td>Supply elasticity wrt effective factor price ( \eta_{xz} )</td>
<td>-0.05</td>
<td>-0.05</td>
</tr>
<tr>
<td>The compliance costs efficiency elasticity ( \eta_{em} )</td>
<td>0.26</td>
<td>0.26</td>
</tr>
<tr>
<td>The proportional change in production ( \Delta Y / Y )</td>
<td>-0.0064</td>
<td>-0.0249</td>
</tr>
<tr>
<td>Exports share of total production ( E / Y )</td>
<td>0.40</td>
<td>0.40</td>
</tr>
<tr>
<td>The proportional change in exports ( \Delta E / E )</td>
<td>-0.0159</td>
<td>-0.0622</td>
</tr>
</tbody>
</table>
2.3. Large country case: Production and exports of olive oil products in the presence of output market price adjustments (Equations 56, 59 and 61).

<table>
<thead>
<tr>
<th>Calculation</th>
<th>Small impact</th>
<th>Large impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>The average compliance costs per ton of olive oil</td>
<td>120 €</td>
<td>250 €</td>
</tr>
<tr>
<td>The proportional increase in the compliance unit cost share of olive oil price</td>
<td>0.05</td>
<td>0.10</td>
</tr>
<tr>
<td>Output own-price elasticity</td>
<td>0.37</td>
<td>0.37</td>
</tr>
<tr>
<td>Domestic demand elasticity wrt output price</td>
<td>-0.63</td>
<td>-0.63</td>
</tr>
<tr>
<td>Export demand elasticity wrt output price</td>
<td>-3.05</td>
<td>-3.05</td>
</tr>
<tr>
<td>Supply elasticity wrt effective factor price</td>
<td>-0.05</td>
<td>-0.05</td>
</tr>
<tr>
<td>The compliance costs efficiency elasticity</td>
<td>0.26</td>
<td>0.26</td>
</tr>
<tr>
<td>Output price elasticity wrt compliance cost</td>
<td>0.18</td>
<td>0.18</td>
</tr>
<tr>
<td>Overall proportional change in production</td>
<td>ΔY / Y</td>
<td>+0.0609</td>
</tr>
<tr>
<td>Exports share of total production</td>
<td>E / Y</td>
<td>0.40</td>
</tr>
<tr>
<td>Domestic consumption share of total production</td>
<td>B / Y</td>
<td>0.60</td>
</tr>
<tr>
<td>Overall proportional change in exports</td>
<td>ΔE / E</td>
<td>+0.3245</td>
</tr>
</tbody>
</table>

In sum, in this scenario we calculated the impact on the production and exports levels of olive oil products as a result of the increase in the average costs per ton of olive oil production for the producer caused by compliance with the policy of Integrated Waste Management for the Olive Oil Pressing Industries. The impact of the increase in the average costs per ton of olive oil production on the production and exports levels was initially calculated to be a decrease of between 1.85-3.70% and 4.63-9.25% respectively. After taking minor efficiency improvements into account, the impact on the production and exports levels was calculated to be a decrease of between 0.64-2.49% and 1.59-6.22% respectively. After including output market price adjustments in the model, the impact on the production and exports levels was calculated to be an increase of between 4.24-6.09% and 27.82-32.45% respectively.

Hence, the overall calculations suggest that the impacts on the Syrian olive oil products, which is 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 4.24-6.09% and 27.82-32.45% increase in the production and exports levels respectively in the case of output price adjustments. Nonetheless, in percentage terms, the range of impacts on the production and exports levels of olive oil products certainly indicates more future satisfactions and strategic thinking with regard to trade competitiveness for the olive oil agro-industrial sector in Syria.
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

(Small impact)

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

(Large impact)
Scenario 4: The output own-price elasticity is assumed to be: \( \eta_{yp} = 0.27 \).

