The Graduate Institute of International Studies, Geneva

Trade Liberalisation and Climate Change

Submitted to Professor Urs Luterbacher
May, 2001

By Marcel Stoessel
Email: marcel@stoessel.ch

This paper is also available on http://www.stoessel.ch/hei/environment/liberalisation.pdf

TABLE OF CONTENTS

Introduction: Trade Liberalisation and Anthropogenic Climate Change

While trade and the environment were largely treated as separate issues until the early 90's, there is a growing understanding about the multiple, complex and important links between the two subjects today. However, as *Friends of the Earth* point out correctly, one "blind spot" in literature is the "relationship between increased *trade liberalisation*, increased trade, increased production, increased energy use and *climate change*"[1]. This study attempts to shed some light onto that blind spot by providing a general research outline on the effects of trade liberalisation on climate change.

From 1950 to 1994, world output grew at an average annual rate of 4%, while worldwide merchandise trade grew at a rate of over 6%. In the past 15 years, international trade has expanded at almost twice the pace of global GDP[2]. This illustrates the greater trade-intensity of the global economy. In 1995, international trade in goods, services and intellectual property was estimated ad US $ 5 trillion.[3] At current growth rates, per capita GDP will double by 2035 and again by 2070[4]. Foreign direct investment increased from 44 billion to 644 billion between 1970 and 1998[5]. Between 1950 and 1998, airfreight transportation increased from 730 million to 99 billion ton-kilometres[6]. There is widespread agreement that this *economic globalisation* has been fostered both by new communication and information technologies and by *reduced barriers to international trade and investment*.[7]

The unprecedented expansion of the global economy – partly fostered through trade – has also led to an unprecedented accumulation of so-called "Greenhouse Gases" (GHG) in the atmosphere. GHGs such as CO_2 make the earth a less efficient emitter of energy back into space.[8] The Earth's surface temperature has increased by about 0.6 degrees in the 20th century and is expected to rise between 1.4 and 5.8 degrees during the 21st century.[9]

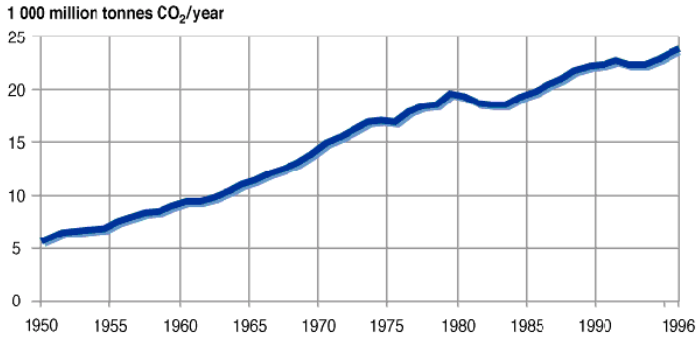

Figure 1 Global carbon dioxide emissions. Source: UNEP, 2000:4.

Humans are responsible for most of the observed climate change, as the Intergovernmental Panel on Climate Change (IPCC) recently confirmed: "There is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities."[10] The primary causes of *anthropogenic climate change* are to be found in the use of energy – mainly the use of fossil fuels – and land use change[11]. In both areas, trade clearly plays a role, and we will try to evaluate that role.

Cole and Rayner[12] estimate that if the Uruguay Round of trade liberalisation had already been fully implemented by the year 2'000, the associated 0.5% worldwide GDP increase would have produced 3.34% more emissions of carbon dioxide and 2.58% more emissions of nitrogen oxides compared to

---

[1] http://www.foei.org/campaigns/ClimateChange/trade_debt_climate.html [Emphasis added]
[2] UNEP / IISD, 2000:vii.
[3] Quoted in Luterbacher and Norrlöf:551.
[4] Nordström and Vaughan, 1999:2.
[5] Quoted in: French, 2000:6.
[6] Quoted in: French, 2000:6.
[7] UNEP / IISD, 2000:1.
[8] Besides carbon dioxide, other gases like methane and nitrous oxide also contribute to the greenhouse effect.
[9] IPCC, 2001:1.
[10] IPCC, 2001:6.
[11] Jepma and Munashinghe, 1998:2.
[12] 2000:345-347.

