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How Can Trade Liberalization Be Conducive to a Better Environment? A Survey of the Literature

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Abstract

This article surveys trade and the environment literature from the perspective of the impact of trade liberalization on the environment. Many theoretical and empirical studies that investigate this subject with different modelling approaches provide evidences for two possible outcomes: (1) trade liberalization generates positive environmental side effects, and (2) trade liberalization increases the environmental degradation. Thus, a universal conclusion related to the environmental impact of trade liberalization will be dubious; the outcome depends on many country-specific factors such as development level of countries, their comparative advantage, the resource intensity of the traded product, current level of environmental awareness, and the existence of environmental policies. The contribution of our survey is to highlight the conditions under which the environmental impact of trade liberalization policies will be positive both locally and globally. This should be a very valuable piece of information.

Keywords: Trade Liberalization, GATT, Environment, Environmental Kuznets Curve.

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1. Introduction

With the emergence of global environmental issues such as ozone-layer depletion, the loss of biodiversity, global warming and acid rain, the role of economics both in the causes of these problems and in the development of policy options is being examined thoroughly. The new environmental phenomenon with its global scale poses significant and serious threats on future generations. A particular branch of the studies on the economics of the environment analyzes the two-way interaction between trade and the environment. It may seem that the work on trade and environment is very recent as a result of the increased public awareness of actual and potential threats to the global environment; nevertheless, pioneers of this literature began publishing their work as early as 1971 (see, for example, Baumol 1971, Magee and Ford 1972, and Walter 1973). This literature is now quite substantial.

The interest in trade and the environment goes beyond academics. The international community started to address these issues at the Stockholm Conference in 1972. In the 1980s, the world witnessed a very successful international environmental agreement: The Montreal Protocol on the Substances that Deplete the Ozone Layer; this protocol with its trade provisions as an enforcement tool makes a prominent example for other global problems such as climate change. The Uruguay Round of the GATT included heated debates between developing and developed countries on environmental issues; however, there were no significant action plans except for the establishment of Committee on Trade and Environment (CTE) under the World Trade Organization. CTE is accordingly charged with investigating methods for how conflicts among trade liberalization, economic development and environmental protection can be resolved. Most recently, United Nations (UN) organized a conference on climate change in Kyoto in December 1997. As opposed to earlier UN conferences on environment, some concrete steps were taken in this conference. The participants agreed to sign the Kyoto Protocol, which, for the first time, set legally binding numerical targets aiming at limitations and reductions of greenhouse gases emissions for the developed countries. Real gains are yet to be seen especially after the recent opposition by US.

Earlier, Dean (1992), Beghin et al. (1994), and Ulph (1994) surveyed the literature on trade and the environment. Ekins et al. (1994) edited a collection of papers on the same subject. Dean's (1992) survey looks at many different aspects of trade and the environment literature: (i) international competitiveness and environmental regulation with subheadings such as relocation of industries to pollution havens, regulation and comparative advantage; (ii) transnational pollution and trade; (iii) product standards as non-tariff barriers; (iv) trade in hazardous substances; and (v) the implications of trade liberalization for environmental degradation and natural resource use. Beghin et al. (1994) update Dean's study on items (i) and (v), and they also introduce the literature on the linkages between trade and environmental policy instruments. Ekins et al. (1994) present a critical assessment of the gains from trade argument from, mainly, an ecological perspective, and offer suggestions for ecologically-accelerated trade deregulation.

A more-specialized survey of this literature in regards to international competitiveness versus environmental regulation is presented by Jaffe et al. (1995). There is a considerable amount of research in this area, but not a solid consensus on the impact of environmental regulations on the international competitiveness. Jaffe et al. (1995) conclude "International differences in environmental regulatory stringency pose insufficient threats to U.S. industrial competitiveness to justify substantial cutbacks in domestic environmental regulations. Nor does the evidence

recommend enactment of stricter domestic environmental regulations in order to stimulate economic competitiveness[1]".

Van Beers and van den Bergh (1996) present an overview of the methodological approaches for investigating the diverse and multi-faceted relationship between international trade and environmental externalities. They classify the studies according to the type of their models (general equilibrium or partial equilibrium models), market structures (perfect or imperfect) and the way environment is treated in the model (as an externality or as an input to the production function). The limitations of each approach are disclosed, and suggestions for improvement are indicated.

Lee (1996) analyzed 79 categorical cases on disputes related to trade and environment. Among these disputes, 24 of them ended in an agreement and 55 in disagreement. Lee concludes that it is not unusual for richer countries to import environmental resources from poorer countries, and that there is a clear indication that issues in developing countries do not receive adequate attention and that richer countries use economic leverage to change the behavior of poor countries.

A final area where trade and environment come together is international environmental agreements. Current trends in the global dimension of the environmental problems necessitate the joint action of countries. In the absence of a supranational authority, solutions to global problems are subject to free-riding, and thus, international environmental agreements are very difficult to achieve and sustain. Related to our subject matter, a particular branch of this literature investigates whether international trade policies may/should be used to enforce international environmental agreements. This line of research, also known as "issue linkage", is analyzed by Folmer et al. (1993), and more recently by Barrett (1997, 1999).

Given the space limitations, we will concentrate only on the environmental consequences of trade liberalization in our survey. To be more precise, the survey will try to answer the question "Does trade liberalization result in increased or decreased environmental degradation?". We think that the environmental impact of trade liberalization deserves a detailed treatment because of several reasons. Firstly, gains-from-trade argument is very popular in political, public and some academic circles; however, given the steady deterioration in global environment, this argument needs to be reassessed with its associated environmental consequences. Secondly, and maybe more importantly, at the start of the new millennium, it is timely to decide whether the rules of the international trade as determined by the now 50-year old GATT should include some environmental make-up, or environment and trade should be considered on equal grounds. For such a critical decision, a survey of the most recent work on the environmental consequences of trade liberalization is worthwhile.

The organization of this survey is as follows. In the next section we briefly introduce elements of freer trade and the environment. Section 3 presents how trade liberalization can lead to improved environmental quality; section 4 analyzes the opposite view in detail. Concluding remarks together with suggestions for further research topics are gathered in section 5.

[1] Increased competitiveness following stricter regulations is thought to be a consequence of innovation strategies taken by regulated firms. This hypothesis is known as Porter hypothesis; see, for example, Porter (1991).

2. Trade Liberalization and the Environment

One of the standard- for some economist, the deepest and most beautiful- results of international trade is that free trade will benefit all participants. That is why trade liberalization is considered to be a very important step towards development by many economists and politicians. Nevertheless, as indicated by Corden (1974), "Theory does not 'say' that 'free trade is best'. It says that given certain assumptions, it is 'best'." As environmental issues were not a big concern at the time when Samuelson's gains from trade arguments were introduced (see, for example, Samuelson 1962), one such assumption was that the environmental impact of trade liberalization policies could be neglected. With the recent emergence of environmental consciousness, the gains from trade argument is being questioned deeply from this side. As Dean (1992) puts it, at the center of debate is whether or not the trade reforms will lead to depletion of non-renewable resources and increased environmental degradation, i.e. a type of development which can not be sustained. Thus, it is essential to identify the environmental consequences of trade liberalization. This is a quite demanding task.

