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**Interactions between Climate and
Trade Policies: A Survey**

Marzio Galeotti and Claudia Kemfert

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Interactions between Climate and Trade Policies: A Survey

Summary

Economic globalization affects the environment and sustainable development in several ways and through various channels. The purpose of this paper is to review the key links between globalization and the environment. The paper intends to consider the major issues in multilateral economic agreements in trade and finance that affect environmental sustainability. Major policy issues addressed by these agreements are considered from the perspective of trade liberalization, international investment and finance, and technology diffusion. The concept of trade reflected here is thus broader than international exchange of goods and services.

Keywords: International climate policy, Sustainable development, Technical change

JEL Classification: H23, O33, Q01, Q25, Q28

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1. Introduction

“National and international economic policy has usually ignored the environment. In areas where the environment is beginning to impinge on policy, as in the General Agreement on Tariffs and Trade (GATT) and the North American Free Trade Agreement (NAFTA), it remains a tangential concern, and the presumption is often made that economic growth and economic liberalization (including the liberalization of international trade) are, in some sense, good for the environment. This notion has meant that economy-wide policy reforms designed to promote growth and liberalization have been encouraged with little regard to their environmental consequences, presumably on the assumption that these consequences would either take care of themselves or could be dealt with separately” (Arrow, Bolin, Costanza, Dasgupta, Folke, Holling, Jansson, Levin, Mäler, Perrings, and Pimentel, 1995).

The increase in overall environmental awareness has coincided with a change in world developments. In the late 1960s and early 1970s the predominant concern was the depletion of global non-renewable resources.¹ Today the main concern is not only the depletion of those resources, but also the limit of the earth atmosphere to assimilate growing levels of pollutants and emissions. Anthropogenic induced climate change and further environmental damages such as ozone layer depletion are cause of increasing concern among experts, policy makers, and informed public opinions. International trade and global activities play a very important role. Indeed, international trade is increasingly seen as both a cause of, and a possible remedy to, environmental problems.

The analysis of the liberalization of international trade is of special interest for two reasons. First, economists argue that trade liberalization leads to improved economic conditions that promote economic growth and expand production, consumption and transportation of goods. This is inevitably accompanied by an increase in resource utilization and environmental damages. Free trade may damage the environment through pollution emissions and an unsustainable use of natural resources. An increase in greenhouse gas emissions threatens the earth’s assimilative capacity.

Second, a more competitive trading environment could lead to less environmental regulation as this could induce competitiveness losses through cost increases relative to other countries with fewer environmental standards. This is commonly referred to as

¹ The World Resource Institute (1994) and (1996) reported different estimates of fossil fuel resources, but oil reserves are seen as having a maximum utilization duration of 40 years, gas 60 years and coal up to 200 years.

“environmental dumping.” The meaning of this definition can be interpreted from two extreme perspectives. On the one hand, countries choose much weaker environmental policies than those implied by the optimal Pigouvian rule of equalizing marginal abatement and damage costs. On the other hand, heavy polluting countries choose much weaker environmental policies acting independently, but pretending to act cooperatively. Environmentalists often argue that this policy competition could cause a “race to the bottom.”

To avoid environmental dumping, environmental policies should be harmonized between countries or should meet some minimum environmental standards for setting environmental policies. If this is not feasible, environmentalists argue that countries with strong environmental policies should be able to set “countervailing tariffs” against imports from countries with weaker environmental policies. This argument was always rejected by free trade advocates as impeding and distorting. These concerns require a profound analysis of the impacts and interactions between trade and the environment.

In order to explain trade policy measures according to WTO rules, a brief overview of the historic development of trade measures is provided in the next section. Section 3 gives a literature overview of the interactions between trade and the environment.² Next, in Section 4 we try to shed some light on the role of the WTO and of environmental agreements on trade policies. We then study the main interactions between trade and the environment in Section 5 and consider trade measures and policies in Section 6. In a fully liberalized global market, a very important role is played by capital flows, direct investments and technology transfer. These aspects are dealt with in Section 7. We also assess how different climate related trade policies affect world regions, especially developing nations. This is done in Section 8. Concluding remarks close the paper.

2. Trade Policies and Their Relationship with the Environment: A Brief Historical Overview

One of the first international trade agreements, the International Trade Organization (ITO), was established in 1945 to liberalize and harmonize international trade interactions. The most important agreement on international trade substantially determining world

² Several surveys are available on the topic of the relationship between environment and trade. A partial list includes Panayotou (2000), Copeland and Taylor (2001), Huang and Labys (2001), Esty (2001), Alpay (2002), Frankel (2002).

economic development was created in 1948: the General Agreement on Tariffs and Trade (GATT). The early GATT negotiation rounds achieved a substantial degree of non-agricultural liberalization. However, the initial momentum began to weaken shortly after its creation, mainly because each concession was granted item by item.³ As the number of concessions grew, nations found it increasingly difficult to find goods possessing a degree of tariff redundancy, causing further tariff concessions to necessitate a greater degree of adjustment. This increased political opposition.

Widespread violations of GATT principles took place. In the 1950s the USA imposed quotas on agricultural commodities without the required domestic production constraints. Most European countries tended to implement import quotas without the balance of payments difficulties required to justify them. The 1963-67 Kennedy Round improved GATT's status as 74 nations negotiated a considerable reduction of non-agricultural tariffs. Only very minimal parts of agricultural trade could be liberalized because the majority of the agricultural protection was in the form of non-tariff barriers.

