

Environmental Impacts of Trade Liberalization: The Case of Egypt

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Abstract

With rising globalization and advances in technology, the impact of trade on environment has increasingly become a vital issue across the world. This paper contributes to this discussion by evaluating the environmental impacts of trade liberalization in Egypt using time series data over the period of 1980-2007. In this context, cointegration analysis is utilized to examine the long-run relationship among the variables, as well as a vector error correction model to determine the short-run dynamics of the system. Results confirm the theoretical concept of the absence of a one-way relationship between trade and environment. For both air and land pollution, the result is rather ambiguous. There are two opposing forces affecting environmental quality in the long run. The ultimate trade effect on environment would be highly dependent on environmental regulations and their enforcement.

أثر تحرير التجارة الدولية على البيئة : حالة مصر

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ملخص

في ظلّ الإتجاه المتزايد للعولمة والتقدم التكنولوجي الذي يشهده الاقتصاد العالمي منذ أكثر من عقدين ، ظهرت قضية تأثير التجارة الدولية على البيئة كأحد أهم القضايا التي تستحوذ على اهتمام كل من الباحثين وصانعي القرار . وتأتي هذه الدراسة للمساهمة في حسم الجدل الدائر حول هذه القضية عن طريق قياس وتحليل أثر تحرير التجارة الدولية على البيئة في مصر خلال الفترة من 1980 إلى 2007 . وتستخدم الدراسة أسلوب تناظر النكامل لاختبار العلاقة طويلة الأجل بين المتغيرات ، بالإضافة إلى نموذج متجه تصحيح الخطأ لتحديد العلاقة في الأجل القصير . وقد جاءت نتائج الدراسة لتؤكد النتيجة النظرية بعدم وجود تأثير مجدّد سواء بالموجب أو السالب لتحرير التجارة الدولية على البيئة . فإظهرت النتائج وجود قوتين متضادتين لتأثير تحرير التجارة على البيئة في الأجل الطويل ، بحيث يعتمد الأثر النهائي على وجود قوانين حماية البيئة وكذلك على جدية تفعيلها .

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1. Introduction

The relationship between international trade and the environment has increasingly become a debatable issue across the globe. For the last ten years, environmentalists and the trade policy community have engaged in a debate over the environmental impacts of trade liberalization. Economists argue that expanding trade from domestic market to international market not only increases market share of each country but also raises competition among nations and improves the efficiency of utilizing scarce resources. On the other hand, environmental economists oppose such argument and claim that liberalizing trade among nations will result in the depletion of natural resources and deterioration of environmental quality (Khalil and Inam, 2006).

The debate was originally fueled by negotiations over the North American Free Trade Agreement and the Uruguay round of General Agreement on Tariffs and Trade (GATT). This was followed by the creation of the World Trade Organization (WTO) and the following rounds of trade negotiations (Copeland and Taylor, 2003). Recently, this debate has been intensified with globalization and advances in technology coupled by the growing concerns related to global warming, species extinction and industrial pollution. This is in addition to the emphasis given to the concept of sustainable development, linking the issue of longer-term growth with trade and environment (Cosbey et al., 2005).

Theoretical literature has relatively been successful in identifying linkages between openness to trade and environmental quality. It states that trade liberalization can affect the environment through three channels namely: (a) the technique effect; (b) the composition effect; and (c) the scale effect (Antweiler et al. 2001). The technique or method effect involves the use of different methods of production that have different environmental impacts. This is due to the possibility of substitution between different inputs following trade liberalization. The composition effect arises from the fact that each good has its own polluting tendency. The composition of traded goods therefore can determine the extent of pollution in any given society. In the case of the scale effect, pollution is the by-product of production and consumption. Thus, increases in the scale of economic activity may definitely affect pollution. (Azhar et al., 2007).

Empirical evidence on the impact of trade liberalization on the environment is rare and largely limited to developed countries. Furthermore, earlier research on the issue focused on cross-country investigations that are considered sensitive to the choice of pollutants and to the countries included in the sample. However, in recent years, an increased emphasis has been placed on examining the experience of individual countries

so that policy frameworks are suggested according to their unique circumstances and resources (Azhar et al., 2007; Khalil and Inam, 2006).

Accordingly, the current study aims at contributing to existing empirical research by evaluating the environmental impacts of trade liberalization in Egypt using econometric techniques. This is in an attempt to determine the extent and nature of each of the previously mentioned effects and how their negative impact can be minimized in the Egyptian case. The importance of these findings is intensified in light of the fact that Egypt's ranking according to the Environmental Sustainability Index (ESI) deteriorated from 74 in 2002 to 115 in 2005.⁽¹⁾ This seems to be the initial empirical attempt to study the linkage between trade liberalization and environment in Egypt.

2. Theoretical Overview

According to the existing literature, the relationship between trade liberalization and environment does not follow a simple pattern. Instead, trade may harm or benefit the environment. In fact, it may be harmful in some aspects and useful in others depending on sectors or countries under study, in addition to prevailing policies. This implies that analyzing this relationship is better done on a case by case basis. In this context, the environmental impact of trade liberalization may be divided into five main categories that interact to determine the overall impact: (a) scale effects; (b) composition or structural effects; (c) technique effects; (d) direct effects; and (e) regulatory effects (Nordström and Vaughan, 1999; Frankel, 2003; Fredriksson, 1999; IISD, 2005 and Cosbey et. al, 2005).