A complex web of interactions between trade liberalization and environmental quality makes it difficult to draw clear-cut conclusions. One needs to consider following set of issues: (i) whether as a matter of positive economic analysis one can predict whether a move to trade liberalization, all else constant, will degrade the environment; (ii) how such a prediction might be affected if trade liberalization is accompanied by endogenously determined environmental policies; (iii) whether environmental policies are affected by strategic trade considerations; (iv) whether empirical evidence supports the predictions of economic analysis; and finally, (v) how all these concerns are affected in case of an environmental problem with international dimension, that is to say, transboundary pollution. In the next two sections, we will identify the channels through which further liberalization affects environment. In each of the two sections, we will try to show the relevance of these five issues on the environmental outcome of freer trade.

The fundamental determinants of environmental degradation are (i) economic activities (consumption--production) and (ii) the stringency of national environmental policy. Obviously, international trade by itself is not a direct source of environmental degradation or improvement. It may be considered as an indirect source due to its potential impact on consumption and production. This potential impact depends on many country-specific factors, and thus can be sometimes positive and sometimes negative. This makes a natural division in the exposition of this literature. Below, we will summarize the methods of analysis and findings of the papers in each group, but a brief introduction of the different linkages between trade liberalization and the environment will be useful.

Trade liberalization will most likely increase the volume of economic activities (including the dirty ones) and thus, will generate higher environmental degradation. Moreover, the pressures associated with the competition of domestic firms with their foreign rivals may lead to relaxation of the stringent environmental policies or may delay the enactment of stringent environmental policies if they do not exist at the time of trade liberalization[2]. This side will be explored in more detail in section 4 under trade liberalization with adverse environmental consequences.

On the other hand, trade liberalization is also expected to change the composition of goods and services produced by the country; this composition effect may be such that the share of pollution intensive commodities in total output may decline. In addition to this, environmental policies of

[2] This is the so called eco-dumping event.

higher-standard countries may be imported to lower-standard ones either voluntarily with the increases in interactions among countries, or as a result of new regulations on the harmonization of the standards among trading countries. Similarly, the threat to impose trade sanctions may also induce better environmental performance. Furthermore, with higher trade liberalization, if countries can realize expected increases in their incomes, then demand for environmental quality will also rise, and this will result in improvement in environmental conditions. In the next section, we will analyze the papers along this line under trade liberalization with positive environmental consequences.

Finally, a few words about the methodologies employed in the studies in this literature will be in order. It is difficult to single out a common pattern in the theoretical approaches; we see a wide spectrum of models ranging from two-sector to the continuum of good ones. Some papers focus on the supply side of the economy, and model environmental resources as an input into the production processes; others use demand for environmental quality as an additional variable in the consumers' utility function. On the other hand, empirical studies are more homogeneous in their modelling; two common approaches have been employed in most of the empirical studies: (i) Computable General Equilibrium (CGE) models, and (ii) models with single reduced form equations (missing structural equations in the background) incorporating some common parameters such as income, pollution and indicators of openness. The latter one is the generic modelling of the Environmental Kuznets Curve (EKC) studies[3]. Some other papers applied simulation techniques to identify the impact of hypothesized trade liberalization policies on environment.

3. Trade Liberalization with Positive Environmental Consequences

In this part, we will try to identify the channels and conditions under which freer trade will generate positive environmental consequences. The impact of trade liberalization can be decomposed into three parts as introduced by Grossman and Krueger (1991): the scale effect, which represents the changes in the size of the economic activities; the composition effect, showing the changes in the bundle of goods being produced; and the technique effect, representing the changes in the production technology, mainly adoption of cleaner technology. In general, scale effect tends to increase the amount of environmental degradation, technique effect lowers it; the sign of composition effect depends on the comparative advantages of the countries, and thus may be positive in some cases and negative in others. Thus, trade liberalization will generate positive environmental consequences if technique effect outweighs the scale and composition effects (in case of a country with comparative advantage in dirty industries) or if technique effect together with composition effect outweighs the scale effect (in case of a country with comparative advantage in clean industries).

Among others, Grossman and Krueger (1991), Bhagwati (1993), Panayotou (1993), Selden and Song (1994), Grossman and Krueger (1995) suggest that the positive impact of composition and technique effects will exceed that of the scale effect for income levels greater than a threshold level. Ferrantino (1997), Antweiler et al. (1998), Ferrantino and Linkins (1999), and Tsai (1999) show some other linkages through which trade liberalization may generate improved environmental conditions.

Among the earlier supporters of this view, Lucas et al. (1992) find that countries with faster rates of GDP growth had lower rates of increase in toxic intensity and that for fast growing low and middle income countries, low levels of trade distortion reduced the growth of toxic intensity

[3] EKC hypothesis will be explained below.

further. A similar study carried out by Anderson (1992) on world food and coal industry shows that liberalizing global trade in coal and food products would likely reduce the global pollution associated with these products. Birdsall and Wheeler (1992) look at the subject from a different angle. In their empirical study on Latin American countries, they try to determine whether greater openness, defined in terms of trade regimes and foreign investment, has been associated with the development of pollution-intensive industries or not. They show that with trade liberalization (through the elimination of barriers to importation of new technology and foreign capital) higher environmental standards of industrialized countries are "imported" to developing countries: more open-economy countries experienced faster growth in clean industries. Now, we will present detailed analysis of more recent works.

Grosmann and Krueger (1995) examine the reduced form relationship between per capita income and various environmental indicators, including urban air pollution, the state of the oxygen regime in river basins, fecal contamination of river basins, and contamination of river basins by heavy metals. Their objective is to determine whether environmental quality deteriorates steadily with economic growth. Their findings have strong implications for the impact of trade liberalization on the environment as economic growth is generally associated with more openness (see, for example, Dollar 1992, Edward 1992, and Harrison 1996; Harrison's study incorporating vector auto-regression suggests that the causality between growth and openness runs in both directions). Grosmann and Krueger estimate the following reduced-form equation:

$$Y_{it} = G_{it}\ \beta_1 + G^2_{it}\,\beta_2 + G^3_{it}\,\beta_3 + \check{G}_{it}\,\beta_4 + \check{G}^2_{it}\,\beta_5 + \check{G}^3_{it}\,\beta_6\ + X_{it}\,\beta_7 + \epsilon_{it}$$

where Y_{it} is a measure of water or air pollution in station i in year t, G_{it} is GDP per capita in year t in the country in which station i is located, $\check{G}_{it}$ is the average GDP per capita over the prior three years, X_{it} is a vector of other covariates (like temperature, population density), and ϵ_{it} is error term.