The next big trade negotiation, the Tokyo Round that lasted from 1973 to 1979, had a much more ambitious agenda of reducing the growth of non-tariff barriers and subsidies. These negotiations helped reduce a substantial amount of tariffs. Furthermore, a standard code - or the GATT Agreement on Technical Barriers to Trade - was created. The main goal of this instrument was to achieve an overview of the application of standards in international trade and reduce their use as non-tariff barriers. The idea was to support harmonized standards. Although the code especially referred to environmental standards, it incorporated some unclear specifications such as the allowance of lower standards than those set by the international norm.

The key objectives of the Uruguay Round, from 1986 to 1994, were especially focused on the treatment of the agricultural sector relative to the industrial sectors, and on reducing non-tariff barriers in both sectors. One important issue was to include developing nations in the negotiations and to extend the coverage of GATT by applying the principle of non-discrimination to trade in services, trade-related intellectual property rights and trade-related investment measures. As an outcome of the negotiations, the Uruguay Round Agricultural Agreement contributed substantially to the liberalization of agricultural trade. This is because

³ An overview of these developments is found in GATT (1991); a brief overview is summarized in Cole (2000).

the agricultural sectors were to be treated in the same way as the industrial sectors; all forms of protection other than tariffs were proscribed for this. One exception to this rule was the treatment of export subsidies, which were forbidden. However, agricultural export subsidies were to be reduced by only 36% over a six-year time period. There was an agreement that no new non-tariff barriers would be created and that all existing non-tariff barriers would be converted into tariffs. Furthermore, tariffs were to be reduced by an average of 30% and market access was to be improved and enhanced. One further main achievement of the Uruguay Round was a significant increase in the number of tariff bindings. In addition, a special treatment of developing countries was reduced, while the formation of the World Trade Organization (WTO) committed all members to submit tariff schedules.

Regarding environmental considerations, the Uruguay Round enlarged the scope of the Technical Barriers to Trade Agreement (TBTA) by focusing on process and production methods. As the first of such agreements to include environmental concerns, the result of this negotiation affirms the principle that “technical regulations shall not be more trade restrictive than necessary to fulfill a legitimate objective.” This objective entails the protection of human health and safety, animal and plant life, and health and the environment. The main aim was to cover not only the finalized product but the production process and its environmental implications as well.

Further environmental requirements were intended to be internalized, as the agreement on agriculture allows direct payments under environmental programs. This was meant to exempt them from the WTO members’ commitment to reduce domestic support for agricultural production. To support industrial environmental improvements, the Agreement on Subsidies and Countervailing Measures guarantees the coverage of twenty percent of environmental legislation costs that industries need to spend.

Additionally, the Uruguay agreement was especially concerned with food safety as well as animal and plant health regulations. The agreement aimed at preventing covert protectionist regulations while encouraging greater transparency of rules and standards. Harmonized international standards should guarantee this development.

The development of the World Trade Organization (WTO) was a key milestone of the Uruguay Round. The WTO was seen as a new organization accepting all agreements of the Uruguay Round. The WTO established a Committee on Trade and Environment (CTE) that investigates the relationship between trade and environmental measures. Its goal is that of

reaching a sustainable development and analyzing potential rules to achieve this development. Furthermore, the committee studies the relationship between multilateral trading systems and trade measures used for environmental purposes, especially those of multilateral environmental agreements. The relationship between multilateral trading systems and environmental measures that induce significant effects on trade need to be examined, as well as the environmental effects of trade liberalization.⁴ Because trade ministers participate in WTO activities, the WTO became a much stronger organization than the GATT ever was.

The Committee on Trade and Environment focused one of its studies on the Multilateral Environmental Agreements (MEA). In the report the CTE notes that trade measures have a very important role. However, trade measures are normally not the most appropriate and effective policy instrument. MEA trade measures need to be compatible with the WTO. The CTE tried to establish a so-called “environmental window” to allow discriminatory trade measures against non-signatories to the MEAs. It has been agreed that a dispute between an MEA and the WTO needs to be resolved using a dispute settlement procedure. The WTO states that in the first instance, a dispute between the WTO and MEA should attempt to be settled under the dispute settlement mechanisms contained within the MEA. If the dispute concerns a non-signatory country to the MEA, it was agreed that the settlement would occur under the WTO. Until today, the WTO regularly organizes symposia dealing with the impacts of trade liberalization on environment, environmental protection, sustained economic growth and the environment.

3. Interactions between Trade and the Environment: A Review of the Applied Literature

Is environmental degradation deepened by international trade liberalization? Is the competitiveness of domestic firms distorted by environmental regulations? Many scientists have analyzed these issues. Many authors find that free trade is not always beneficial to all nations when environmental constraints are considered. Some authors suggest that trade liberalization will generate more economic growth and higher income and thus induce a

⁴ Anderson (1992) summarizes the basic tasks: see Cole (2000) for an overview. Antweiler, Copeland, and Taylor (2001) set out a theoretical model of how openness to international goods markets affects pollution concentrations: trade's impact on pollution is divided into scale, technique, and composition effects and then data on sulfur dioxide concentrations are used to assess the theory. It concludes somewhat surprisingly that freer trade appears to be good for the environment.

higher demand for environmental quality. Others argue that higher growth could increase the environmental degradation if no regulation takes place, especially in developing countries. However, not all empirical studies could confirm that all environmental policies have negative impacts on international competitiveness. Some authors find that free riding can be reduced if they cooperate on international trade. Baumol (1971), Magee and Ford (1972) and Walter (1973) have conducted pioneering studies about the very general interrelations of trade and environment. Ulph (1994) surveyed the theoretical literature on trade and the environment. Ekins, Folke and Costanza (1994) edited a special issue on trade and environment for *Ecological Economics*.