Scale Effect

International trade and trade liberalization is usually expected to increase the level of economic activity in the country and consequently, the country's GDP. Economic theory since Smith and Ricardo's idea of comparative advantage, has been advocating this theoretical concept (Copeland and Taylor, 2001). However, the effect of this expansion in economic activity and income on the environment is not straightforward as it incorporates direct and indirect effects. A negative direct scale effect is associated with the increase in physical scale of production due to trade. This is because greater economic activity increases pollution and harms the environment through raising demand for inputs (Fredriksson, 1999), extracting raw materials, consuming renewable resources, creating wastes and increasing emissions (IISD, 2005). This emphasizes the importance of regulations to ensure that additional economic activities cause no harm (op cit.).

The indirect scale effect of expansion of economic activity resulting from trade, stems from the associated increase in income. This has both positive and negative effects on the environment. On one hand, increase in income resulting from trade means increase in consumption, which in turn can bring increased pollution and factor draw down of resources, especially in the absence of appropriate environment policies (Medalla and Lazaro, 2005). On the other hand, a higher level of income brought about by increased production due to trade, will increase the demand for environmental quality, as people value their standard of living as measured by both GDP and the environment (Frankel and Rose, 2002).

Composition Effect⁽²⁾

Trade liberalization induces specialization, which lead to changes in the structure of the country's economy. According to international economic theory, production shifts to produce more of the good or services that the country has a comparative advantage in producing it. Accordingly, the composition effect can be either positive or negative with respect to the environment. On the positive side, if the country's comparative advantage is in clean industries, trade liberalization will decrease pollution. On the negative side, if the goods that a country enjoy a comparative advantage in is pollution intensive industries, then in the absence of appropriate environment policies, trade liberalization will increase the production of this good and consequently increase pollution and harm the environment – (Barbier and Burgess, 2001; IISD, 2005; Medalla and Lazaro, 2005).

In this context, international trade is expected to redistribute pollution problems from countries that have comparative advantage in less polluting goods or services to countries that have comparative advantage in more polluting goods or services (Nordström and Vaughan, 1999). Hence, the comparative effect for a certain country depends on its comparative advantage. However, it bears asking the question: What determines this comparative advantage?

There are two major possible determinants of comparative advantage (Frankel 2003; Copeland and Taylor, 2003; Fredriksson , 1999):

- According to the neoclassical trade theory of Hecksher–Ohlin, the comparative advantage is determined by standard factors such as factor endowments and natural resources endowments (Hecksher and Ohlin 1991). For example, capital-intensive goods are considered pollution-intensive goods. Hence,

composition effect for capital-abundant nations will be negative. Thus, trade liberalization would increase pollution.

- An alternative approach is the Pollution Haven hypothesis that states that comparative advantage will be determined by difference in environmental regulations between trading countries. Countries with relatively weak environmental policies will have a comparative advantage in pollution-intensive goods, so the composition effect will be negative and vice versa (Frankel, 2003; Copeland and Taylor, 2003). There are several reasons for differences in regulations between countries. It may be demand-driven; arising, for example, from differences in income. Higher income shifts demand towards cleaner goods, that is, clean goods are relatively income-elastic (Frankel, 2003 and Dean, 1999). Alternatively, it could be supply-driven, arising from difference in supply of environment quality due to, for instance, differences in population density (Frankel 2003). Countries with high land per capita have weaker regulations and become pollution havens compared to those that are more densely populated (Frankel and Rose, 2002).⁽³⁾

Technique Effect

The technique effect refers to changes in production methods that follow trade liberalization resulting in a change in pollution emission per unit of output. This effect could harm or benefit the environment (Najam et al., 2007). On one hand, technique effect could result in a decrease in pollution emissions per unit of output when trade involves the adoption of cleaner production techniques. This could be achieved through one of two channels: (a) Firstly, trade may lead to imported efficiency where foreign investment brings modern technology that is likely to be more efficient and cleaner than the older ones. (b) Secondly, if income increases due to trade liberalization, this may result in an increase in demand for clean environment. If clean environment is income-elastic, then this will be reflected in an increase in affluent charges, as people will accept higher levels of pollution only if these charges are higher. These higher affluent charges encourage firms to use cleaner production techniques thereby reducing emissions (Fredriksson, 1999; Dean, 1999). On the other hand, a negative technique effect may occur if trade brings imports of outdated technologies that are less clean due to weak environmental regulation set by governments. This is in an attempt to compete for environment and jobs (Copeland and Taylor, 2000; Dean, 1999).

Whether the overall technique effect is positive or negative, will depend on conditions and policies that determine availability and choices of technology in the country – mainly prices and environmental regulation. Accordingly, technique effect is ambiguous. However, it is generally believed to be positive for environmental quality, especially if it is accompanied by effective environmental policies (Fredriksson, 1999; Copeland and Taylor, 2003).

Income Effects

Based on the previous analysis, income increases associated with trade liberalization has three effects on the environment. Greater economic growth resulting in an increased income causes an increase in consumption hence increasing pollution scale effect. However, as income increases, demand for cleaner environment increases causing a decrease in pollution technique effect. Finally, income growth increases demand for cleaner goods causing a decrease in the share of pollution-intensive goods in output composition effect (Dean, 1999). Therefore, trade liberalization, through its effect on raising income, increases pollution directly through scale effect but decreases pollution indirectly through both composition and technique effects (Fredriksson, 1999).