They used the panel data from the Global Environmental Monitoring System's (GEMS) tracking of urban air quality in different cities in the developing and developed world, and the panel data from the GEMS monitoring of water quality in river basins around the globe. Estimation has been done by using generalized least squares (GLS) method to account for any other characteristics that are not included in their list of regressors.

They find no evidence that economic growth harms the natural habitat steadily. Rather, they determine an inverted-U type relationship between economic development[4] and environmental degradation for most of the environmental indicators they have used: economic development brings an initial phase of deterioration which is followed by a subsequent phase of improvement. This is the so-called Environmental Kuznets Curve hypothesis. EKC hypothesis can be linked to trade liberalization implicitly by considering the impact of more openness on economic development. The turning point of the inverted-U type relationship is less than $8000 per capita in most cases. More specifically, for a country with a per capita income of $10000, the hypothesis that further growth will generate environmental degradation can be rejected at the 5 percent significance level for many of the pollution measures they have used. The important question that comes to mind is what linkage between income and environment exists to explain these results. Their answer comes from a review of the available evidence on instances of pollution abatement by OECD (1991) which suggests that as countries experience greater prosperity, their citizens' demand for higher environmental quality rises.

[4] Economic development is measured by GDP per capita.

One problem with Grosmann and Krueger (1995) paper is the specific reduced-form equation employed in their estimations. As they also mention in their paper, it is unclear why the estimated relationship between pollution and income exists. A more consistent but also more complex analysis, would be to model the structural equations relating environmental regulations, technology and industrial composition to GDP, and then to link the level of pollution to the regulations, technology and industrial composition. Such a structural approach is undertaken by Antweiler et al. (1998), and will be summarized below. One other problem associated with their results is that they only use certain indicators of environmental conditions. Admittedly, it is very difficult to obtain one general indicator of environmental quality; however, it may not be very desirable to generalize the results pertaining to specific indicators. They state that inverted-U relationship needs to be taken very carefully since it depends on the type of the polluting particle; increase, for example, in solid waste, and ground water contamination in developed countries continues with economic growth (see, for example, World Bank 1992). In support of this, Ekins (1997) uses an aggregate indicator of environmental impact developed by OECD which incorporates 10 different environmental measures, in the analysis of EKC hypothesis. He finds no evidence of inverted-U type relationship between this indicator and the income.

In an earlier paper, Grossman and Krueger (1991) also included variables representing openness to trade in their analysis of EKC hypothesis. The approach was very similar to the one described above, and they concluded that sulfur dioxide levels were significantly lower in the cities of the countries that conduct a great deal of trade. In an analogous EKC study, Shafik and Bandyopadhyay (1992) test the hypothesis that the more open a country's trade regime the cleaner will be her production processes. Their results are mixed, and at best, they find weak evidence that more open economies pollute less. Other EKC studies related to our subject matter will be summarized in the next section.

Ferrantino (1997) presents some arguments in favor of a constructive interaction between trade liberalization and the environment. Protection in heavy industries (such as chemicals, iron and steel, pulp and paper) in developing countries generates environmental problems (as they can not use expensive cleaner technologies); these problems may be avoided by trade liberalization which would shift these industries to developed countries where cleaner technologies are in place, with an overall improvement in environmental quality in developing world and probably, globally.

In a more specific case, trade liberalization may have positive impact on deforestation problem. Ferrantino (1997) states that the largest source of wood depletion in developing countries is probably wood gathering for household fuel and not the land clearing for farms. Higher incomes induced by trade liberalization will reduce household wood gathering by making other fuels affordable, and therefore, a decline in deforestation will be seen. Finally, freer trade in chemical and other agricultural inputs could increase the productivity of the existing land, and thus reduce the pressure to clear new land.

One of the most comprehensive studies in this literature is by Antweiler et al. (1998). It starts with setting out a theory of how openness to international goods markets affects pollution levels to assess the environmental consequences of international trade. In their model, they assume a small open economy that has two primary factors (labor and capital) and produces, in competitive markets, two final goods, one of which is capital-intensive and generates pollution as a by-product. There are N consumers with preferences over consumption goods and clean environment. It is assumed that government sets a pollution tax as an increasing function of optimal tax (which is determined by the maximization of the sum of utilities of consumers). This kind of tax policy not only allows for the possibility that government behavior varies across countries (due to political systems, for instance), but also allows pollution policy to respond endogenously to changing economic conditions.

Firstly, let us talk about theoretical findings of their paper. If we compare countries with similar incomes and scale, we expect to find that openness will be associated with higher pollution in countries with a comparative advantage in the polluting good, and with lower pollution in countries with a comparative advantage in the clean good. This result tells us that looking for a simple correlation between openness and environmental quality is unlikely to be fruitful, and instead, we have to focus on the link between openness, comparative advantage, and pollution. In a model such as theirs, comparative advantage is determined by the interplay of relative factor endowments and differences in pollution policy (which is mainly determined by per capita income). With this in the background, they show that if a country is sufficiently rich then the pollution haven motive for trade will eventually outweigh factor endowment considerations, and this country will export the clean good in trade (thus, openness will be associated with lower pollution). On the other hand, if a country is sufficiently capital abundant then the factor endowment basis for trade will eventually outweigh any pollution haven motive for trade and this country will export the dirty good (thus, openness will be associated with higher pollution)[5].

In the second part of the paper, empirical investigations have been carried out. They use the Global Environment Monitoring System data on sulfur dioxide emissions. Their data set consists of 2621 observations from 293 observation sites located in 109 cities representing 44 countries spanning the years 1971-1996. The majority of the data on economic variables (GDP per capita, population, capital stock per worker, trade intensity) come from the Penn World Tables. The estimated model is:

$$Z_{ijkt} = \beta_0 + \beta_1 GDP_{jkt} + \beta_2 KL_{kt} + \beta_3 KL^2_{kt} + \beta_4 I_{kt} + \beta_5 I^2_{kt} + \beta_6 R_{ijk} + \beta_7 B_{ijk} + \beta_8 M^T_{jkt} + \beta_9 M^P_{jkt} + \beta_{10} O_{kt} + \beta_{11} O_{kt} RKL_{kt} + \beta_{12} O_{kt} RKL^2_{kt} + \beta_{13} O_{kt} RI_{kt} + \beta_{14} O_{kt} RI^2_{kt} + \epsilon_{ijkt}$$

where i is index for site, j for city, k for country, and t for time; z represents pollution concentrations; GDP is measured by real GDP per unit area (so that they can obtain GDP for cities); KL is capital to labor ratio; I is one period lagged three year moving average of GDP per capita; R is a dummy indicating site ijk is in rural location; B is a dummy for suburban location; M^T is average temperature; M^P is the variation in precipitation; O is measured by the ratio of exports and imports to GDP (an indicator of openness); O-RKL term represents interactions of openness with capital labor ratio; and O-RI term represents the interactions of openness with income. For the indicator of openness, one of the key variables of the model, other measures such as black market premium, average tariffs, average quota and Sachs and Warner dummy are also considered in the estimation stage.