Many authors have studied the empirical relationship between environment and economic growth. They have formulated and tested an inverted-U hypothesis known as Environmental Kuznets Curve. According to Grossman and Krueger (1995) it results from a composition effect (changes of bundles of goods being produced) and a technique effect (changes in the production technology) being jointly greater than a scale effect (changes in the size of economic activities) for income levels. In this analysis international trade could play an explicit role. Frankel (2002) puts it as follows: “The question relevant [is] whether globalization helps or hurts in achieving the best tradeoff between environmental and economic goals. Do international trade and investment allow countries to achieve more economic growth for any given level of environmental quality? Or do they undermine environmental quality for any given rate of economic growth?” (p.4). Grossman and Krueger (1993) include in their Environmental Kuznets Curve formulation a trade intensity variable (the ratio of exports and imports to GDP) in order to test the hypothesis that greater openness to trade leads to lower environmental standards in an effort to preserve competitiveness in the face of international competition. They do not find significant associations between pollution and trade, except in the case of urban concentrations of SO₂, for which they find evidence that trade actually helps lower rather than raise pollution levels. Shafik and Bandyopadhyay (1992) use the same measure of openness and find weak evidence that economies that are more open tend to pollute less. Selden and Song (1994), Lopez (1994), and Dean (1997) perform similar investigations. Lucas, Wheeler and Hettige (1992) find this relationship between GDP growth rates and the increase in toxic intensities. In fast-growing, low- and middle-income countries with increased GDP rates, they find reduced toxic intensities, especially where tax distortions were decreased. Most recently, Cole (2004) uses detailed data

on North-South trade flows for pollution-intensive products in order to assess the extent to which the Environmental Kuznets Curve can be explained by trade, and specifically by the migration of dirt industries from developed to developing regions.

The effect of trade on environment *for given level of income per capita* is an interesting question for at least two reasons (Frankel, 2002; Frankel and Rose, 2002). Suppose that trade had an adverse effect of the environment because openness raises nations' incomes and higher incomes reduce environmental quality, should we choose deliberate self-improvement as a means to a clean environment? Secondly, the answer to the question is not known or the issue is not yet settled. There are possible effects in both directions. Regarding international competitiveness effects of international free trade, some authors argue that higher environmental regulation leads to decreased competitiveness of domestic firms (Pethig, 1976; Siebert, 1977; McGuire, 1982; Simpson and Bradford, 1996). More generally, countries open to international trade will adopt laxer environmental standards out of fear of reduced international competitiveness. This is sometimes referred to as *race to the bottom hypothesis*. Trade is thus detrimental for environment. Others hold the opposite view, that trade is good for environment. Several arguments can be put forth in both directions. A popular one suggests that tightened environmental regulation stimulates technological and managerial innovation, thus increasing firms' productivity and international competitiveness. This is known as the *Porter hypothesis* (Porter, 1991; Porter and van den Linde, 1995; Eliste and Frederiksson, 2001). Multinational corporations, for instance, tend to bring clean state-of-the-art production techniques from high-standard countries of origin to host countries where they are not yet known (Esty and Gentry, 1997). Another possibility is that, because trade offers consumers the opportunity to consume goods of greater variety, it allows countries to attain higher levels of welfare (for any given level of domestically produced output), which will raise the demand for environmental quality. Again, if the appropriate institutions are in place, this demand for higher environmental quality will translate into effective regulation and the desired reduction in pollution. More generally, trade allows countries to achieve higher standards of living, which include not only more measured income but also more environmental goods. This is the *gains from trade hypothesis*.

Birdsall and Wheeler (1992) show that higher environmental standards for trade liberalization could also be imported from developed into developing countries, for example in Latin American countries. Dean (1997) finds that improvements in Chinese international

trade relationships lead to increased income but also increased emissions growth. Copeland and Taylor (1994) analyzed the international trade options of a global theoretical North-South model. They find that free trade lowers pollution levels in the North but increases them in the South. Chichilnsky (1994) shows in a theoretical work that invalid property rights could lead to false environmental policies, thus inducing negative externalities. Daly (1993), Esty (1994), Dua and Esty (1997) and Esty and Geraldin (1997) illustrate that trade liberalization could lead to “environmental dumping” by relaxing environmental standards. This might not only be done to increase the competitiveness of a country, but also for strategic reasons (Barrett (1994), Rauscher (1994), Kennedy (1994)). Robke (1994), Daly and Goodland (1994) and argue that free trade could lead to environmental degradation in developing countries.

Empirical evidence showing that environmental control costs are very low in comparison to other production costs is given by Magee and Ford (1972), D’Arge (1974), Richardson and Mutti (1977), OECD (1978), Ugelow (1982), Walter (1982), Pasurka (1985), and Robinson (1988). No empirical evidence could be found indicating that developed nations’ firms invest mainly in countries with lax environmental standards (Knodgen, 1979; Walter, 1982; Bartik, 1988; Levinson, 1997). Tobey (1990) finds that environmental policy does not impact trade patterns. Sartzetakis and Constantatos (1995) illustrate that market-based environmental policies induce more incentives than command and control instruments. Cole and Elliott (2003) examine the impact of environmental regulation on trade patterns within the traditional comparative advantage based model and within the “new” trade theoretic framework. No influence is found in the first case, whereas the shares of trade that are inter-industry and intra-industry appear to be affected by environmental regulation differentials between two countries. Eskeland and Harrison (2003) and Grether and de Melo (2003) are the latest examples providing empirical evidence not supporting the pollution haven hypothesis.