1990 emissions. As we will see in *Section 1*, such estimates are based on important assumptions about human behaviour and political action as a result of economic growth. Our brief discussion of the general trade – environment link is methodically divided into six effects; it is important to note that these effects can be both positive and negative for the environment. *Section 2* deals with perhaps the most obvious effect of trade liberalisation: goods are increasingly transported across borders and over larger distances. The cause for this development, however, is not only trade liberalisation in itself, but also market and policy failures. The same is true for the energy sector, which will be discussed in *Section 3*. Subsidies to coal mines for electricity production, for example, are evidence of a lack of liberalisation, not the contrary. Finally, *Section 4* examines whether the pressures exerted by the international market lead to the transformation of forests into agricultural land. We argue that trade plays a relatively small role in that process, and that the root causes are to be found elsewhere.

We will not directly address policy issues in this paper. In addition, we will not try to find ways on how the two very different bodies of law – multilateral environmental agreements (MEAs) and GATT/WTO law – can avoid collision. There are a number of studies on both subjects[13]. It is simply our aim to establish a framework of analysis with regards to the effects of trade liberalisation *per se* on anthropogenic climate change. Amongst the problems encountered while reviewing the large body of literature[14] were the prevailing lack of basic economic knowledge on the part of the environmental community and a certain free trade bias on the part of some environmental economists.

[13] See, for example: Luterbacher and Norrlöf, 2001; Cosbey, 1999.

[14] See Bibliography.

Section 1: The general trade environment relationship

The effects of trade on the environment are so complex that it makes sense to divide them into six distinct, but interrelated effects[15]. They all interact with each other when trade is liberalized.

Scale effects

Trade liberalisation expands global consumption and production; it fuels economic growth[16] (greater demand for raw materials, energy, and transportation). It is easier to find customers for any products or services in a system of free and open trade. Much environmental damage is due to the increased scale of global economic activity. "International trade constitutes a growing portion of that growing scale, making it increasingly important as a driver of environmental change."[17] If production and/or consumption of a good is pollutive, then an expansion in global output will, "in the absence of increased pollution taxes or a greater use of less-pollutive production methods, lead to greater environmental degradation."[18] In other words: If the scale effect *dominates* technology and composition effects and if externalities are not internalised, economic growth will always be harmful to the environment.[19]

Composition effect

Trade reveals countries' comparative advantages and increases pressure to specialize in products and services that they can produce relatively efficiently. If comparative advantage lies in lax environmental regulation or enforcement, environmental damage may result.[20] If labour or capital is the source of comparative advantage, effects on the environment are ambiguous. However, a trade-induced structural change due to the more efficient allocation of resources can lead to improvement of the environment. To take the example of agriculture, trade can replace domestic chemically intensive agriculture products with imported products, which rely on less damaging production methods.

Technology effect

According to the OECD[21], 75% of all international technology transfers stems from trade. New technology can be beneficial if pollution per output is reduced, e.g. through the import of foreign, more efficient technologies. Inversely, harmful technologies can be spread and more environmentally friendly and socially valuable traditional production methods can be harmed.[22] Some claim that certain cultures become dependent on luxury goods such as automobiles and jet planes[23], e.g. through new technology brought into China by General Motors.[24] But in balance, the technology effect is generally thought to be positive for environmental quality.[25]

Product effect

This effect needs no elaboration. Low-sulphur coal may replace high-domestic high sulphur coal, for example. The opposite may also be true.

Income effect

The less controversial part of this effect concerns the fact that extremely poor people tend to over-exploit the environment in order to survive.[26] Much more controversial is the *Inverted U-shaped*

---

[15] This distinction is drawn from Panayotou, 2000.
[16] Sachs and Warner, 1995.
[17] UNEP / IISD, 2000:2.
[18] Anderson and Blackhurst, 1992:53.
[19] Nordström and Vaughan, 1999:29.
[20] See "Regulatory effects of trade liberalisation".
[21] OECD, 1995.
[22] UNEP / IISD, 2000:36.
[23] Menotti, 2001:7.
[24] Chandler, 2000.
[25] Fredriksson, 1999:2.
[26] UNEP / IISD, 2000:37.