The coefficient of the degree of openness turns out to be negative in the estimated model, indicating that higher openness result in lower sulfur dioxide emissions. The calculated trade intensity elasticity, which measures the predicted change in pollution concentrations for a 1% change in the ratio of exports plus imports to GDP, is -0.869. Higher openness will also generate trade-induced increase in output and income. Associated with this increase, there are scale and technique effects on pollution concentrations. The scale elasticity for an average country is 0.193 (higher pollution), and the technique elasticity is -1.611 (lower pollution). Taken together, the full impact of further openness to international trade, through scale, techniques and composition effects, will be a reduction in sulfur dioxide concentrations for an average country. They conclude that these estimations yield a somewhat surprising conclusion: freer trade appears to be good for the environment.

Antweiler et al. (1998) study can be improved in several ways. Sulfur dioxide is only one of the many different forms of environmental pollution. Using it as an indicator of environmental

[5] One problem with these results is the definition of sufficiently rich and sufficiently capital abundant.

quality in isolation of the other notable pollutants may generate misleading results. Although it will be a very demanding task, a further work which can incorporate an index of environmental quality, composing many different environmental indicators as in Ekins (1997), will be a worthwhile attempt. In addition to this, the assumption that factor endowments and technology remain fixed in the presence of higher openness is not very satisfactory. Trade may spur capital accumulation, may bring knowledge spillovers and hasten the technological progress. It is of interest to determine whether these possible trade-induced changes bring about a further improvement in the environment.

Ferrantino and Linkins (1999) estimate the potential changes in toxic industrial emissions arising from two trade liberalization experiments conducted using computable general equilibrium (CGE) modelling. The study is very comprehensive in terms of its coverage of countries and sectors. The aggregated model consists of 10 regions representing the developed world (separated into four as North America, Japan, Australia--New Zealand and European Union), and developing world (grouped under six different regions such as Latin America, Africa--Middle East--South Asia, Korea--Singapore, and transition economies including former Soviet Union, Eastern Europe, North Korea). The main sectors considered in the study are textiles, apparel, leather, pulp and paper, chemicals, iron--steel, and non-ferrous metals which generate very high toxic emissions.

Two trade liberalization scenarios are considered: (i) trade liberalization arising from Uruguay Round, and (ii) a "zero--for--zero" agreement that will eliminate all tariffs in manufactures. As the employed model is not a dynamic one, the first scenario represents what the effects of liberalization would have been if the full implementation had occurred in 1992.

Production, trade and protection data come from the Global Trade Analysis Project (GTAP) database. Liberalization experiments were analyzed by conducting simulations using the GTAP CGE model. On the production side, this model assumes perfect competition, constant returns to scale technology with internationally immobile factors of production (land, labor and capital); at the industry level, constant elasticity of substitution functions are used for the value added and composite nests. On the demand side, representative consumer modelling is used with the utilization of a constant difference of elasticities (CDE) functional form for private household demands. The authors first estimate the changes in the output levels in each sector after the liberalization policies have been carried out, and then calculate the associated changes in the toxic emissions under the assumption that U.S. emissions coefficients apply to all regions. This assumption may not be so plausible as indicated in the paper. The simulation results show that local percentage changes in toxic emissions will vary from -3.43 (in China and Hong Kong) to 1.84 (in Southeast Asia) for the first liberalization policy. The world emission for this case will remain unchanged. In the zero--for--zero liberalization case, regional toxic emissions vary between -7.74 (in China and Hong Kong) and 1.40 percent (in Korea, Singapore, and Taiwan); global toxic emissions will decline this time, although by a very small margin (0.18 %).

In conclusion, Ferrantino and Linkins (1999) find that trade liberalization and environmental protection are complementary on the global scale. They explain this by the historical practice of granting high protection to high emission industries in developing countries, and the shift of dirty production from developing to developed countries following the liberalization. Additionally, improvements in income due to trade liberalization may lead to greater political demand for environmental regulation and/or greater investments in clean technologies. This study, being one of the most comprehensive ones due to its coverage of sectors and countries, should be improved by the incorporation of a dynamic framework.

Very recently, Tsai (1999) uses a partial equilibrium strategic trade framework to show that trade liberalization can improve environmental quality. In this theoretical study, a very simple international duopoly model is employed. Both the domestic and foreign firms export an

identical product to a third market; the production of the good generates pollution which is regulated by the governments. An export subsidy is also given by the home government only. Firms maximize their profits net of abatement expenditure, and governments maximize social welfare inclusive of environmental damage by choosing the optimal emission standards and in the case of home country, per unit export subsidy. Trade liberalization is reflected by a decline in the export subsidy.

Tsai (1999) considers both partial and complete trade liberalization scenarios. In both cases, liberalization leads to better environmental quality. This result is robust to the type of the competition, i.e., it holds under both Cournot and Bertrand competition among the firms. The novelty of this paper is that it suggests comparing the post-liberalization emission levels with the pre-liberalization emission levels instead of optimal emission level, as done in other theoretical pieces in this literature. The post-liberalization emission level turns out to be higher than optimal emission levels but lower than the pre-liberalization emission level. Thus, from an environmental perspective, liberalization is a preferred policy over protection, but it is not the best policy.

Tsai's (1999) results will be more valuable and attract more attention if it is generalized and improved in several ways. Domestic consumption is fully neglected; inter-governmental policy competition is ignored as well. Introduction of oligopolistic competition among domestic firms also seem to be useful; finally, a general equilibrium framework can be employed.

Another area where international trade can be used to the benefit of environment is international environmental agreements (IEA). In the absence of a supranational authority, IEAs are subject to free-riding, and thus, their chance of being successful is very limited if a proper enforcement mechanism is not developed. Barrett (1999) considers the applicability of trade sanctions as an instrument to enforce international environmental agreements aiming to provide a global public good, such as reduction in different pollutants[6]. He shows that trade policies can be used to enforce international environmental agreements provided that (1) every country must be better off as a signatory than as non-signatory when sanctions are imposed against free riders, and (2) when free-riding occurs, signatories must be better-off by imposing sanctions than by continuing to trade with non-signatories[7].

In a 2x2 Ricardian model with two private goods and one public good (representing environmental protection), Alpay (2000) shows that countries are not always reluctant to contribute to global environmental protection. Even if there is no self-financed transfers between countries, when the terms of trade changes associated with environmental protection are taken into consideration, countries may choose to contribute to global protection instead of free riding on others' contribution. This non-cooperative contribution, contrary to the conventional results, exceeds that of the cooperative one. As a policy implication, he concludes that the assessment of

[6] An earlier study by Blackhurst and Subramanian (1992) on multilateral cooperation on environmental issues, sets out the obstacles in the path to cooperation (free-riding being the main component). They state that trade policies generate incentives for countries to participate in multilateral efforts to deal with environmental problems.

[7] If countries are interacting with each other through trade, trade policies are one of the very few instruments that can be used to enforce international environmental agreements. Although the outcome may be restriction of trade instead of liberalization, the mere existence of trade is beneficial to environment under such circumstances.

government policies on global environmental protection in a partial equilibrium framework by ignoring the possible trade interactions, may very well be misleading.