According to the existing literature, the relationship between income and environmental quality is governed by the Environmental Kuznets Curve (EKC) (Kuznets, 1955) and introduced by the pioneering work of Grossman and Krueger (1993) on the North American Free Trade Agreement (NAFTA) (Frankel and Rose, 2002; Copeland and Taylor, 2003). It represents an inverse U-shaped relationship between a country's per capita income and its level of environmental quality. It shows that increased income will lead to increased pollution in poor countries and a decline in pollution in rich countries (Copeland and Taylor, 2003). This means that pollution levels increases with the increase in income at low-income level but later on, pollution is reduced as countries become rich. The standard theoretical rationale is that increased production makes some pollution unavoidable but the demand for environmental quality rises with income (Frankel and Rose, 2002). This is better explained by the interaction between the previously mentioned scale, composition and technique effects (Fredriksson, 1999). The inverted U-shaped Kuznets curve suggests that at low income level, the scale effect outweighs the composition and technique effects, causing an increase in pollution levels. As income level increases, the scale effect becomes weaker until the level of income at which composition and technique effects outweighs the negative scale effect thereby resulting in a reduction in pollution levels (Dean, 1999).

Direct Effects

Trade has also a direct effect on environment related to the act of trade itself. International trade in itself, can harm the environment through many aspects. The first is related to the increase in pollution resulting from the transportation of traded goods which increases emissions of carbon dioxide (CO_2) and sulphur dioxide (SO_2) (Copeland and Taylor, 2001; Cosbey et al., 2005). The second direct effect arises when trade liberalization leads to an increase in the trade of goods that are environmentally harmful like hazardous wastes. Accordingly, the risk of accidental exposure to such wastes increases. However, this only occurs if cross border transport of such materials implies a longer trip than within the country transport (Cosbey et al., 2005; Medalla and Lazaro, 2005). A final direct effect of trade liberalization on environment stems from the effect that trade may have on the spread of invasive species of plants and animal that are unintentionally transported with traded goods.⁽⁴⁾

In summary, the five main effects of trade on the environment described above confirm that the links between trade and the environment are complex and multiple. Trade liberalization is neither necessarily beneficial nor harmful to the environment. This depends on the relative weight of each of these effects, which in turn differ among countries. Hence, the net environmental impact of international trade is ambiguous. It is therefore useful to quantify the relative magnitude of these effects and their net effect on individual country basis. Hence, this is the main objective of this study using Egypt as the scenario.

3. Empirical Literature

The empirical literature concerning the relationship between trade and environment has developed in three main tracks. Firstly, there are studies that primarily examine the link between income or growth and environmental quality that is the validity of the EKC. The results of these studies are often interpreted as indicative of the relative strength of the scale effect versus the technique effect (Antweiler et al., 2001). The second group of studies examines how the level of abatement costs or firmness of pollution regulations in the trading partner countries may themselves affect trade flows. In other words, it shows how differences in environmental regulations can reverse the classical pattern of comparative advantage that is the validity of the Pollution Haven Hypothesis (Antweiler et al., 2001 and Nordstrom et al., 1999). Finally, there are those studies that attempt to explicitly estimate and then add up the scale, composition and technique effects of trade liberalization.

Growth and Environment

The empirical literature linking economic growth to environmental outcomes has flourished over the past decade following the influential study of Grossman and Krueger (1993). Most of this work focused on either verifying the existence of similar relationships across different pollutants, while using additional explanatory variables, such as income inequality or political freedom, or testing the robustness of previous studies. However, environmental impact of growth or more precisely, the applicability of the Kuznets curve is still a controversial issue in literature. Many studies support the existence of this relationship. The study of Grossman and Krueger (1993) – which is considered one of the most widely cited examples of the existence of an EKC – used panel data on air quality from 42 countries. It found a hump-shaped relation between some measures of air quality such as SO₂ concentrations and per capita income. Selden and Song (1994) using data on SO₂ emissions, confirmed a similar pattern. Hilton and Levinson (1998) examined the link between automotive lead emissions and income per capita using a panel of 48 countries over the period 1972–1992. Their study concluded a strong evidence of an inverted U-shaped relationship between lead emissions and per capita income. Foster and Rosenzweig (2003) found supportive evidence in the time series study for India.

Another group of studies pointed out that the relationship depends on the type of pollutant used, such as those of Grossman and Krueger (1995) and Shafik and Banyopadhyay (1992). For some pollutants, such as contaminated drinking water, pollution decreases monotonically with income per capita; while for others, such as carbon emissions, pollution is likely to rise with income per capita. Shafik (1994) found evidence of the inverted-U shape for deforestation, suspended Particulate Materials (PM) and SO₂, but not for water pollution and some other measures. Bradford, Schlieckert and Shore (2000) obtained evidence of the EKC for arsenic, chemical oxygen demand (COD), dissolved oxygen, lead and SO₂, but found more negative results in the cases of PM and some other measures of pollution.

However, some studies have empirically proved that such relationship between per capita income and environmental quality does not hold. Koop and Tole (1999) found no evidence of any empirical relationship between deforestation and per capita income. Stern and Common (2001) compared 73 countries of the Organization for Economic Co-operation and Development (OECD) and non-OECD countries using data on sulfur emissions over 31 years and concluded that the data do not support a common EKC across countries. Similarly, List and Gallet (1999) studied SO₂ and

nitrogen dioxide NO_2 emissions in US states over 65 years and discovered no evidence of a common EKC across states. Cropper and Griffiths (1994) found little evidence across countries of an EKC for forest growth.