hypothesis[27], also called the *Environmental Kuznets Curve* (EKC): With raising per capita income, environmental deterioration doesn't continue linearly. It rather reaches a turning point and then starts to *decrease* because people become more concerned with environmental quality and can turn their attention towards long-term issues.[28]
Suri and Chapman[29] show that trade liberalisation has changed the composition of GDP in a more energy-intensive way in rapidly industrializing countries and in a less energy-intensive way in mature industrialized countries. Antweiler *et al.* find "evidence that increases in income will, after a point, lead to lower concentrations of *some* pollutants" [30]. Although the general pattern of the hypothesis seems to be confirmed, turning points seem to be different for each pollutant and for each country. "While countries are often willing to control emissions that primarily harm themselves (and close neighbours), such as sulphur dioxide and nitrogen oxide emissions, they are not always equally ready to accept the costs of reducing carbon dioxide and other emissions with a global reach"[31]. Moomaw and Unruh[32] estimate the CO_2 turning point – meaning the point at which people would be ready to adopt effective measures against climate change – at 35'400 $; some estimations go into several hundreds of thousands of dollars.[33]
This leads us to a first critique: The EKC "ignores the role of ma*rket and policy failures* and, … *threshold effects* and the risk of *irreversible environmental damages*" before reaching turning point[34] - if that point exists at all[35]. The strongest link between income and pollution is, according to Grossman and Krueger, via the induced policy response.[36] Anderson and Blackhurst[37] and Chia-Li Lin[38], however, draw the attention to the fact that politicians don't satisfy the median voter but are prone to special interest group influence.
The EKC and empirical evidence show that not all growth is bad for the environment, but also that income growth is not sufficient to reverse environmental degradation.[39]

Regulatory effects of trade liberalisation

These effects are of major concern for environmentalists.

The *pollution haven hypothesis*[40] claims that poor countries may have a comparative advantage in dirty goods because of lax environmental policy or enforcement and therefore may specialize in pollution-intensive sectors as a result of trade liberalisation.
This is as long as if differences in environmental standards dominate classical forms of comparative advantage, i.e. capital-abundance in developed countries and labour-abundance in developing countries.[41] While there is some empirical evidence that OECD countries moved away from pollution-intensive industries in the period 1960-1995[42], "low wage havens" seem to have played a much more important role than "pollution havens"[43]. Pollution abatement costs run only at about 2 to 3 percent[44], perhaps 5 percent[45] for the worst polluters. Also investment in developing countries does not have a

[27] Grossman and Krueger, 1995.
[28] Nordström and Vaughan, 1999:6.
[29] 1998.
[30] Antweiler *et al.*, 1998:5. (Emphasis added)
[31] Nordström and Vaughan, 1999:4.
[32] 1997, cited in Nordström and Vaughan, 1999:53.
[33] Suri and Chapman, 1998.
[34] Panayotou, 2000:6.
[35] The inverted U-shape may also reflect structural change from industry to services, which is driven by many factors, including trade liberalisation.
[36] Grossman and Krueger, 1995:372.
[37] 1992:20.
[38] 1999:4-5.
[39] Nordström and Vaughan, 1999:7.
[40] Copeland and Taylor, 1994.
[41] Nordström and Vaughan, 1999:31.
[42] Mani and Wheeler, 1995.
[43] Chomitz, 1999:127.
[44] UNEP / IISD, 2000:44.
[45] Nordström and Vaughan, 1999:4.

bias towards polluting sectors for the moment. "Neither studies on trade flows nor on FDI flows suggest that environmental regulations are an important factor in international location decisions"[46].

The *race-to-the-bottom hypothesis* claims that developed countries refrain from adapting higher environmental standards due to competition with countries that have lower standards. Sound environmental policies such as pollution taxes that internalise externalities may not be taken up. For example, several multinational companies in the Netherlands allegedly forced the Dutch government to roll back on increases in energy and environmental taxes by threatening to invest elsewhere[47]. Esty and Geradin[48] mention the failure of major industrialized countries (EU, US, Japan, Australia) to adopt energy taxes for climate change mitigation.
It is, of course, impossible to establish the real motivations behind government's decisions. However, considering again the small part of abatement costs in total production costs, it is more likely that special interest groups are working on the creation of a *perceived* "regulatory chill". A real chill may exist in the area of commodities such as copper, because very small price changes actually do send buyers elsewhere. "This is a serious problem, given the importance of commodity exports to many developing nation economies, and the wide-ranging environmental consequences of most commodity production"[49].

The *"Porter hypothesis"*[50] assumes the contrary, a *race-to-the-top*: Regularity pressure encourages industrial innovations that make production cleaner, e.g. innovations as a result of the Montreal Protocol[51].

The highest alchemy of environmental economics is to calculate the net outcome of these effects, which "is theoretically ambiguous, and is therefore ultimately an empirical question"[52]. An empirical study by Cole, Rayner and Bates[53] estimates that the net effect of the Uruguay round liberalisation is a 0.5 per cent increase in CO_2, a 0.2 increase in SO_2 and a 0.5 increase in NO_2. CO_2, the main GHG, is projected to increase everywhere[54], which suggests that all countries are still on the upward part of the inverted U-curve.