Empirical tests of these assertions are very limited. Fredriksson and Gaston (1999) investigate the relationship between trade flows and delays in ratification of the United Nations Framework Convention on Climate Change (UNFCCC). They are particularly interested in the impact of openness to international trade on the ratification process. They find mixed evidence that trade matters for the ratification of FCCC; whereas total exports has a positive effect on the speed of ratification, total imports has negative impact on the speed of that process. We need to have more empirical studies similar to Fredriksson and Gaston (1999) work to increase our understanding on this important subject.

Finally, we close this section with an interesting connection shown in Copeland and Taylor (1999). They consider a two-sector dynamic model consisting of a smokestack manufacturing industry and an environmentally sensitive industry (such as agriculture, fishing). When industrial pollution arising from the manufacturing production lowers the productivity in environmentally sensitive sector, international trade can play a useful role in spatially separating these incompatible industries across countries with complete specialization.

To be able to evaluate the findings upto this point in a comprehensive manner, it seems to be very useful to look at the studies demonstrating the opposite point of view on the environmental impact of trade liberalization at this stage. A detailed discussion will be presented in the last section.

4. Trade Liberalization with Adverse Environmental Consequences

In this part, we will try to identify how trade liberalization policies may result in increased environmental degradation. Theoretically, trade liberalization will generate negative environmental consequences if scale and composition effects outweigh the technique effect in case of a country with comparative advantage in dirty industries, and if scale effect outweighs the technique and composition effects in case of a country with comparative advantage in clean industries. The proponents of this view state that if proper environmental measures are not taken (as in the current trading system regulated by GATT), more openness will result in aggravated environmental damage. This damage will be reflected in the overuse of natural resources, increases in the use of pesticides, fertilizers, and in many other forms of environmental degradation due to increased production and consumption activities. Additionally, increased competition as a result of freer trade forces firms to reduce their cost of production, and firms may successfully lobby for the relaxation of stringent environmental policies. Governments may start devising strategically optimal emission standards, which will be weaker than the environmentally optimal emission standards. This is the so-called eco-dumping phenomenon, and detailed analysis can be seen in Rauscher (1994), Barrett (1994), and Kennedy (1994)[8].

A collection of papers that are constructively critical of the gains from trade argument from an environmental perspective has been edited by Ekins et al. (1994). Their most significant arguments include: (i) for economic growth to benefit the environment, it is not enough to generate additional resources, but those resources must be targeted towards environmental quality; a common observation in outward-oriented economies is that this is not being realized; (ii) even if some of these additional resources are directed to environmental protection, nothing

[8] We should mention that some other studies in this literature do not favor eco-dumping phenomenon; see Xu (2000) for the latest work.

can be done about irreversible damages of economic growth to the environment, and (iii) increases in the volume of transportation generated by trade liberalization will contribute substantially to energy-related environmental damage. We will now focus on more recent theoretical and empirical studies.

Chichilnisky (1994) identifies the impact of freer trade on the use of natural resources when some countries lack clearly defined property rights. She considers a general equilibrium model with two goods, two inputs and two countries, similar to a standard Heckscher--Ohlin one except that the supply of the inputs is price-dependent. One of the inputs is chosen as environmental resource (E), which is extracted from a resource pool by either capital or subsistence labor. The fundamental assumption of her model is one country (South) has ill-defined property rights regime as compared to the other (North). This key feature is introduced into the model through the supply functions of the environmental resource; at any given price the supply of E in the South with ill-defined common property rights is higher than that of North, which has well-defined private property rights:

$$E = \alpha (P_E / q) + E^0$$

where P_E is the price of the environmental resource and q is the opportunity cost of the input used in extracting E. Here, the coefficient α represents the property rights regime for the pool from which E is extracted, and differs between North and South (α for South is larger than that of the North). North and South differ only with respect to this aspect.

Solving the model in a general equilibrium framework, she shows that two countries with identical technologies, endowments, and preferences will trade with one another if one has ill-defined property rights on her environmental resources. The country with ill-defined property rights already overuses the environment as a factor of production; trade with a country with well-defined property rights will increase the overuse of resources and makes the present misallocation worse. Although trade equalizes the prices of traded goods and factors of production, this does not improve resource allocation. In the resulting world economy, resources are underpriced and there is overproduction in the South and overconsumption in the North.

The implication of this result is very vital as many environmental resources are unregulated common property in developing countries. Rain forests, which are used for timber or destroyed to give way to the production and export of cash crops like coffee, sugar, and palm oil, constitute an important example.

Another interesting result of the paper is that the traditional policies designed to overcome this common resource problem may not be adequate, and in fact, may make the situation worse. To show this, Chichilnisky (1994) assumes the existence of subsistence labor, which is only employed in the extraction of environmental resource in the South. Introduction of a unit tax for the use of environmental resource may not deter overextraction. Taxes can force lower income harvesters to work harder and extract more resources to keep up with their pre-tax consumption behavior. As a result, taxes can lead to more rather than less extraction of the resource. Thus, policies aiming at correcting the property rights problem should be preferred.

Chichinilsky (1994) also presents some real life examples of such property-rights approaches: agreements involving debt-for-nature swaps; allocation of a piece of the Amazon (4,303 square miles in size) to its Indian population by the government of Ecuador; the agreement between US pharmaceutical industry and Costa Rica on the use of genetic information within its forests. In this last example, a Costa Rican research institute is prospecting for promising plants, micro-organisms, and insects to be screened for medical uses by Merck and Company (the world's largest drug company), and Merck, in turn, will share any resulting profits with Costa Rica.

In brief, the main conclusion of Chilchilnisky (1994), in her own words, is "the international market transmits and enlarges the externalities of the global commons. No policy that ignores this connection can work."

In another theoretical study, Copeland and Taylor (1994) analyze the scale, composition, and technique effects of international trade on pollution in a North-South model. They consider a model with two countries, one primary input (human capital), and a continuum of private goods. Pollution is produced as a by-product. Countries differ only with respect to their human capital endowment. Governments set pollution policy endogenously, and since environmental quality is a normal good, the higher-income (higher human capital) country turns out to have tougher environmental regulations. In this set-up, they demonstrate (i) free trade lowers the pollution level in the human-capital-rich country (North), but increases the pollution level in the human-capital-scarce country (South), and increases worldwide pollution provided that factor prices are not equalized across countries[9]; (ii) an increase in the rich North's production possibilities increases pollution while similar growth in the poor South lowers pollution; and (iii) unilateral transfers from North to South reduce worldwide pollution. The driving force of all these results is the incentives to trade to exploit the differences in pollution policy. Growth in South or transfers from North to South reduces the gap between autarky factor prices, and thus reduces differences in pollution policies.

Copeland and Taylor's model is subject to criticism from its having only one factor of production, and thus ignoring potential role factor abundance can play in determining the trade patterns (see Antweiler et al. 1998). One also wonders the robustness of their results with respect to continuum of goods assumption.