On the other hand, a growing body of work tested the robustness of previous studies and generally found that the relationship is sensitive to the sample used. Harbaugh et al. (2002) examined the robustness of the work of Grossman and Krueger (1993) and pointed out that the shape of the curve is sensitive to the functional form used, the time period chosen and the set of countries included in the study. Barbier and Burgess (2001) confirmed that income effects tend to vary from region to region, and do not always exhibit an EKC relationship.

Finally, few recent studies focused on assessing the rationale behind the EKC. This kind of studies is essential to understand how growth or trade affects the environment. The previously mentioned Hilton and Levinson (1998) study is considered the first to address directly the scale and technique effects that together result in an EKC. It factored the changes in pollution into two components: (a) technique effect; and (b) scale effect. The technique effect is found to produce an almost monotonic negative relationship between lead content per gallon of gasoline and income per capita, while the scale effect links greater gasoline use to greater income. Gale and Mendez (1998) presented another paper that tried to evaluate the significance of composition effect in determining differences in pollution levels across countries. They regressed pollution concentrations (sulfur dioxide data) on factor endowment data for a group of countries, as well as an income indicator that captures scale and technique effects. They found a strong relationship between capital abundance and pollution concentrations even after controlling for incomes per capita differences between countries. This result signaled a strong role of factor composition that affects pollution demand.

A review of literature reveals two studies assessing the relative importance of scale, technique and composition effects in accounting for changes in pollution. Selden, Forest and Lockhart (1999) tried to assess the relative importance of scale, technique and composition effects in affecting pollution levels in the USA. They compared emissions of 6 air pollutants in 1970 and 1990, and then decomposed the observed changes into changes in scale of economic activity, composition of economic activity (resulting from changes in sectors shares of output) and technical changes in emissions per unit of output. Their results showed that technique effects played an important role in explaining the decrease in emissions. There was evidence of the presence of composition effect, but it was not strong enough to explain the observed decline in aggregate emissions during the period of study.

With the same objective, but applying a more sophisticated methodology, Hettige, Mani and Wheeler (2000) attempted to separate composition and technique effects, and explain how they vary with income using panel data on industrial water pollution for 12 countries. Firstly, they divided pollution into manufacturing pollution intensity, share of manufacturing in the economy, and total output. They then regressed each of the firm level pollution intensities, average pollution intensity in manufacturing, and manufacturing share on per capita income. They found evidence of composition effect – a hump-shaped relation between the share of manufactures and per capita income. However, this composition effect is small in magnitude relative to the scale effect. They also found evidence of a strong technique effect (the income elasticity of the pollution intensity was about -1). They concluded that industrial water pollution tends to rise with income and then decline, with the strong technique effect being responsible for offsetting the scale effect of growth. In other words, they found evidence of an EKC for industrial water pollution.

Based on the previous review of empirical work on the EKC, it may be generalized that there is no simple, predictable relationship between pollution and income. Empirical work finds that the shape of this relationship is sensitive to functional form, the sample of countries, pollutants used, and the time period chosen. The existing literature on EKC has made two important contributions: (a) It has highlighted important empirical questions about how trade and growth affect the environment; and (b) It has offered reasonably compelling evidence that income effect can raise environmental quality.

Pollution Haven Hypothesis vs Classical Pattern of Comparative Advantage

It is now time to turn to empirical studies focusing on other channels through which international trade can affect the environment. Trade may promote a relocation of polluting industries from countries with strict environmental policy to those with less strict policy. This goes along with the Pollution Haven Hypothesis. These shifts may in turn increase pollution or they may have a race to the bottom effect on environmental policy. Countries will be reluctant to tighten environmental regulations because of concerns over international competitiveness. Accordingly, this group of studies focuses on testing the Pollution Haven Hypothesis versus the classical Factor Endowment Hypothesis as a determinant of comparative advantage and hence, trade pattern.

Most of the early work in this regard suggested that environmental regulation is not the main determinant of firms' comparative advantage. In other words, most evidence

did not support the Pollution Haven Hypothesis. Issues – such as labor costs and market access – were considered more important than the strictness of local environmental regulation (Busse, 2004; Baumert and Kete, 2002; Jaffe et al., 1995; Sorsa, 1994; Low and Yeats, 1992; Tobey, 1990; Kalt, 1988).⁽⁵⁾ This is justified by the fact that polluting industries tend to be capital-intensive, and that abatement costs – even in countries with the most strict regulations – represent a small percentage of production costs.

However, most of the recent empirical research found that differences in environmental policies can affect trade flows (Lee and Roland-Holst, 1997; Smarzynska and Wei, 2001; Levinson and Taylor, 2008; Ederington and Minier, 2003). These studies explicitly took account of the endogeneity of pollution policy and country-specific variables that may affect trade flows. However, a number of these recent researches failed to reach conclusive results concerning the Pollution Haven Hypothesis vs the traditional Natural Endowments Hypothesis (Frankel and Rose, 2002).

In summary, earlier evidence do not appear to support the view that developing countries are gaining a comparative advantage in pollution-intensive production because of weak environmental regulations. Rather, they seem to demonstrate that developed countries are strengthening their position in polluting industries, which implies that classical factors of comparative advantages dominate over difference in environmental regulations. Nevertheless, recent work has been explicitly taking into account the endogeneity of pollution policy when examining the impact of stricter pollution regulations on trade flows. This has caused a significant reversal of earlier results. It supports the existence of a pollution haven effect. In other words, it shows that stricter environmental policies would restrict dirty production, but with no evidence that this effect is strong enough to be the key determinant of the direction of trade flows.