The relative magnitude of the effects varies according to country and according to sectors that are being liberalized. It seems to us that at the present time, whatever other mitigating factors may be at work, the *scale* effect clearly dominates the others. But it is very important to insist on the assumptions, which the authors worked with. Strutt and Anderson[55] simulated the effects of the Uruguay Round and of APEC trade liberalisation on Indonesia's environment. As the tables below show, a higher growth assumption of 0.5 percent *p.a.* significantly changes the result in terms of emissions.

	Total change	Scale effect	Composition effect
Carbon (%)	*+2.9*	+1.6	+1.3
Sulphur (%)	+4.8	+1.7	+3.1
Nitrogen (%)	+4.9	+1.6	+3.4

Table 1 Decomposition of pollution effects in Indonesia under APEC liberalisation, 2020. Percentages are of 1992-2020 absolute changes. Source: Strutt and Anderson, 1998:27.

[46] Nordström and Vaughan, 1999:40.
[47] Esty, 1994: 23.
[48] 1998:17-18.
[49] UNEP / IISD, 2000:45.
[50] Porter, 1995.
[51] *The Montreal Protocol on Substances that deplete the Ozone Layer*, 16 September 1987, http://www.unep.org/ozone/montreal.htm
[52] Nordström and Vaughan, 1999:2.
[53] 1998.
[54] Although more in developing countries than in developed countries.
[55] 1998.

	Total change	Scale effect	Composition effect
Carbon (%)	*+16*	+11	+1
Sulphur (%)	+19	+15	+4
Nitrogen (%)	+19	+15	+5

Table 2 Decomposition of pollution effects in Indonesia under APEC liberalisation*, with 0.5 percent p.a. extra GDP growth in APEC economies,* 2020. Percentages are of 1992-2020 absolute changes. Source: Strutt and Anderson, 1998:28.

To summarize the complex trade – environment relationship: Trade can both have positive and negative effects; positive effects flow from increased wealth generated by trade and the dissemination of environmentally sound goods, services, and technology; negative effects flow from the creation of new market opportunities which expand the scale of production and consumption and thereby threaten the assimilative and regenerative limits of ecosystems. At the same time, there is a danger of depletion of natural resources (scale effect), and environmental policies may be more difficult to adapt or enforce in a more competitive economic environment.

Section 2: Transportation

Part of the environmentalists' response to *Section 1* would emphasize the role of transportation of goods and people. ¼ of world energy use already stems from transportation[56] (most of it fossil fuel driven), 70% of which in industrial countries[57]. Transportation energy use is projected to constitute more than half of the world's oil consumption in 2020.[58] Trade liberalisation, they would argue, increases senseless transports over long distances, as can be witnessed already on the streets of the European Union (EU).

Key current trends

The OECD identifies several significant trends in transportation: The near total dependence of transport on oil; the concentration of oil demand in the transport sector; and the growing share of transport to overall energy-related CO_2 emissions.[59] Transport sector energy consumption is expected to rise 56% from 1993 to 2010[60], which raises legitimate concerns about the transport sector's contribution to anthropogenic climate change. "Such concerns … are due not only to the overall continuing rates of such rises but the fact that *road haulage* and *heavy goods vehicles* are carrying most of the increment"[61]. The greenhouse externalities have been calculated as 4 ECU per 1'000 t-km for road transport, compared to 1 ECU for rail transport[62]. Air transport fuel demand and emissions are rapidly increasing[63] and therefore there are a growing area of concern in spite the fact that air cargo accounts for less than one per cent of worldwide freight at the present time.[64] Boeing forecasts a tripling in air cargo traffic by 2017[65]. This is a clear-cut example of a sector where the scale effect dominates the technology effect.

But trade does not only make transportation of goods over longer distances necessary; trade also diffuses modes of transport that contribute to climate change. In 1950, there were only 70 million cars, trucks, and buses on the world's roads. By 1994, there were about nine times that number, or 630 million[66].

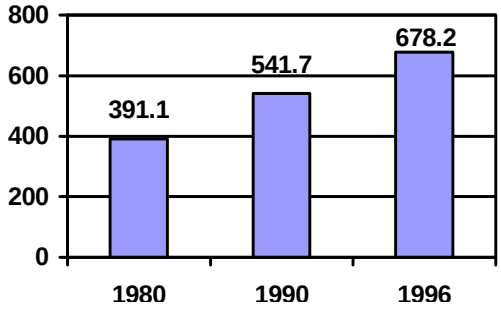

Figure 2 Number of motor vehicles (mio). Source: UNEP, 2000:2.