A companion paper by the same authors investigates the case of transboundary pollution in a very similar model. In addition to changes in the nature of pollution, Copeland and Taylor (1995) also allow for an arbitrary number of countries; they consider the cases of large and small number of countries to isolate the effects of terms of trade motivations for pollution policy from purely environmental motives. Pollution targets are implemented with a marketable permit system. Main results of this paper are: (i) if human capital levels differ substantially across countries, then a movement from autarky to free trade raises world pollution; if they are similar, world pollution does not rise with free trade (the driving force behind these is whether factor prices, including pollution permit prices, are equalized or not through trade); (ii) when free trade in goods raises world pollution, allowing for international trade in pollution permits can counteract this rise in global pollution (because pollution permit prices will get equalized and pollution-haven effect will be eliminated); (iii) untied international transfers of income lower the recipient's pollution but raise the donor's pollution, and thus may have no effect on global pollution as well as on prices and surprisingly on welfare levels of either country; on the other hand, income transfers tied directly to pollution reduction can be welfare enhancing. This last result underlines the potential importance of income effects both in analyzing global pollution reform and in determining how international trade affects the global environment.

Lopez (1997) presents not only theoretical arguments but also empirical evidences for adverse impact of trade liberalization on the environment. His principal purpose is to estimate the value of environmental resources as factors of agricultural production and to measure the potential effects of various economy-wide policies (mainly trade liberalization policies) on agricultural income by explicitly accounting for environmental effects. The analysis has been carried out in a two-sector general equilibrium framework. Along with the conventional factors of production, like labor and capital in the urban sector, agricultural sector also uses an environmental input, called biomass in the paper. The empirical analysis is done on Ghana, where the government has been taking important steps towards liberalizing the economy since 1983.

[9] Otherwise, world pollution level will remain unchanged.

Lopez (1997) uses a unique data set for an area in Western Ghana. These data include household survey information from 12 villages for the periods 1988-1989 with remote sensing data on the area under closed forest, area under natural bush (fallow area), and density of biomass in the fallow area. The detailed survey includes data on production, land use, employment, use of conventional factors of production, and demographic characteristics.

First, a general theoretical approach is presented, and it is shown that if the environmental externality (as reflected in land cultivation decisions) is fully internalized, trade liberalization will unambiguously increase national income; however, if land cultivation decisions are socially inefficient, the net effect of trade liberalization is, in general, ambiguous. His estimations show that the impact of deepening of trade liberalization on biomass depletion (a form of environmental deterioration) is quite significant: further losses of biomass on the order of 2.5 to 4 percent follow the trade liberalization.

The net income elasticity associated with trade liberalization fluctuates between -0.002 and -0.0078 for various simulations executed for a wide range of non-farm labor demand elasticity. Thus, further trade liberalization generates a fall, albeit small, in the national income due to its detrimental effects on the environment.

Several very recent papers analyze the issue empirically in a Computable General Equilibrium (CGE) model. Lee and Roland-Holst (1997) assessed the linkage between trade and the environment in a two-country CGE model (for Indonesia and Japan) by removing Indonesia's nominal tariffs on all imports. This unilateral trade liberalization by Indonesia would increase the ratio of emission levels to real output for almost all major pollution categories (total percentage changes for the 10 different pollutants included in the study range from 0.51 to 3.73 for biological oxygen demand-BOD and lead, respectively.). If tariff removal policy is combined with a uniform effluent tax policy (as opposed to an export tax or sector specific taxes), the twin objectives of welfare enhancement and environmental quality improvement appear to be feasible from the simulation studies they have carried out. This result is supportive of the main conclusion of this survey: trade liberalization accompanied by environmental considerations may very well be welfare enhancing.

Beghin et al. (1997) analyze the linkages between growth, trade and the environment in Mexican agriculture with an empirical economy-wide model through the investigation of trade liberalization, environmental policy reform, and their coordination. Outward orientation induces pollution growth in some agricultural sectors. Their main result is that more liberal trade combined with targeted effluent taxes can achieve significant environmental mitigation and efficiency gains, but with the implication of a contraction of most agricultural sectors.

Beghin et al. (1999) investigate the linkages between trade integration, environmental degradation and public health for Chile. In a 72-sector CGE model incorporating monitoring functions for 13 effluent categories[10] and a variety of mortality and morbidity indicators, they show that unilateral opening to world markets induces substantial worsening of pollution emissions and expansion of resource-based sectors. NAFTA integration is shown to be environmentally benign in terms of pollution emissions, and in fact, it reduces emissions in several pollutants. This decline in effluents is achieved through strong composition effects in production, outweighing the scale expansion induced by NAFTA; however, these decreases in emissions do not translate into major gains for urban health. Simulations for integration via MERCOSUR[11] case result in adverse effects on the environment and on urban morbidity and

[10] Sulfur dioxide, carbon dioxide, volatile organic compounds, particulate intensity, biological oxygen demand, toxic pollutants in water, air and land are some of the effluents investigated.

[11] MERCOSUR is a regional treaty for trade liberalization among Argentina, Brazil, Paraguay and Uruguay.

mortality. Finally, taxing air pollutants and simultaneously reducing trade distortions (by maintaining revenue neutrality) induces net welfare gains from both reduced health damages and increased efficiency, a double-dividend-type result.

Cole et al. (1998) estimate the impact of the Uruguay Round of trade negotiations in terms of four local air pollutants and carbon dioxide. The monetary cost associated with this impact is also estimated. They have calculated the composition effect, the scale effect and the technique effect explicitly. Their results indicate that most developing and transition regions will experience an increase in emissions of all five pollutants; for the developed regions three local air pollutants are predicted to decrease, whilst the other pollutants increase. They also indicate that the environmental impact will typically be considerably greater if the Uruguay Round affects the rate of economic growth. Monetary damage estimates are large as 1.2% of a region's estimated gains from the Uruguay Round.

In a recursive dynamic CGE model for Costa Rica, Dessus and Bussolo (1998) studies a quantitative assessment of the interdependencies of trade liberalization and environmental policies. Similar to previous CGE papers, they demonstrate that trade liberalization induces a risk of specialization in dirty activities; however, free trade combined with appropriate effluent taxes reduces emissions significantly. Abler et al. (1999) also examine the environmental impacts of trade liberalization in Costa Rica in a CGE model. This model includes eight environmental indicators covering deforestation, pesticides, overfishing, hazardous wastes, inorganic wastes, organic wastes, greenhouse gases, and air pollution. As opposed to most other studies, Abler et al. (1999) incorporate possible technology changes after trade liberalization into their analysis. They find out that the impact of trade liberalization on the environmental indicators are generally negative, but small or moderate in magnitude.