Scale, Composition and Technique Effects

Looking at studies to explain variation in pollution levels by scale, composition and technique effects, the report of Antweiler, Copeland, and Taylor (1998) is considered the first study to explicitly estimate scale, composition and technique effects separately. This study pointed out that freer trade is good for the environment. It developed a theoretical model to divide the impact of trade on pollution into scale, technique and composition effects and then estimate and add up these effects using data on ground level SO₂ concentration. It used a panel of 44 countries over the period 1971 to 1996. Both factor endowment and pollution haven motives for trade were allowed for. This

study differs from the previous ones in the importance given to the role of theory in developing and examining the hypotheses, and in the use of a consistent data set to estimate all three effects of trade. The study found a highly significant, but relatively small composition effect created by further trade liberalization.⁽⁶⁾ Moreover, the results showed that the composition effect of trade is more likely to be pollution increasing for high-income countries. Since capital-labor ratios are higher in high-income countries, this result suggested that traditional factor endowment determinants of trade are more important than the Pollution Haven Hypothesis. Thus, richer countries seem to have a comparative advantage in emission-intensive goods. At the same time, the estimates indicated that the technique effect dominated the scale effect. Other things being equal, a 1% increase in the scale of economic activity raised SO₂ concentration by 0.3%. The technique effect, resulting from higher income levels, decreased pollution by 1.4%. This resulted in a net reduction of 1.1%. Thus, income gains created by freer trade, led to a net reduction in pollution concentrations from the scale and technique effects.

Frankel and Rose (2002) stated that although Antweiler et al. (1998) was probably the most intensive existing study explicitly focusing on the effects of trade on environment, it did not take into consideration that trade may be the result of other factors rather than the cause, i.e., the endogeneity problem. Hence, they tested whether the endogeneity of trade could explain the results of Antweiler et al. (1998). They applied an EKC framework in which openness to trade was added as an additional explanatory variable. Their main result was that controlling for the endogeneity of openness did not significantly affect these earlier results.

Cole and Elliot (2003) used national emission data to examine the impact of trade liberalization on several kinds of pollutants. They used the Antweiler et al.'s approach to isolate the composition effect of trade but they did not distinguish between scale and technique effects. Their results confirmed Antweiler and co-researchers' results for SO₂ and found similar results on composition effects for CO₂. However, their evidence indicated that Biological Oxygen Demand (BOD) and NO₂ responded differently to trade liberalization, suggesting the importance of including other pollutants in future studies.

Grether et al (2007) represented a new framework to analyze how trade, through reallocating production across countries and sectors, affects the overall level of SO₂ emissions worldwide. They tried to overcome the lack of disaggregated data linking pollution directly to production and to the resulting trading activities.⁽⁷⁾ This was done by combining data from different sources and constructing a consistent database of SO₂

manufacturing emission intensities which vary across time, countries and sectors. This allowed for a simple and complete decomposition of worldwide SO₂ emission into scale, technique, and two composition effects across countries and across sectors. Contrary to concerns raised by environmentalists, and confirming results of previously mentioned studies, this study showed that technique effect, working towards a reduction in emissions, dominated scale effects. Hence, trade is not harmful for the environment.

Finally, very few recent studies tried to estimate scale, composition and technique effects of trade liberalization for specific countries. Azhar et al. (2007) and Khalil and Inam (2006) focused on the pollution effects of the scale, composition and techniques of trade liberalization in Pakistan. Both studies used a methodology based on a linear-trade environmental model similar to that developed by Antweiler et al. (1998). Azhar et al. (2007) used national carbon dioxide emission and textile industry data (% of total BOD emissions) to examine the impact of trade liberalization on air and water pollution. On the other hand, Khalil and Inam (2006) focused on air and land pollution for the period from 1972 to 2002. The findings of both studies suggested that, in the long run, trade liberalization would increase pollution. Moreover, there was a significant effect in the short run. The results supported the fact that trade liberalization has a negative impact on environmental indicators.

4. Data and Methodology

This study is designed to investigate the relationship between trade liberalization and environmental quality in Egypt during the period 1980–2007. The methodology used is based on a linear-trade environmental model, which is similar to that developed by Antweiler et al. (2001) and utilized by Azhar et al. (2007).

There are three basic environmental issues: (a) air pollution; (b) water pollution; and (c) land degradation. Due to data availability, this paper is confined to two environmental areas: (a) air; and (b) land. Air pollution is defined as the introduction of chemicals, particulate matter or biological materials into the atmosphere. This would cause harm or discomfort to humans or other living organisms, or damages the natural environment. Land pollution is the degradation of earth's land surfaces often caused by human activities and its misuse. Haphazard disposal of urban and industrial wastes, exploitation of minerals, and improper use of soil by inadequate agricultural practices are a few of the contributing factors.