1. The impact of the increase in the cost of olives for the producer due to compliance with the policy of IPM for the olive oil agro-industrial sector on the production and exports of Syrian olive oil products (the case of “input-specific” environmental policies)

1.1. The basic model case: The impact of higher olives prices for the producer on the production and exports of olive oil products (Equations 9, 10 and 11).

<table>
<thead>
<tr>
<th></th>
<th>Small impact</th>
<th>Large impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>The proportional increase in the olives price for the producer ( \Delta w / w )</td>
<td>0.033</td>
<td>0.067</td>
</tr>
<tr>
<td>Output own-price elasticity ( \eta_{yp} )</td>
<td>0.27</td>
<td>0.27</td>
</tr>
<tr>
<td>Input demand elasticity with respect to output ( \eta_{XY} )</td>
<td>1.06</td>
<td>1.06</td>
</tr>
<tr>
<td>Share of olives costs in total olive oil revenues ( wX / pY )</td>
<td>0.41</td>
<td>0.41</td>
</tr>
<tr>
<td>Output cross price elasticity wrt input price ( \eta_{yw} )</td>
<td>-0.12</td>
<td>-0.12</td>
</tr>
<tr>
<td>The proportional change in production ( \Delta Y / Y )</td>
<td>-0.0039</td>
<td>-0.0078</td>
</tr>
<tr>
<td>Exports share of total production ( E / Y )</td>
<td>0.40</td>
<td>0.40</td>
</tr>
<tr>
<td>The proportional change in exports ( \Delta E / E )</td>
<td>-0.0096</td>
<td>-0.0196</td>
</tr>
</tbody>
</table>

1.2. Including efficiency improvements into the basic model case: Efficiency improvements due to higher olives prices (Equations 15, 16 and 17).

<table>
<thead>
<tr>
<th></th>
<th>Small impact</th>
<th>Large impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>The proportional increase in the olives price for the producer ( \Delta w / w )</td>
<td>0.033</td>
<td>0.067</td>
</tr>
<tr>
<td>Output cross price elasticity wrt input price ( \eta_{yw} )</td>
<td>-0.12</td>
<td>-0.12</td>
</tr>
<tr>
<td>The efficiency of input use elasticity to his price ( \eta_{qw} )</td>
<td>0.58</td>
<td>0.28</td>
</tr>
<tr>
<td>Output cross price elasticity wrt input price ( \Psi_{fw} )</td>
<td>-0.05</td>
<td>-0.08</td>
</tr>
<tr>
<td>The proportional change in production ( \Delta Y / Y )</td>
<td>-0.0016</td>
<td>-0.0056</td>
</tr>
<tr>
<td>Exports share of total production ( E / Y )</td>
<td>0.40</td>
<td>0.40</td>
</tr>
<tr>
<td>The proportional change in exports ( \Delta E / E )</td>
<td>-0.0041</td>
<td>-0.0141</td>
</tr>
</tbody>
</table>
1.3. Large country case: Production and exports of olive oil products in the presence of output market price adjustments (Equations 22, 25, 26, 27, 28 and 29).