One of the most recent contributions is due to Frankel and Rose (2002). As noted above, the causal link between trade and environment could go either way. The authors note that the empirical analysis has to address a formidable simultaneity problem. They solve it by using appropriate instrumental variables in a two-equation system. Their econometric results for SO₂, NO₂, and SPM suggest that growth has a beneficial effect on pollution and that a higher ratio of trade to income seems if anything to reduce air pollution. These results do not

hold in the case of other broader measures of environmental quality. In particular, the optimistic story does not hold for CO₂ emissions, where trade and growth alone are not sufficient, but international cooperation is needed for this sort of global environmental problem. In a similar vein, Ederington and Minier (2003) ask whether trade agreements should be extended to include negotiations over environmental policy. The answer depends on whether countries distort levels of environmental regulations as a secondary means of providing protection to domestic industries. Unlike previous studies finding a negligible correlation between environmental regulation and trade flows, the authors treat the level of environmental regulation as an endogenous variable. Using data for 4-digit U.S. industries from 1978 to 1992, they find that environmental policy has a much stronger impact on net import levels than previously found. This implies that a country's environmental regulations are a valid area of international negotiation.

Environmental policy cooperation to avoid free riding could benefit all coalition nations. Carraro and Siniscalco (1993) studied free riding options. Barrett (1994, 1997) argues that cooperation agreements on environmental regulation between countries must be individually and collectively rational. Barrett (1999) studies the impacts of trade sanctions that could be used as a means of enforcing international environmental agreements. He finds that when sanctions are imposed against free riders, every country is better off as a signatory rather than as a non-coalition member. In climate policy, trade sanctions are not valid instruments for convincing free riders to join a coalition (Kemfert, 2002).⁵

4. Trade Liberalization, Environmental Agreements and the WTO

While promoting economic growth, trade liberalization can also increase environmental damages. It can do so through the unsustainable use of natural resources, while emissions could threaten the earth's assimilative capacity. International environmental agreements could include trade measures, which violate international WTO rules.⁶ Furthermore, international trade agreements involve market access provisions that could (to some extent) limit the ability of nations to implement domestic environmental regulations.

⁵ The role of international trade in climate policy and international environmental agreements is analyzed in a few recent papers (Buchner and Roson, 2002; Kemfert and Tol, 2002; Kemfert, 2004).

⁶ See Yoshino, Fischer, and Hoffmann (2002) for a brief institutional overview of trade and environmental agreements.

Free trade also carries the danger that countries with low environmental standards may have a competitive advantage over those countries with higher standards. Free international trade as suggested and applied by the WTO may prevent countries from implementing trade restrictions to protect the environment.

Regulations and protectionism can prevent environmentally harmful goods from entering a country. Environmental regulation could be a potential vote-winning issue in specific countries. This political pressure can make it hard for governments to refuse such an implementation. This could reduce the efficiency gains from international trade. Furthermore, in order to protect individual nations from the competitive force of an open international market, nations may use protectionism in the guise of environmental measures.

An often-used argument against free trade is that trade liberalization could limit the ability of nations to protect the environment, irrespective of whether nations are operating unilaterally or multilaterally. Control of global environmental problems like climate change or ozone depletion calls for multilateral responses in the form of multilateral environmental agreements such as the Montreal Protocol or the Kyoto Protocol. Many MEAs contain trade-based enforcement mechanisms to prevent free riders from undermining the effectiveness of such agreements. However, any restriction of trade between signatory and non-signatory nations could be illegal under WTO rules. Because of this, the WTO could effectively prevent the imposition of MEAs. MEAs inducing restrictions to international free trade could be allowed under article XX of the WTO.

Opponents of international trade liberalization argue that the WTO limits the implementation of environmental legislation at national and international levels. This can be caused by the fact that enforced market access agreements could have the effect of establishing environmental standards at the lowest level, thus preventing nations from implementing stricter environmental standards or limiting trade of environmentally unfriendly goods, products or technologies. This could induce trade restriction in the form of “green protectionism.” To avoid the trade of product or consumption externalities, countries implement trade restrictions. Environmentalists criticize the WTO for the allowance of trade restrictions and the failure to deal appropriately with environmental externalities.

Whether a trade restriction to avoid consumption externalities can be allowed and legitimized under the WTO rules depends on several conditions.⁷ The consumption externality must be proven to exist, and any resulting restriction must be universally applied. Furthermore, it needs to be verified that there is no other way to remove the externality. Additionally, it must be verified that the trade restriction is primarily aimed at removing the externality and not at protecting the domestic market. The benefits of the trade restriction and removal of the externality must be proportional. A trade restriction should not be applied in a way that constitutes a “disguised restriction on international trade”.⁸ These proofs assess the environmental benefits of the externality’s removal against the costs arising from the disruption to trade. If the costs of a disruption to trade do not exceed the environmental damages, trade restrictions can generally be justified under WTO rules.

With regard to damages resulting from the production of goods and services, trade restrictions are strictly prohibited under WTO rules. The Technical Barriers to Trade Agreement (TBTA) mentioned earlier could allow processes and production methods to be regulated. Therefore, trade restrictions are not allowed that support regulations which control foreign production processes which are not detectable in the final output. The WTO does not allow any trade restrictions in response to environmental damage occurring outside their jurisdiction.