Accordingly, two different indicators of environmental quality are used to examine the impact of trade. These models are specified as follows:

$$\text{Model: 1} \quad AP_t = \beta_1 + \beta_2 OT + \beta_3 CE + \beta_4 SE + \beta_5 TE + \mu_t$$

$$\text{Model: 2} \quad LP_t = \alpha_1 + \alpha_2 OT + \alpha_3 CE + \alpha_4 SE + \alpha_5 TE + \mu_t$$

where OT: accounts for trade intensity
CE: represents the composition effect
SE: represents the scale effect
TE: represents the technique effect
AP: proxy for air pollution
LP: proxy for land pollution

These two models consist of six variables: land pollution (LP) measured by arable land in hectares;⁽⁸⁾ air pollution (AP) measured by carbon dioxide (CO₂) emissions in year t (kt in thousands); trade liberalization or trade intensity (OT) measured as imports plus exports in year t divided by GDP in year t, composition effect (CE) measured as a ratio of gross capital in real terms (K_t) to total labor force (L_t) in year t; scale effect (SE) measured in terms of real gross domestic product per square kilometer; and finally technique effect (TE) taken as the real gross domestic product per capita in year t. All data were obtained from the World Development Indicators (WDI) database (2010).

Econometric Procedure

In the attempt to analyze the impact of trade variables on environmental quality indicators, both CO₂ emission and arable land separately, several steps are carried out. Firstly, each variable is pretested to assess its order of integration. This is done using the Augmented Dickey-Fuller (ADF) test. The second step involves investigation of the existence of a long-run relationship among the variables. According to Shintani (1994), Johansen's Maximum Likelihood multiple cointegration test is more powerful than the Engle-Granger method. Finally, if the variables are found to be co-integrated – that is, there exists a long-run equilibrium relationship between them – a Vector Error Correction Model (VECM) is estimated to determine the short-run dynamics of the system.

The credibility of the results relies primarily on the accuracy of the tests in both specification and implementation. The accurate univariate analysis is a prerequisite for the implementation of the multivariate analysis. The right order of integration of each variable, with the appropriate lag length, should be determined in order to apply Johansen cointegration test.⁽⁹⁾ This is because a long-run relationship between variables cannot be considered unless they are all integrated of the same order. However, it has been proved that if the variables are integrated of different orders, cointegration can still be examined if the order of integration of the dependent variable is not higher than that of any of the explanatory variables. Moreover, there must be either none or at least two explanatory variables integrated of an identical order higher than the order of integration of the dependent variable (Charemza and Deadman, 1997).

In addition, in the specification of the Johansen cointegration test and the VECM, the lag interval used is that determined by the unrestricted Vector Auto regression Analysis (VAR) specification. This VAR specification is run for all variables in levels where all variables are taken as endogenous in an appropriate order that goes along with logical economic thinking. The Schwartz Bayesian Criterion is used for lag selection. Accordingly, the VAR of lag length p for a vector of n -series takes the following form:

$$X_t = \sum_{j=1}^p \Pi_j X_{t-j} + \mu + \varepsilon \quad t= 1,2,3,\dots,T$$

where Π_j are matrices of constant coefficients, μ is an intercept, ε is an error term and T is the total number of observations. The corresponding VECM is given by

$$\Delta X = \sum_{j=1}^p \Gamma_j \Delta X_{t-1} + \Pi X_{t-p} + \mu + \varepsilon$$

where Δ is first difference operator and the expressions for Γ_j and Π are given in Johansen and Jeselius (1990). The rank of the Π , r , equals the number of cointegrating vectors. Furthermore, Π can be factored as $\Pi = \alpha\beta$, with the matrix β comprising r cointegrating vectors and α can be interpreted as the matrix of corresponding VECM weights. These VECM weights α_i determine the short-run term error correction responses of the variables to deviations from long-run equilibrium values (Azhar et al., 2007).

5. Empirical Results and Analysis

Before testing for the existence of a long-run relationship among the variables, the ADF test is carried out on the time series in levels and first differences. The results are presented in Table 1.

Table 1: Unit Roots Test Results

	Variables	ADF [No. of Lags]
A. Series in levels	AP	-0.88[1]
	LP	-1.57[0]
	OT	0.89[0]
	CE	-0.47[0]
	SE	2.36[0]
	TE	0.17[0]
B. Series in first differences	Δ AP	-5.57* [0]
	Δ LP	-4.49* [0]
	Δ OT	0.08[3]
	Δ CE	-3.26[0]
	Δ SE	-1.46 [1]
	Δ TE	-2.14[0]

N.B.

(1) A * indicates rejection of the null hypothesis of non-stationarity at the 5% level of significance using Mackinnon (1991) critical values.

(2) ADF (p) is the Augmented Dickey-Fuller test. It gives the t-statistics from a specification that includes a constant and p lagged changes in the dependent variable.

The previous results show that all the variables are non-stationary at levels. AP and LP are integrated of order 1. The rest of the variables show that they are integrated of order 2. Given the previous univariate time series analysis results, the next step is the application of the Johansen Maximum Likelihood Cointegration test to investigate the presence of a long-run relationship among the variables. This is done first for the AP and then for the LP. However, the prerequisite is running the unrestricted VAR in levels in order to specify the appropriate lag length. Using Schwartz criterion, the lag length is found to be 1. Statistical results of the Johansen test for AP are summarized in Table 2.

Table 2: Johansen Cointegration Likelihood Ratio Test

Hypothesis			Critical Values		
Null	Alternative	Eigen value	Likelihood Ratio Test Statistic	5%	1%
$r = 0$	$r = 1$	0.753188	89.58849	76.07	84.45
$r \leq 1$	$r = 2$	0.635045	53.21115	53.12	60.16
$r \leq 2$	$r = 3$	0.469219	27.00363	34.91	41.07
$r \leq 3$	$r = 4$	0.230780	10.53506	19.96	24.60

N.B.
 Maximum lag length 1 in VAR. r represents the number of cointegrating vectors.
 Test assumptions: No deterministic trend in the data.