<table>
<thead>
<tr>
<th></th>
<th>Small impact</th>
<th>Large impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>The proportional increase in the olives price for the producer $\Delta w / w$</td>
<td>0.033</td>
<td>0.067</td>
</tr>
<tr>
<td>Output cross price elasticity wrt input price $\eta_{yw}$</td>
<td>-0.12</td>
<td>-0.12</td>
</tr>
<tr>
<td>The efficiency of input use elasticity to his price $\eta_{qw}$</td>
<td>0.58</td>
<td>0.28</td>
</tr>
<tr>
<td>Output own-price elasticity $\eta_{yp}$</td>
<td>0.27</td>
<td>0.27</td>
</tr>
<tr>
<td>Domestic demand elasticity wrt output price $\eta_{yp}$</td>
<td>-0.63</td>
<td>-0.63</td>
</tr>
<tr>
<td>Export demand elasticity wrt output price $\eta_{yp}$</td>
<td>-3.05</td>
<td>-3.05</td>
</tr>
<tr>
<td>Output cross price elasticity wrt input price $\Psi_{yw}$</td>
<td>-0.05</td>
<td>-0.08</td>
</tr>
<tr>
<td>Output market price elasticity wrt input price $\eta_{pw}$</td>
<td>0.03</td>
<td>0.05</td>
</tr>
<tr>
<td>Price adjustment factor $A$</td>
<td>0.86</td>
<td>0.86</td>
</tr>
<tr>
<td>Overall supply elasticity wrt input price $\Omega_{yw}$</td>
<td>-0.04</td>
<td>-0.07</td>
</tr>
<tr>
<td>Overall proportional change in production $\Delta Y / Y$</td>
<td>-0.0014</td>
<td>-0.0048</td>
</tr>
<tr>
<td>Exports share of total production $E / Y$</td>
<td>0.40</td>
<td>0.40</td>
</tr>
<tr>
<td>Domestic consumption share of total production $B / Y$</td>
<td>0.60</td>
<td>0.60</td>
</tr>
<tr>
<td>Overall export supply elasticity wrt input price $\Omega_{Ew}$</td>
<td>-0.08</td>
<td>-0.14</td>
</tr>
<tr>
<td>Overall proportional change in exports $\Delta E / E$</td>
<td>-0.0026</td>
<td>-0.0092</td>
</tr>
</tbody>
</table>

In sum, in this scenario we calculated the impact on the production and exports levels of olive oil products as a result of the increase in the cost of olives for the producer caused by compliance with the policy of IPM for the olive oil agro-industrial sector. The impact on the production and exports levels was initially calculated to be a decrease of between 0.39-0.78% and 0.96-1.96% respectively. After taking minor efficiency improvements into account, the impact on the production and exports levels was calculated to be a decrease of between 0.16-0.56% and 0.41-1.41% respectively. After including output market price adjustments in the model, the impact on the production and exports levels was calculated to be a decrease of between 0.14-0.48% and 0.26-0.92% respectively.

Hence, the overall calculations suggest that the impacts of compliance with the policy of IPM on the Syrian olive oil products is within the range of between 0.14-0.48% and 0.26-0.92% decrease in the production and exports levels respectively in the case of output price adjustments. Nonetheless, in percentage terms, this range of impacts certainly indicates some future concerns and more strategic thinking with regard to trade competitiveness for the olive oil agro-industrial sector in Syria.
The impact of the increase in the cost of olives for the producer due to compliance with the policy of IPM for the olive oil agro-industrial sector on the production and exports of Syrian olive oil products

(Small impact)
2. 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 case of wastewater effluents or “end-of-the-pipe” environmental policies)

2.1. The basic model case: The impact of the increase in the average cost of olive oil production for the producer on the production and exports of olive oil products (Equations 35 and 36).

<table>
<thead>
<tr>
<th></th>
<th>Small impact</th>
<th>Large impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>The average compliance costs per ton of olive oil ( m )</td>
<td>120 €</td>
<td>250 €</td>
</tr>
<tr>
<td>The proportional increase in the compliance unit cost share of olive oil price for the producer ( m / p )</td>
<td>0.05</td>
<td>0.10</td>
</tr>
<tr>
<td>Output own-price elasticity ( \eta_p )</td>
<td>0.27</td>
<td>0.27</td>
</tr>
<tr>
<td>The proportional change in production ( \Delta Y / Y )</td>
<td>-0.0135</td>
<td>-0.0270</td>
</tr>
<tr>
<td>Exports share of total production ( E / Y )</td>
<td>0.40</td>
<td>0.40</td>
</tr>
<tr>
<td>The proportional change in exports ( \Delta E / E )</td>
<td>-0.0338</td>
<td>-0.0675</td>
</tr>
</tbody>
</table>

2.2. Including efficiency improvements into the basic model case: Efficiency improvements due to the increase in the average cost of olive oil production (Equations 49, 50 and 51).