5. Interactions between Trade and the Environment

Economic globalization may induce severe impacts on the environment and sustainable development. Globalization contributes to economic growth, accelerates structural changes, diffuses capital and technology and could magnify market failures and policy distortions. This could increase environmental damages. Globalization may act as a motor for improved prospects of international economic growth in some industries and sectors, but could also conceivably reduce economic prospects in other countries. This may result in poverty-induced resource depletion and environmental degradation.

Trade liberalization is a driver of globalization. The natural environmental quality is affected by various impacts of trade liberalization. World trade has grown faster than world

⁷ Pearce (1992) notes that several GATT/WTO disputes have shown that under specific circumstances trade restrictions may be allowed under the WTO law.

⁸ For an overview see Cole (2000).

output. This means that trade intensity in the global economy has increased drastically. The economic theory of international trade liberalization says that free trade maximizes the efficiency of resource allocation. However, only if natural and environmental resources are efficiently priced, i.e. all externalities and social costs are internalized, will global output be brought into balance with environmental costs. If resources are unpriced or underpriced or externalities are not taken into account due to market or policy failures, resources will be misallocated. In this case, free trade would not maximize global social welfare. This means that positive welfare effects of trade liberalization could be overcompensated for by negative welfare effects such as wasteful resource depletion or environmental degradation.

Trade liberalization stimulates economic growth that induces increased economic activities. A larger volume of economic activities raises the aggregate level of natural resource use and environmental pollution unless improved resource efficiency and structural change reduces resource use and pollution intensity. For a given structure and resource use efficiency, the scale effects on the environment are unambiguously negative. These negative scale effects are larger if market failures such as incorrectly defined property rights, unpriced ecosystems, incorrectly internalized externalities and underprovided public goods exist.

A larger volume of economic activities also increases economic income. Higher incomes induce higher consumption that could increase environmental externalities but also raise the willingness to pay for environmental improvement. On the other hand, economic growth increases potential resources for environmental protection that raises environmental quality. World economic trade liberalization may help decrease pressures on developing countries to encroach on natural resources. But free trade and increased competition could also lead to decreased access to international technology standards or capital uses in developing regions. Trade liberalization may reinforce the vicious circle between poverty and environmental degradations. Free trade and international competition could force environmental depletion as it is exploited for exports. Studies on income levels and environmental degradation found an inverted U-shaped relationship (Grossman and Krueger, 1995). At low income levels, income growth is associated with higher levels of environmental degradation until a turning point is reached (between US\$5,000-10,000). Beyond this average income level, further income increases environmental improvement results. This relationship is known as the Environmental Kuznets Curve. Environmental degradation could therefore be reduced by increased economic income rather than through targeted environmental policies.

This could be interpreted that any restriction on trade slows the transition to a positive income-environment relationship. However, such an interpretation ignores the role of market and policy failures in determining the level of environmental damage cost per additional unit of GDP and the scope for policy reform to reduce it (see Panayotou, 2000). Additionally, it ignores the threshold effect and the risk for irreversible environmental damages. Furthermore, it forgets that current income levels are far away from the necessary turning point. Thus, environmentally polluting industries continue to produce, resulting in significant environmental damages.

International trade liberalization and globalization also leads to substantial structural and composition effects. For example, developing countries can produce with low cost labor inputs compared to any other production factor. Through this, trade liberalization tends to shift labor- intensive production to developing countries. Furthermore, developing countries are often endowed with significant natural resources and less demand for environmental quality. This could lead to structural shifts towards increased specialization in non-sustainable production activities.

International trade liberalization induces the diffusion of products and technologies. The impacts of these trades are highly dependent on the types of products and technologies. Trade liberalization could contribute to an increase in more efficient capital equipment of more environmentally friendly technologies. Furthermore, on the consumption side, more “greener” products such as organic foods, low emissions vehicles and recyclables can be supported. Almost 40 percent of global international trade is in machinery and equipment (see United Nations, 1996), of which 80 percent is traded by developed nations and about a third is imported by developing regions. Trade liberalization and increased income growth not only leads to increased technology trade but also increased technological innovations that contribute to sustainable development. Technological progress can be increased through economies of scale, enhanced incentives to innovate and less repetition of research and development efforts through reduced protectionist barriers. On the demand side, pressure from customers, regulators, shareholders or the community could induce producers to invest in less environmentally polluting technologies and offer environmental friendly products. On the supply side, technological change is determined and influenced by abatement costs and the ability of firms to benefit from environmental damage mitigation. Environmental policies could contribute to increased incentives for environmentally friendly technology development

and management. Market-based instruments and increased research and development expenditures could encourage the use of innovative and environmentally friendly technologies.

6. Trade Measures and Policies

As previously described, international trade liberalization could lead to fewer environmental policies, as they could induce competitiveness losses by raising costs relative to other countries with less environmental standards (“environmental dumping”). However, there is substantial evidence that differences in environmental standards and environmental control costs have had very small effects on trade patterns. The primary reason for this is that environmental control costs represent a very small fraction of overall production costs.⁹ Any comparative advantage induced by lax environmental standards is overcompensated by other comparative advantages such as differences in natural and resource endowments, technologies, physical and human capital, infrastructure, and macroeconomic policy setting. Furthermore, trade liberalization could increase the share of trade in pollution-intensive products from developing countries due to fewer environmental standards. Empirical evidence has shown that the share of pollution-intensive products from the USA has fallen from 21 to 14 percent and that of Southeast Asia has risen from 3 to 8 percent from 1965 to 1988 (see Low and Yeats, 1992, and Panayotou, 2000). However, these changes represent more of a general increase in demand for pollution-intensive products from newly industrialized countries rather than an increased demand for their pollution-intensive production processes.