In another study on Indonesia, Strutt and Anderson (1999) present simulation results on the environmental impact of two liberalization policies: the Uruguay round and most-favored-nation liberalization by Asian-Pacific Economic Cooperation (APEC). The paper is also valuable in that it incorporates the likely impact of new technology adoption on emissions. By performing a simulation in which Indonesia's income growth is assumed to increase by an extra 0.5 percent[12] per year (a conservative estimate) as a result of trade liberalization, they show that by 2020 air pollution would be 12 to 15 percent greater and water pollution 6 to 12 percent greater following the liberalization. They suggest that the policy-makers have to make sure that the environmental reforms (especially in pollution-intensive or resource-extracting sectors) are put in place before severe environmental degradation occurs in order to make trade reform welfare improving.

Two very recent studies by Suri and Chapman (1998) and Agras and Chapman (1999) consider the environment--trade linkage in EKC-type modelling. Suri and Chapman (1998) use commercial energy consumption (per capita) as the dependent variable as a proxy for environmental stress. The ratios of imports and exports of all manufactured goods to domestic production of manufactured goods are included in the model to estimate the impact of openness to trade on the environment. As usual, income and its square are also used as independent variables. Their data set consists of observations on 33 countries over a 21-year period beginning in 1971 and ending in 1991. The signs of the estimated coefficients for trade terms are positive for export-manufacturing and negative for import-manufacturing ratio as expected[13],

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[12] Here one should note the importance of this assumption on growth as it was shown that trade policy reforms would improve the environmental conditions and reduce the depletion of resources in the static version of the same model (which keeps growth rate constant).

[13] Higher emissions with increased exports, and lower emissions with increased manufactured imports.

and they are significant. This shows that trade in manufactured goods has an important structural effect on per capita energy use, and thus, on emissions. Another important finding is that the turning point for the inverted-U relationship (between income and pollution) increases almost by factors of two and three (from 55,535 to 143,806 and to 224,162 dollars in different models) when the trade variables are included in the model. This indicates that the EKC hypothesis will be very difficult to observe practically with higher trade liberalization. Thus, they suggest that policies based on "wait and grow" assumption will not serve environmental objectives properly. This study by Suri and Chapman can be criticized on the grounds that energy is not a pollutant, and it can be produced and consumed without pollution as in the case of renewable energy. Although the main source of some notable pollutants, such as carbon dioxide, is currently energy use, it is still better to use the emissions themselves to avoid any misunderstanding. Emission data on those pollutants are readily available, and used by Agras and Chapman (1999)[14] in a similar study.

At this stage, it will be appropriate to mention two important concerns related to the EKC hypothesis. Firstly, we have to mention that not all empirical studies support the inverted-U type relationship between income and emissions (see, for example, Hettige et al. 1999). Secondly, the global aspect of the EKC hypothesis is being missed. If the improvement in the environmental conditions are only associated with changes in the production patterns and not by changes in consumption patterns (which is completely plausible in EKC hypothesis), then environmental degradation is being displaced from one country to the other, rather than getting reduced, and maybe increasing on the global scale. Moreover, this way of reducing environmental degradation will obviously not be available to the latest-developing countries. For more details on these considerations, one can see Rothman (1998).

Finally, we see Batra et al. (1998) touching an important but ignored area: energy intensity of international trade. Energy intensity is defined as the amount of energy used by an activity per dollar of its value-added. International trade necessitates the transportation of goods across vast land areas and the seas, which generate excessive amount of energy-related pollution. For example, air freight increased from 23% of commercial air traffic in 1970 to 25% in 1990 with the corresponding level of energy consumption rising from 4.2 million metric tons of aviation fuel to 11.2 million tons. Thus, trade related air freight fuel consumption almost tripled in just two decades. Batra et al. (1998) examine the impact of energy-intensity of trade on pollution. Although estimates of energy intensities are not available at the global level, the estimates for US show that trade is more energy intensive as compared to the overall economic activity and transportation. They consider a model where pollution is a function of energy consumption associated with domestic and global production and also with transportation of exports and imports. With pollution generating a direct utility cost to consumers, they demonstrate that trade with energy tariff or a global consumption tariff is superior to free trade.

[14] Agras and Chapman (1999) test EKC hypothesis with the incorporation of trade variables and energy prices simultaneously in a general autoregressive-distributed lag formulation. Their model is very similar to Suri and Chapman (1998) except for the inclusion of lag terms and energy prices. They could not detect a significant impact for the trade variables.

5. Conclusions

We survey trade and the environment literature from the perspective of the impact of trade liberalization on the environment. Many theoretical and empirical studies that investigate this subject with different modelling approaches provide evidences for the two possible outcomes: (1) trade liberalization generates positive environmental side effects, and (2) trade liberalization increases the environmental degradation. Thus, a universal conclusion related to the environmental impact of trade liberalization will be dubious.

The interactions between trade liberalization and environmental quality depend on the country-specific factors and the existing institutional structures, especially related to the environment. We may list following set of factors as the key determinants of this interaction: (i) whether the country in consideration is a developed or developing one (demand for environmental quality is a positive function of income); (ii) the comparative advantage of the country implementing liberalization policies; (iii) resource intensity of the traded product and the property-rights structure associated with the use of the resource; (iv) existence or enactment of environmental policies during trade liberalization; and (v) whether environmental policies are affected by strategic trade considerations. In fact, all these issues can be considered as the points of departure among the studies in this literature, and naturally, they may be seen as the main constituents of the contrasting results summarized in our survey.

Due to differences in the environmental policy stringency levels between developed and developing countries, developing countries will most likely have comparative advantage in pollution intensive goods; thus, production of these goods may easily shift to the developing countries following trade liberalization policies, and consequently, may result in increased pollution both locally and globally. It has been shown strongly that the differences in pollution policies would generate incentives to trade, and one should seriously consider further environmental deterioration in countries with lax regulations following trade liberalization. Therefore, from an environmental perspective, it is important that trade liberalization policies should be accompanied by "harmonization" of environmental policies[15] across countries; given the current differences between developing and developed country stances on this issue, this seems to be not very plausible at this point.

Removal of tariffs in highly protected polluting industries in developing countries or removal of export subsidies in those sectors will open ways for improved environmental quality; however, this kind of trade liberalization policies can not be easily implemented by the governments of developing countries as it implies the loss of competitiveness, and so, of jobs in these industries in developing countries. To make this shift possible, some kind of trade adjustment programs between developed and developing world seems to be required.

Another area where international trade can be used to the benefit of environment is international environmental agreements (IEA). Current trends in the global dimension of the environmental problems necessitate the joint action of countries. In the absence of a supranational authority, IEAs are subject to free-riding, and thus, their chance of being successful is very limited if a proper enforcement mechanism is not developed. If countries are interacting with each other through trade, trade policies can be used as an instrument to enforce international environmental agreements. Although the outcome may be restriction of trade instead of liberalization, the mere

[15] The harmonization procedure should not be construed as one-to-one matching of policies; it should incorporate any relevant differences among countries such as pollution absorption capacity and so on.

existence of trade and the threat to impose sanctions will serve environmental objectives under such circumstances.