<table>
<thead>
<tr>
<th></th>
<th>Small impact</th>
<th>Large impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>The average compliance costs per ton of olive oil ( m )</td>
<td>120 €</td>
<td>250 €</td>
</tr>
<tr>
<td>The proportional increase in the compliance unit cost share of olive oil price ( m / p )</td>
<td>0.05</td>
<td>0.10</td>
</tr>
<tr>
<td>Output own-price elasticity ( \eta_p )</td>
<td>0.27</td>
<td>0.27</td>
</tr>
<tr>
<td>Factor demand elasticity wrt output level ( \eta_{xy} )</td>
<td>1.06</td>
<td>1.06</td>
</tr>
<tr>
<td>Share of factor cost in total revenues ( wX / pY )</td>
<td>0.41</td>
<td>0.41</td>
</tr>
<tr>
<td>Compliance-induced efficiency parameter ( e )</td>
<td>1.52</td>
<td>1.52</td>
</tr>
<tr>
<td>Share of the effective factor cost in total revenues ( ZX / pY )</td>
<td>0.27</td>
<td>0.27</td>
</tr>
<tr>
<td>Supply elasticity wrt effective factor price ( \eta_{xz} )</td>
<td>-0.05</td>
<td>-0.05</td>
</tr>
<tr>
<td>The compliance costs efficiency elasticity ( \eta_{en} )</td>
<td>0.26</td>
<td>0.26</td>
</tr>
<tr>
<td>The proportional change in production ( \Delta Y / Y )</td>
<td>-0.0014</td>
<td>-0.0149</td>
</tr>
<tr>
<td>Exports share of total production ( E / Y )</td>
<td>0.40</td>
<td>0.40</td>
</tr>
<tr>
<td>The proportional change in exports ( \Delta E / E )</td>
<td>-0.0034</td>
<td>-0.0372</td>
</tr>
</tbody>
</table>
2.3. Large country case: Production and exports of olive oil products in the presence of output market price adjustments (Equations 56, 59 and 61).

<table>
<thead>
<tr>
<th></th>
<th>Small impact</th>
<th>Large impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>The average compliance costs per ton of olive oil ( m )</td>
<td>120 €</td>
<td>250 €</td>
</tr>
<tr>
<td>The proportional increase in the compliance unit cost share of olive oil price ( m / p )</td>
<td>0.05</td>
<td>0.10</td>
</tr>
<tr>
<td>Output own-price elasticity ( \eta_{yp} )</td>
<td>0.27</td>
<td>0.27</td>
</tr>
<tr>
<td>Domestic demand elasticity wrt output price ( \eta_{bp} )</td>
<td>-0.63</td>
<td>-0.63</td>
</tr>
<tr>
<td>Export demand elasticity wrt output price ( \eta_{ep} )</td>
<td>-3.05</td>
<td>-3.05</td>
</tr>
<tr>
<td>Supply elasticity wrt effective factor price ( \eta_{iz} )</td>
<td>-0.05</td>
<td>-0.05</td>
</tr>
<tr>
<td>The compliance costs efficiency elasticity ( \eta_{em} )</td>
<td>0.26</td>
<td>0.26</td>
</tr>
<tr>
<td>Output price elasticity wrt compliance cost ( \eta_{pm} )</td>
<td>0.14</td>
<td>0.14</td>
</tr>
<tr>
<td><strong>Overall proportional change in production</strong> ( \Delta Y / Y )</td>
<td>+0.0359</td>
<td>+0.0224</td>
</tr>
<tr>
<td>Exports share of total production ( E / Y )</td>
<td>0.40</td>
<td>0.40</td>
</tr>
<tr>
<td>Domestic consumption share of total production ( B / Y )</td>
<td>0.60</td>
<td>0.60</td>
</tr>
<tr>
<td><strong>Overall proportional change in exports</strong> ( \Delta E / E )</td>
<td>+0.2205</td>
<td>+0.1867</td>
</tr>
</tbody>
</table>