Multilateral trade rules distinguish between product standards and process and production methods. In order to make product standards more transparent and non-discriminatory between domestic and foreign sources, multilateral trade rules allow national requirements to meet specific environmental, health and safety standards.

Production method-based standards established through e.g. taxes or charges to imported products conflict with the principle of national sovereignty. However, border tax adjustments are allowed under WTO rules. This means that production methods could be treated in the same way as product standards. At the same time, standards or charges for non-

⁹ For example, Grossman and Krueger (1993) found that pollution abatement costs in the USA have not affected US imports from Mexico.

product-related PPM violate WTO rules. Border tax adjustments or countervailing duties for non-product-related PPM are not allowed. Where transboundary and global environmental issues are concerned, a harmonization of non-product PPM requirements may be indispensable.

7. Capital Flows, Foreign Investment, Technology and the Environment

One major channel through which globalization and international trade affect the environment are international capital flows. Indeed, foreign investment, technology diffusion and trade expansion provide the primary impulse of economic integration.

Globally, international capital movements are larger than international trade flows. They are also larger than official flows: in 1996 private capital flows to developing countries were six times the funds of the Official Developing Assistance (ODA) Program (World Bank, 1997). Moreover, while the former has been increasing the latter have been steadily falling. Private capital flows are mostly driven by rate of return considerations. Opportunities have increased considerably in the past decade after a strong drive to market liberalization and privatization of state enterprises and public utilities promoted by an increasing number of countries. Recent examples are the privatization of electric utilities in Argentina, concessions to private developers for public transport and waste management in Thailand and for water and sanitation in the Philippines. Yet, being motivated by market opportunities rather than by aid or developing policy choices, private flows tend to be concentrated in a restricted number of emerging economies and to avoid poor countries with high risk and undeveloped institutions and poor infrastructure. This fact bears important consequences for its environmental implications, although there is little information available about their environmental and social impacts.

Nearly 45% of private capital flows to developing countries are represented by foreign direct investment (FDI), 33% by debt finance and 19% by portfolio equity investments. This last item has only indirect links to the environment through the effect on the value of companies that they are directed to. If they build up the value of companies with high environmental performance, they have positive impacts; if instead, they put pressure for short-term profitability, they create disincentive for environmental performance. Indeed, investors appear to play an important role in encouraging especially quoted companies to adopt clean production processes (Konar and Cohen, 1997; Lanoie, Laplante, and Roy, 1998). Note that

similar effects of environmental news on stock prices have been identified in developing countries such as Argentina, Chile, Mexico, and the Philippines (Dasgupta, Laplante, and Mamigi, 2001). In fact, the market responses in those countries are much larger than those reported for the U.S. and Canadian firms. Debt financing or commercial lending to private companies gives the lender a stake in the borrower's financial performance, which may be affected by environmental risks.

Foreign direct investment is highly concentrated: only 7% of FDI and portfolio flows are directed to developing countries, and within this group China has the lion's share while sub-Saharan countries receive only 2% of these flows. This is why private capital flows are not and cannot be a substitute for ODA flows, since poor countries that need them the most attract them the least. From the point of view of the sectoral destination, FDI goes mainly into manufacturing industries, mining development, power stations, telecommunications, port development, airport and road construction, water supply or sanitation (see Panayotou, 2000). They all generate environmental implications. FDI is also a primary vehicle of technology transfer. In the absence of data and quantitative investigations, the net environmental impact of FDI on the environment and sustainable development is difficult to gauge. On the one hand, FDI provides risk capital that contributes to economic growth, employment and, more generally, poverty alleviation. Furthermore, it creates positive externalities in the form of increased competition, improved management skills and access to environmentally friendly technologies. On the other hand, decisions to invest in foreign countries are influenced by fewer environmental standards or lax enforcement. Is there evidence that lax environmental standards actually attract more foreign investment? Repeated tests of the "pollution haven" hypothesis failed to find evidence of a systematic tendency of manufacturing plants to be located in countries with lax environmental standards. In choosing how much to invest and where, firms take into account many factors in addition to environmental regulations, such as size of the local market, the quality of the labor force, the available infrastructure, ability to repatriate profits, political stability, and the risk of expropriation. In this context, evidence indicates that the stringency or laxity of environmental regulations is insignificant as a determinant of location decisions. Indeed, Wheeler and Mody (1992) found that multinational firms base their investment decisions primarily on labor costs and market access, while corporate tax rates and, by extension, environmental control costs play little or no role. In addition, if environmental regulations affect FDI location decisions, we would expect foreign

direct investment in pollution-intensive sectors to account for a larger share of foreign direct investment *from* countries with stringent environmental regulations today than it did in the 1960s or 1970s. Repetto (1995) showed that the reverse is true. He concluded that, to the extent that “greener” countries seem to be exporting their “dirty” industries, they are predominantly sending them to each other, not to developing countries with weaker regulations. In 1995, only 5% of U.S. direct investment in developing countries was in pollution-intensive sectors, compared to 24% in developed countries with equally stringent (compared to the U.S.) environmental regulations. Finally, Eskeland and Harrison (2003) examine whether multinationals are flocking to developing countries that are pollution havens and find that the evidence is weak at best. The authors also ask if foreign firms pollute more than domestic ones. It is found that foreign plants are significantly more energy efficient and use cleaner types of energy. Data are used for four host countries: Ivory Coast, Morocco, Mexico, and Venezuela. Finally the study of US outbound investment reveals that the pattern is skewed towards industries with high costs of pollution abatement, but the econometric results are not robust across different specifications.