Table 2 indicates the presence of 1 cointegrating equation at 1% significance level (the value of likelihood ratio test statistic is less than the 1% critical value, thus accepting the null hypothesis of having 1 cointegrating relationship). This implies the existence of some equilibrium relation between AP and trade in the long run.

Similarly, the long-run relation between LP and trade is examined. The results are presented in Table 3.

Table 3: Johansen Cointegration Likelihood Ratio Test

Hypothesis			Critical Values		
Null	Alternative	Eigen value	Likelihood Ratio Test Statistic	5%	1%
$r = 0$	$r = 1$	0.799357	101.7563	76.07	84.45
$r \leq 1$	$r = 2$	0.683174	59.99436	53.12	60.16
$r \leq 2$	$r = 3$	0.463748	30.10989	34.91	41.07
$r \leq 3$	$r = 4$	0.308005	13.90795	19.96	24.60

N.B.
 Maximum lag length 1 in VAR.
 r represents the number of cointegrating vectors.
 Test assumptions: No deterministic trend in the data.

Table 3 indicates the presence of one cointegrating equation at 1% significance level implying the existence of some equilibrium relationship between LP and trade.

The estimated long-run relationship between environmental quality and trade is given as follows:

$$\text{Model 1: } AP = 603301.4 - 10454.4OT + 28.9CE + 5.9SE - 934.1TE$$

$$\qquad\qquad\qquad (-2.32) \quad (1.92) \quad (2.53) \quad (-3.06)$$

$$\text{Model 2: } LP = 7468188 - 1579076OT + 1008.2CE + 102.7SE - 15442.04TE$$

$$\qquad\qquad\qquad (-2.61) \quad (4.71) \quad (4.15) \quad (-4.77)$$

The numbers in parenthesis are the t-statistics. At 5% significance level, all coefficients are statistically significant except for the composition effect of trade on air pollution.

Once the long-run relationship is established, the focus shifts to the short-run dynamics of both models through the VECM. Using the lag length specified in the unrestricted VAR, previously mentioned to be 1, the estimated results of the VECM are presented as follows:

$$\text{Model 1: } \Delta AP = -0.278\Delta AP_{t-1} + 28090.3\Delta OT_{t-1} + 21.26\Delta CE_{t-1} + 3.44\Delta SE_{t-1} - 185.1\Delta TE_{t-1} + 0.03EC_{t-1}$$

$$\qquad\qquad (-1.07) \quad (0.58) \quad (0.831) \quad (1.55) \quad (-0.75) \quad (0.18)$$

$$\text{Model 2: } \Delta LP = -0.19\Delta LP_{t-1} - 1095567\Delta OT_{t-1} + 297.88\Delta CE_{t-1} - 55.2\Delta SE_{t-1} + 742.04\Delta TE_{t-1} - 0.26EC_{t-1}$$

$$\qquad\qquad (0.96) \quad (-1.77) \quad (0.84) \quad (-1.11) \quad (0.199) \quad (-2.1)$$

where EC_{t-1} is the lagged residual from the long-run relationship between air and land pollution on one hand, and trade variables on the other hand, in levels. This term represents the error correction term. The coefficient of the error correction term is statistically significant, at 10% significance level, in the second model only. It also has the correct negative sign. Thus, there is a tendency in the model of land pollution to return to its long-run equilibrium path whenever it drifts away. That is, nearly 26% of the disequilibrium between land pollution and trade is compensated in the following period. However, the rest of the specified variables are found to be insignificant. This means that there is no effect of trade on air and land pollution in the short term, which is quite reasonable since it is expected to take some time for the different effects of trade to be reflected on the environmental quality.

The results reveal that in the long run, the scale effect of trade, associated with greater economic activity, has a deteriorating impact on air pollution and thus, environmental quality. This may be attributed to raising demand for inputs, consuming

non-renewable resources, creating wastes and increasing missions associated with trade. However, trade appears to have a positive impact on environmental quality reflected in cleaner air through both its technique effect and intensity. The technique effect of trade improves environmental quality through imported efficiency in production and increase in demand for cleaner environment accompanied by increase in income. The eventual effect of trade on the environment depends on the relative strength of each of these opposite forces. Here, the role of regulations and their enforcement are central in limiting the negative scale effect and reinforcing the beneficial technique effect.⁽¹⁰⁾

Before turning to land pollution, it is worth noting that the dependent variable here is arable land, which reflects a clean environmental stance. In the long run, trade intensity and technique effect have a harmful impact on land pollution. This indicates that regulations do not give enough attention to the potential impacts of imported technology on land degradation, as opposed to the case of air pollution. On the other hand, the scale and composition effects have a desirable impact on land pollution. The positive composition effect implies that Egypt has a comparative advantage in less polluting industries, thus abiding by the neoclassical trade theories as a determinant of comparative advantage. It also indicates the insignificance of the environmental regulations in determining the comparative advantage. As for the positive scale effect, it stems from the association between the increase in income, as a result of trade, on one hand, and the demand for environmental quality, on the other. Thus, in the absence of strict environmental regulations, trade liberalization would likely deteriorate environmental quality.