In sum, in this scenario we calculated the impact on the production and exports levels of olive oil products as a result of the increase in the average costs per ton of olive oil production for the producer caused by compliance with the policy of Integrated Waste Management for the Olive Oil Pressing Industries. The impact of the increase in the average costs per ton of olive oil production on the production and exports levels was initially calculated to be a decrease of between 1.35-2.70% and 3.38-6.75% respectively. After taking minor efficiency improvements into account, the impact on the production and exports levels was calculated to be a decrease of between 0.14-1.49% and 0.34-3.72% respectively. After including output market price adjustments in the model, the impact on the production and exports levels was calculated to be an increase of between 2.24-3.59% and 18.67-22.05% respectively.

Hence, the overall calculations suggest that the impacts on the Syrian olive oil products, which is 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 2.24-3.59% and 18.67-22.05% increase in the production and exports levels respectively in the case of output price adjustments. Nonetheless, in percentage terms, the range of impacts on the production and exports levels of olive oil products certainly indicates more future satisfactions and strategic thinking with regard to trade competitiveness for the olive oil agro-industrial sector in Syria.
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

(Small impact)

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

(Large impact)
A sensitivity analysis: Summary of all scenarios put forward for the possible estimations and assumptions of the output own-price elasticity for the olive oil agro-industrial sector

1. The impact of the increase in the cost of olives for the producer due to compliance with the policy of IPM for the olive oil agro-industrial sector on the production and exports of Syrian olive oil products (the case of “input-specific” environmental policies)

<table>
<thead>
<tr>
<th>Small impact</th>
<th>Large impact</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>The proportional increase in the olives price for the producer</strong></td>
<td><strong>0.033</strong></td>
</tr>
<tr>
<td>Output own-price elasticity</td>
<td>0.56</td>
</tr>
<tr>
<td>Input demand elasticity with respect to output</td>
<td>1.06</td>
</tr>
<tr>
<td>Domestic demand elasticity wrt output price</td>
<td>-0.63</td>
</tr>
<tr>
<td>Export demand elasticity wrt output price</td>
<td>-3.05</td>
</tr>
</tbody>
</table>

**The basic model**

| The proportional change in production | -0.0080 | -0.0067 | -0.0053 | -0.0039 | -0.0162 | -0.0136 | -0.0107 | -0.0078 |
| The proportional change in exports | -0.0200 | -0.0168 | -0.0132 | -0.0096 | -0.0406 | -0.0341 | -0.0268 | -0.0196 |

**With efficiency improvements**

| The proportional change in production | -0.0034 | -0.0028 | -0.0022 | -0.0016 | -0.0117 | -0.0098 | -0.0077 | -0.0056 |
| The proportional change in exports | -0.0084 | -0.0071 | -0.0056 | -0.0041 | -0.0292 | -0.0245 | -0.0193 | -0.0141 |

**With output market price adjustments**

| The proportional change in production | -0.0025 | -0.0022 | -0.0018 | -0.0014 | -0.0087 | -0.0076 | -0.0063 | -0.0048 |
| The proportional change in exports | -0.0047 | -0.0042 | -0.0034 | -0.0026 | -0.0165 | -0.0145 | -0.0120 | -0.0092 |
1: The basic model; 2: With efficiency improvements; 3: With output market price adjustments.