Foreign economic relations also imply technology transfer. Trade flows give rise to 75% of international technology transfer, while 18% of such transfer is due to investment flows (OECD, 1995). International trade also increases the rate of technological innovations. Capital flows and FDI contribute to technological innovations and diffusions through direct capital exports for financing equipment, increased R&D expenditures and technology spillover effects. These innovative technologies are normally more environmentally friendly than older technologies (see Grossman and Helpman, 1995; Panayotou, 2000).

Indeed, improved technology does not only lead to increased productivity in the manufacture of old products, but it signifies also the development of new products. From the environmental perspective, the distinction is important, as process innovation may lead to less material usage and to greater energy efficiency. On the other hand, unknown new problems may emerge, such as the emergence of new sectors and industries with new kinds and degrees of pollution problems (e.g. new toxins). As put by Stiglitz (1999), with international trade technological innovation is even more important than in a closed market economy. Developed countries must continually innovate in order to grow and maintain their real incomes. For developing countries, in addition to its direct benefits, technology transfer brings the indirect benefit of improved terms of trade (Krugman, 1990).

Trade favors the diffusion of technology. This prevents economic late-comers from requiring the same level of materials and energy inputs per units of GDP as those needed in the past by older industrialized countries. Panayotou (2000) argues that capital flows, especially FDI, contribute to technological innovation and diffusion in at least three ways: by generating greater finance from capital exporting countries for financing investments in equipment, embodying more advanced technologies that are available in the host country; by investing in R&D overseas; and by generating technological spillover to national firms, through imitation, employment turnover, and by supplying multinationals demanding higher quality standards. The technology transfer by multinationals tends to be more advanced than what already exists in the host country because 80% of FDI originates in countries that are primary sources of technological innovations such as the U.S., U.K., Germany and Japan and because, in order to overcome institutional, regulatory, cultural, and other hurdles in the host country, multinationals tend to apply advanced technology which, along with management, tend to be their most important competitive advantages (Grossman and Helpman, 1995).

Of course, after having mentioned to positive implications of technological transfer and diffusion across countries, we must ask what are the implications for environment quality. The evidence here is scant and somewhat indirect. An example is the trend in material intensity of output (basic material inputs such as wood, metals, minerals, steel and raw agricultural materials) that was generally reduced across all regions of the world in the last three decades (see Panayotou, 2000, and the references cited therein). Of course, this decline is only partly due to technological change, and partly to structural change. In addition, we may ask if technological innovations tend to be less environment-intensive or cleaner. Environmental intensity changes when there is a change in the product or the production process, when one input is substituted for another and when the technology is used more efficiently. While there is no comprehensive analysis of recent technologies as to their environmental intensity, Johnstone (1997) provides a list of selected technological innovations with significant, positive environmental impacts, which have been widely adopted in recent years and are spreading throughout the developing world. These include: (i) SO₂ emission reducing coal scrubbers (end-of-pipe type of technical improvement); (ii) energy saving electric arc furnace (process innovation); (iii) HCFCs leading to reduced ozone depletion (input substitution type of change); (iv) biodegradable packaging implying reduced waste accumulation (product innovation); (v) thermomechanical pulping producing reduced

waste water discharges (process innovation); (vi) low-solvent paint generating reduced smog (product innovation); (vii) reverse osmosis purification producing reduced waste water discharges (end-of-pipe change); (viii) counter-current rinsing entailing reduced heavy metal waste (process innovation).

8. Environment and Trade: The Effects on Developing Countries

Standard trade theory suggests that, under free trade, developing countries will specialize in the production of goods which are intensive in the factors of which they are relative more abundant: labor and natural resources. Developed countries, on the other hand, will specialize in human and physical capital intensive activities (manufactured products and services). It follows that the part of the reduction in environmental degradation observed in middle and high income countries may be the consequence of this trade specialization (Hettige, Lucas, and Wheeler, 1992). Thus, an explanation of the declining arm of the Environmental Kuznets Curve is the presumption that developed countries “export” to developing countries pollution intensive production activities, either through trade or through foreign direct investment. Another aspect of this explanation does not highlight trade specialization, but rather the strictness of environmental regulation. Thus “environmental dumping” takes place toward those countries, typically LDCs, where environmental standards are laxer, thereby worsening the effects of trade specialization for those countries. Still, another aspect relates to what is known as “carbon leakage” in climate change agreements. For example, a high carbon tax in developed countries may induce carbon intensive industries to move to developing countries. Pezzey (1992) reckons that, if the European Union were to cut carbon energy consumption by 20%, the corresponding reduction in world consumption would be of less than 1%. Wyckoff and Roop (1994) study the quantity of carbon embodied in imports of manufactured product by developed countries: they calculate that about 50% of such carbon is in the production of goods that were not thought to be energy-intensive themselves. They also reckon that the ratio of carbon embodied in imports relative to those countries’ total carbon emissions ranges from 10% to 40%.