Expected increases in income associated with freer trade will generate demand for environmental quality and thus, will put downward pressure on emission levels. Nevertheless, this seemingly automatic transition is subject to some criticism. If the pollution in high income countries is being reduced by shifting polluting industries to lower income countries, this kind of pollution reduction will not be available to the latest-developing countries as there will be no countries coming up behind them to which this relocation can be directed[16]. Thus, installation of better technologies and shift to cleaner production processes should be given priority; again, the way how this will be done (in terms of funding) will be a hot debate topic between developed and developing countries. Existence of studies which show that a negotiation linking trade and environment policies may be better than a trade-only negotiation for developing countries, but compensation for environmental restraint would be even better for them[17], makes this issue more interesting.

Moreover, in the presence of a negative production externality (in particular, industrial pollution effecting the outcome of an environmentally sensitive industry, such as fishing), international trade can play a useful role in spatially separating these incompatible industries across countries with complete specialization.

On the other hand, in the absence of environmental policies, increased economic activity associated with trade liberalization will obviously put upward pressure on emission levels in countries with comparative advantage in dirty industries. The changes in the composition of production stemming from freer trade may relocate dirty industries to developing countries from developed ones; although an improvement is observed in developed countries after trade, on the global level the emissions may increase. Production shift resulting from trade is of no use for the environment if it is not associated with changes in the consumption behavior.

The pressures associated with the competition of domestic firms with their foreign rivals may lead to relaxation of the stringent environmental policies, or may delay the enactment of stringent environmental policies if they do not exist at the time of trade liberalization.

Finally, the balance in the use of natural resources will be destroyed if these are opened to international markets without any reservations, and in particular, in the absence of clearly defined property rights, which is the case in many developing countries. Linkages between increases in the volume of trade and deforestation associated with the production of cash-crops in some developing countries are well known. Given the importance of these resources for the global environment, protective environmental policies need to be enacted with freer trade in these products. Practical evidence shows that cooperation between developing and developed countries on this issue is required as well.

These are the main channels, suggested in the literature, through which trade liberalization will have impact on the environment. Luckily, some countries may observe improved environmental conditions with higher liberalization without taking any precautions; however, a wiser approach will be to complement trade policies with environmental ones; most of the studies we surveyed require an active environmental policy for a better environmental quality after trade liberalization. Since developing countries pay normally more attention to economic growth, and since environmental policies are seen as an obstacle for growth, active cooperation between

[16] Moreover, increases in income after trade liberalization will only be useful if in fact some of the additional resources generated are devoted to environmental improvement; this is not an automatic change.

[17] See, for example, Abrego et al. (1999).

developed and developing countries is required. This cooperation will need to consider the interactions between trade and environment mentioned above, and make sure that when designing their trade policies, developing countries should not take the environmentally misguided path of developed countries during the industrialization process. Among other things, this seems to require financial assistance to developing countries from developed ones as indicated by developing countries in many debates on this issue, and also as seen practically in some of the successful international environmental agreements (for instance, Montreal Protocol).

Another interesting conclusion of this survey, at least for the short and medium terms, is that the impact of trade liberalization on environment casts serious doubt on the well-known gains-from-trade argument. Not only can trade liberalization generate environmental deterioration, but also an overall welfare decline can be observed (given that environmental quality is included in the welfare expression). Unconditional superiority of trade liberalization should be taken with precaution; the policies toward more open economy will serve the desired objectives better if they are accompanied by environmental policies.

We think that further research in the following areas will be very useful. Firstly, to improve our understanding of the interactions between trade liberalization and environmental quality, we need more empirical studies at the individual country levels[18]. This way, the country specific factors, such as development level, population, income distribution, that affect the links between trade and environment will be taken into consideration. With that information at hand, the policies on trade and the environment can be made more constructive and supportive of each other.

The concerns of developed and developing countries on trade and environment issues are asymmetric, i.e., better trading conditions are more important for developing countries whereas higher environmental quality for developed world. There exists somehow a complementarity between trade and environmental policies stemming from the asymmetric structure and distribution of the gains and losses across developed and developing countries associated with each of these two policy dimensions. Thus, global cooperation will be much easier to sustain when pursued through linked negotiations. This needs to be advocated more by new empirical and theoretical research.

The energy intensity of trade has not received an adequate attention in the literature. Given that many of the environmental problems have energy use as their main source, the trade-energy-environment linkage needs to be disclosed. This is very important because the energy intensity of trade has been estimated to be higher than the energy intensity of overall economic activity, and than that of the transportation. In addition to the use of energy in the production of traded goods, the use of energy associated with the transportation of these goods internationally (an essential part of any trade activity) is even higher. More research is needed in this area.

The impact of trade liberalization on the stringency of environmental regulations is another area, which is not studied adequately. The two competing views that, with trade liberalization, higher environmental standards of developed countries will be imported to developing countries and that competitiveness pressures will force countries with higher environmental standards to switch to more lenient environmental regulations ("race to the bottom") need to be studied in more detail. A number of theoretical papers present mixed evidence, and there are only a few

[18] The differences, for example, between developing and developed world on environmental issues and the current trading patterns support our view. A general observation is that developing countries are specializing in dirty industries (Low and Yeats 1992); developing country exports are in relatively polluting products and developed countries are exporting clean products (Lee and Roland-Holst 1994).

empirical papers on this subject. More research is required before we reach a satisfactory conclusion on this issue.

Obviously, environmental quality is a normal good and demand for higher environmental quality will rise with increases in income. The current environmental awareness in developed countries is mainly due to increased income levels. The role of trade liberalization in reaching this wealthy position can not be ignored. For developing countries, the policies generating higher economic growth (including trade liberalization) are therefore important from an environmental perspective; however, developing countries do not need to repeat the environmental mistakes of developed countries. It is wrong to assume that trade liberalization can only be achieved in the framework drawn by the current GATT rules. It will be much better if free trade targeting of the GATT is changed to sustainable free trade. Short term expansion of GATT articles for the protection of the environment and the transformation of GATT into GATE (General Agreement on Trade and the Environment) over the long term emerges as an important policy[19]. The key factors in the design of GATE will be to generate a consensus for treating trade and the environment equally (i.e. do not favor one over the other without any scientific reason), and to allow for a functional trade system with utmost environmental quality[20]. This should be an important item of the agenda of the next round of the GATT.

Studies on trade and environment are very valuable as both trade and environment are essential components of modern life. As stated very nicely in Ekins et al. (1994), "If the world's trading system were to collapse, doubtless much hardship and suffering would result. But, if the global environment were to collapse, the result would be much worse." Thus, we need policies that will not sacrifice environment for trade and trade for environment. It is very vital to develop the institutions and the framework for environmentally sustainable trade, and research towards this goal should be given priority and support.

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[19] This has been indicated and analyzed by DeBeveulle et al. (1994).

[20] Jones (1998) investigates the institutional framework between trade and the environment. In particular, he raises the question whether a single international institution can provide a universal system of rules governing both trade policy and environmental policy. The answer is not in affirmative.

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