The impact of the increase in the cost of olives for the producer due to compliance with the policy of IPM for the olive oil agro-industrial sector on the production and exports of Syrian olive oil products (Small impact)

The impact of the increase in the cost of olives for the producer due to compliance with the policy of IPM for the olive oil agro-industrial sector on the production and exports of Syrian olive oil products (Large impact)
In sum, the overall calculate suggests that the impacts on the olive oil agro-industrial sector, which is resulting from the enforcement of compliance with the policy of IPM, is within the range of between 0.14-0.48% and 0.26-0.92% decrease in the production and exports levels respectively in the case of output price adjustments. In other words, the lower the output own-price elasticity means that the lower the resultant negative impact of compliance with the policy of IPM on the production and exports levels of olive oil products will be. This elasticity is considered reasonably consistent with a general perception of inelastic supply response in the olive oil sector due to the special climatic conditions and the long time period required before young olives trees give fruit. Nonetheless, in percentage terms, the range of impacts on the production and exports levels of olive oil products certainly indicates some future concerns and more strategic thinking with regard to trade competitiveness for the olive oil agro-industrial sector in Syria.

2. 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 case of wastewater effluents or “end-of-the-pipe” environmental policies)

<table>
<thead>
<tr>
<th></th>
<th>Small impact</th>
<th>Large impact</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>The proportional increase in the</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>compliance unit cost share of olive oil</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>price**</td>
<td>0.05</td>
<td>0.10</td>
</tr>
<tr>
<td>Output own-price elasticity</td>
<td>0.56</td>
<td>0.47</td>
</tr>
<tr>
<td>Domestic demand elasticity wrt output price</td>
<td>-0.63</td>
<td>-0.63</td>
</tr>
<tr>
<td>Export demand elasticity wrt output price</td>
<td>-3.05</td>
<td>-3.05</td>
</tr>
<tr>
<td><strong>The basic model</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The proportional change in production</td>
<td>-0.0280</td>
<td>-0.0235</td>
</tr>
<tr>
<td>The proportional change in exports</td>
<td>-0.0700</td>
<td>-0.0588</td>
</tr>
<tr>
<td><strong>With efficiency improvements</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The proportional change in production</td>
<td>-0.0159</td>
<td>-0.0114</td>
</tr>
<tr>
<td>The proportional change in exports</td>
<td>-0.0397</td>
<td>-0.0284</td>
</tr>
<tr>
<td><strong>With output market price adjustments</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The proportional change in production</td>
<td>0.1262</td>
<td>0.0926</td>
</tr>
<tr>
<td>The proportional change in exports</td>
<td>0.5561</td>
<td>0.4414</td>
</tr>
</tbody>
</table>
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 (Small impact)

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 (Large impact)
In sum, the overall calculate suggests that the impacts on the olive oil agro-industrial sector, which is 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 9.82-12.62% and 48.61-55.61% increase in the production and exports levels respectively in the case of output price adjustments. In other words, the higher the output own-price elasticity means that the higher the resultant positive impact of compliance with the policy of Integrated Waste Management for the Olive Oil Pressing Industries on the production and exports levels of olive oil products will be.

On the other hand, the overall calculate suggests that the impacts on the olive oil agro-industrial sector, which is 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 1.35-2.70% and 3.38-6.75% decrease in the production and exports levels respectively in the basic model case. Thus, the lower the output own-price elasticity means that the lower the resultant negative impact of compliance with the policy of Integrated Waste Management for the Olive Oil Pressing Industries on the production and exports levels of olive oil products will be.

This elasticity is considered reasonably consistent with a general perception of inelastic supply response in the olive oil agro-industrial sector due to the special climatic conditions and the long time period required before young olives trees give fruit. Nonetheless, in percentage terms, the range of impacts on the production and exports levels of olive oil products certainly indicates more future satisfactions and strategic thinking with regard to trade competitiveness for the olive oil agro-industrial sector in Syria.
References


Curriculum Vitae

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1998 – 1999: Diploma's Degree in International Economics Relations, Faculty of Economics, Tishreen University, Syria.
1994 – 1998: Bachelor's Degree in Economics, Faculty of Economics, Tishreen University, Syria.

Languages:

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- German: Basic
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Chemnitz, December 20, 2012

Mohamad Ahmad
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Mohamad Ahmad