The consequences of these facts are at least twofold. Even if an inverted-U relationship between growth and the environment has existed in the past, the pressure of global competition on environmental regulations makes it unlikely to emerge in the future. In the “race to the bottom” scenario (Dasgupta, Laplante, Wang, and Wheeler, 2002), relatively

high standards in rich countries impose high costs on polluters. Shareholders, bank lenders, consumers then drive firms to relocate to low-income countries, where eagerness for jobs and income prevail upon other environment-related considerations. However – the story goes – rising capital outflows force governments of high-income countries to relax environmental standards. In the end, arbitrage in a frictionless globalized world leads to generalized lax environmental regulation and the environmental Kuznets curve flattens and shifts upward to highest existing levels of pollution. The second aspect originally noted by Grossman and Krueger (1995) is that developing countries “will not always be able to find still poorer countries to serve as havens for the production of pollution-intensive goods” (Grossman and Krueger, 1995, p.372).

The evidence that either the patterns of trade or the location of investment are significantly influenced by differential environmental standards among countries appears to be rather weak. Hettige, Lucas, and Wheeler (1992) find that toxic emissions grew faster in developing countries than in developed economies, but also that more open economies have less growth in toxic emissions. As for the pollution haven hypothesis, the econometric results of those authors are to some extent consistent with the “industrial displacement effect” of dirty industries from OECD to developing countries (see also Low and Yeats, 1992; Ekins, Folke, and Costanza, 1994). Another contributing factor has been the “import protection” imposed by developing countries (pp. 480). For example, countries with high tariffs and quota on chemicals have experienced faster growth of toxic intensity in their industrial production mix than those that followed outward oriented policies (Grossman and Krueger, 1993).

Clearly, more work needs to be done to fully understand the role of international trade in mediating the relationship between environment and economic growth. On the one hand, there appears to be little evidence in support of the pollution haven hypothesis; to the contrary, there is increasing evidence that open economies tend to be cleaner than closed economies. On the other hand, a growing body of ecological economics literature marshals evidence showing that, while the production patterns of developed countries may have grown cleaner over time, their consumption patterns continue to be as environmentally burdensome as ever. To resolve these issues, we need more analytical and disaggregated structural models than the standard reduced-form specifications.

As a solution of the “race to the bottom” problem, high environmental standards that are uniform across the world are proposed. For countries that unwilling or unable to enforce

such standards, tariffs, restrictions or penalties should be imposed on exports of their pollution-intensive products to offset their advantage as pollution havens. But how big is the incentive to relocate due to the difference in environmental standards across countries relative to other incentives? Research into the determinants of relocation decisions in both high-income and low-income countries shows that pollution control does not impose high costs on businesses. Jaffe, Peterson, Portney, and Stavins (1995) provide evidence in this direction. They note that firms in developing countries often have lower abatement costs than OECD nations, because the labor and materials used for pollution control are less costly than in OECD economies. Moreover, several studies have demonstrated that pollution control costs are not a major determinant of relocation relative to other motives such as distance to market, infrastructure quality and cost (Tobey, 1990; Modi and Wheeler, 1992; Grossman and Krueger, 1993; Levinson, 1997). These considerations cast doubts on the “race to the bottom” hypothesis. After all, as noted by Dasgupta, Laplante, Wang, and Wheeler (2002), after decades of increasing capital mobility and trade liberalization the “race to the bottom” should be by now well under way everywhere. Instead we do not observe a general relaxation of environmental standards in developed economies. At the same time, as documented by Wheeler (2001) for China, Mexico and Brazil (countries which received 60% of 1998 total foreign direct investment to developing countries), inflows of foreign direct investment is negatively - not positively - correlated with pollution levels.

9. Concluding Remarks

Foreign economic relations affect the environment and sustainable development in several ways and through various channels. Increased economic integration rises living standards as conventionally measured by promoting economic growth of the parties involved. As the economic globalization proceeds, so does concern for environmental degradation of countries. Through greater use of natural resources and greater pressure on the carrying capacity of the planet due to increased emissions and pollution, many see economic globalization as the foe of environmental sustainability. On the contrary, others see in international trade, finance, investment and technology diffusion the way to promote a sustainable development to all countries of the world.

In this paper we have reviewed these issues and made an attempt to assess the costs and benefits of increased foreign economic relationships for the environment. We have also

considered the opposite link: the way in which environmental considerations may affect international trade. International trade has been in all its dimensions: the exchange of goods, of technology, and of capital. The problem has also been considered with a special eye also on developing countries.

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- (lix) This paper was presented at the ENGIME Workshop on “Mapping Diversity”, Leuven, May 16-17, 2002
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- (lxi) This paper was presented at the Eighth Meeting of the Coalition Theory Network organised by the GREQAM, Aix-en-Provence, France, January 24-25, 2003
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- (lxv) This paper was presented at the EuroConference on “Auctions and Market Design: Theory, Evidence and Applications” organised by Fondazione Eni Enrico Mattei and sponsored by the EU, Milan, September 25-27, 2003
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- (lxvii) This paper has been presented at the international conference on “Tourism and Sustainable Economic Development – Macro and Micro Economic Issues” jointly organised by CRENoS (Università di Cagliari e Sassari, Italy) and Fondazione Eni Enrico Mattei, and supported by the World Bank, Sardinia, September 19-20, 2003
- (lxviii) This paper was presented at the ENGIME Workshop on “Governance and Policies in Multicultural Cities”, Rome, June 5-6, 2003
- (lxix) This paper was presented at the Fourth EEP Plenary Workshop and EEP Conference “The Future of Climate Policy”, Cagliari, Italy, 27-28 March 2003
- (lxx) This paper was presented at the 9th Coalition Theory Workshop on "Collective Decisions and Institutional Design" organised by the Universitat Autònoma de Barcelona and held in Barcelona, Spain, January 30-31, 2004

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