6. Conclusion

This study tackled the relationship between international trade and environment using time series data for Egypt over the period of 1980–2007. In this context, cointegration analysis was utilized to examine the long-run relationship among the variables, as well as a vector error correction model to determine the short-run dynamics of the system.

The results confirm the existence of only a long-run relationship among trade liberalization and environmental indicators in the case of air and land pollution. However, the results are rather ambiguous. There are two opposite forces affecting environmental quality. The ultimate effect would be highly depending on the environmental regulations and their enforcement. Thus, results of this study go along with the theoretical concept of the absence of a one-way relationship between trade and environment.

To this end, the Egyptian government has undertaken a sequence of steps in favor of improving environmental quality including, strengthening the legal framework, engaging in various environmental activities and assigning specific articles related to the environment within trade and investment policies.⁽¹¹⁾ However, these efforts still remain to be reflected in the results implying that there still are some problems that need to be solved. These problems may be attributed to a number of factors. The corruption in the executive institutions hinders the enforcement of the regulations protecting the environment. Also, the concept of continuity of previous leaders' achievements is often absent. This is obvious in the previously mentioned contradiction between the Egyptian rank according to the EPI – i.e. measuring environmental performance in the short run – and that according to the ESI – i.e. measuring the sustainability of environmental performance in the long run. This contradiction reflects the absence of a reliable framework that protects the environment and, at the same time, promotes sustained economic growth.

Accordingly, the Egyptian government should ensure that any trade agreement does not contain provisions that jeopardize its environment. It must always aim at minimizing environmental costs associated with its industrial development in order to maximize its gains from trade liberalization and achieve a sustained and high-quality growth path. It should introduce environment-friendly innovations, which will contribute to sustainable development. It is also crucial to try to minimize the intensity of industrial pollution through the transfer of cleaner technology. This is in addition to promoting awareness and capacity building concerning environmental friendly production methods which play an important role in reducing pollution resulting from inefficient management of resources.

Finally, the study recommends that the government should dedicate further attention to the challenges, opportunities and constraints faced when participating in further trade liberalization. In trade negotiations, there should be a clear goal to minimize the negative impacts of any trade agreements and, at the same time, not to compromise areas in which Egypt exhibits a comparative advantage.

Footnotes

(1) <http://sedac.ciesin.columbia.edu/es/esi/rank.html>. However, Egypt's rank according to the Environmental Performance Index (EPI) improved from 85 in 2006 to 71 in 2008 to 68 in 2010. This may suggest that Egypt is facing significant long-term sustainability challenges but is managing its present circumstances well.

(2) Often referred to as structural effects.

(3) In this context, according to the first approach, trade liberalization through composition effect will increase pollution in developed countries, which is considered capital-abundant while it will decrease pollution in developing countries that is labor-intensive. Meanwhile, according to the pollution haven hypothesis, trade liberalization through composition effect would harm the environment in developing countries under the assumption that this group of countries has less stringent environment regulations than developed countries. Hence, the net composition effect will depend on the relative importance of each alternative in determining comparative advantage of the country.

(4) For example, the Asian long-horned beetle damaging the hard wood forests of northeastern USA probably arrived to the USA from Asia in wooden packaging boxes (IISD, 2005).

(5) Most of these studies are motivated by the Heckscher-Ohlin model of international trade linking the cross-sectional variation in trade flows to either industry, country, or region-specific measures of regulatory costs and other variables that affect trade, such as factor costs (Copeland and Taylor, 2003).

(6) The study pointed out that there is a composition effect of trade that varies across countries, but this estimated effect is quite small. One possible explanation for this is that the factor endowment effects and pollution haven effects tend to offset each other. High-income countries are capital-abundant, which means having a comparative advantage in dirty goods, but they also have stricter environmental policy, which works in the opposite direction and would tend to lead to a comparative advantage in clean goods. Therefore, a small net effect is consistent with strongly offsetting motives (Copeland and Taylor, 2003).

(7) A common feature of previous studies is that their estimates of the scale, composition and technical effects are indirect due to lack of disaggregated data linking pollution directly to production and to the resulting trading activities. These studies attempted to control for lack of data (e.g. using SO₂ concentrations rather than production-related emissions by Antweiler et al. (2001) or Frankel and Rose (2005), or economy-wide emissions rather than industry-specific ones as in Cole and Elliott (2003). In addition, due to the absence of data at the sector level, one cannot know if a change in the average emission intensity of a country is due to cleaner production techniques (i.e., more abatement activities) or to structural change (i.e., a shift towards cleaner activities).

(8) Originally meaning fit for cultivation, as opposed to pasture or wood land, the term is now applied to agricultural land used for growing crops.

(9) This lag length is determined using the Schwartz Bayesian Criterion or the Akaike Information Criterion.

(10) For example, Articles 6 and 7 of the Decree #770/2005 that issues the executive regulations to implement import and export law (#118/1975). These articles put restrictions on the goods being traded to ensure the safety of the environment. Another good example is the Free Zone Advantages. It encourages exports and easy purchase of new equipment that have an indirect positive impact on the environment. Also, engaging in Trade Agreements, encouraging trade with countries where environmental compliance of trade partners is a binding constraint for export (such as in the case of the EU) is most likely to have an overall indirect and direct positive impact on the environment. This is especially true given that the EU is considered Egypt's first trade partner (see Abdel-Latif, 2008 for more details).

(11) For more details, see the Egyptian's Ministry of State for Environmental Affairs web site, <http://www.eea.gov.eg/English/main/law4.asp>.

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