Effect of Transportation on Climate Change

The principal GHG, CO_2, is an inherent by-product of currently prevailing transportation modes. "Emissions of carbon monoxide (70 per cent of which are produced by the transport sector) and carbon dioxide (25 per cent of which are produced by the transport sector) … threaten to destabilize the earth's climate"[67]. H. Landis Gabel identifies transport as one of the major causes of environmental

---

[56] OECD / IEA, 1997:1.
[57] Dunn, 2001:93.
[58] Energy Information Administration, 1999. http://www.eia.doe.gov/oiaf/archive/ieo99/transportation.html
[59] OECD / IEA:19.
[60] World Energy Outlook 1996, cited in: OECD / IEA:20.
[61] OECD, 1997c:12. (Emphasis added)
[62] OECD, 1997c:6.
[63] OECD, 1997c:6.
[64] OECE / IEA, 1997:14.
[65] Quoted in Menotti, 2001:3.
[66] For more information see World Resource Institute http://www.wri.org/wri/trends/autos.html
[67] McConnell, 1999:123-124.

degradation in industrial countries due to the depletion of non-renewable energy resources, noise, and the development of infrastructure.

Ships: Conservative estimates by the International Chamber of Shipping's (ICS) state that ships emit around 2% of global CO_2 emissions, but they carry 90% of world's trade in goods[68].

Land: Roads and railways are built everywhere to accommodate for increasing trade. The proposed "NAFTA superhighway" from Quebec to central Mexico is just one example. As mentioned above, road transport generates more greenhouse externalities than rail – and much more than sea-based freight transport.

Air: Air cargo is especially harmful because it uses more energy than any other mode of transport and because emissions (CO_2, NO_2 and water vapour) are far less absorbed by the Earth's ecosystem. As mentioned above, vast increases are projected.

Consequences of Trade Liberalisation

The reduction of trade barriers at borders implies more transportation[69]. For all practical purposes, we have to assume that the *scale* effect dominates in the transportation sector. This is not automatic, as bilateral trade flows may decrease. Overall projected increases in global volume of traded goods due to the Uruguay Round liberalisation represent around 3 to 4 percent; increase in transport associated with the Uruguay Round around 4 to 5 percent[70]. Manufactured goods show an above average increase in trade expansion and are transported relatively even further[71]. As a consequence "aggregated for the group of IEA countries as a whole, there is a strong association between overall economic activity and overall transport energy use"[72]. However, the OECD points out that these changes in international transport associated with the implementation of the Uruguay Round are relatively small compared to those resulting from economic growth from all other reasons; the figure of a 4.5 percent increase as a result of the Uruguay Round is compared with a 71% rise as a result from economic growth in general.[73]

The EU is a good case study. Gabel projects energy use by international truck transport – trucks are already the biggest energy user in all IEA countries[74] - to increase by 30 to 50 percent as a result of continued economic integration and deregulation of the transport sector[75]. At the same time, trade liberalisation in the transport sector should result in productive and allocative efficiency in the use of transport services. But these positive effects may not outweigh the environmental degradation caused by the increased use of transport services to move geographically dispersed inputs to points of production and then to move finished goods and services over potentially long distances from points of production to points of consumption[76]. According to Runge, adverse effects dominate in the EU[77], also due to the tendency to move more towards the periphery (associated members in the Mediterranean and in Central and Eastern Europe; Southern European states).[78]

An OECD study shed some light on the liberalisation of the transport sector itself[79]. For *Europe*, it emphasizes the high degree of regulation still present in the road haulage market. Although it was liberalized, it was only partially harmonized with competing modes of transportation.[80] The railway sector was basically left unchanged. "The opening up of the road sector to competitive forces was not accompanied by any framework of social, environmental and safety restrictions to harmonize inter-modal competition. Therefore, there are strong indications to support the argument that the absence of

---

[68] Quoted in Menotti, 2001:2.
[69] OECD / IEA, 1997:28.
[70] OECD, 1997c:7.
[71] OECD, 1997c:7.
[72] OECD / IEA, 1997:22.
[73] OECD, 1997c:8.
[74] OECD / IEA, 1997:25.
[75] Gabel, 1994:169.
[76] Gabel, 1994:160, 164.
[77] Runge, 1994:96.
[78] OECD, 1997c:4.
[79] Shipping, air cargo, trucking, rail, pipelines and inter-modal terminals.
[80] OECD, 1997c:11.

harmonization accelerated the modal shift from rail and waterways to the roads"[81]. By contrast, in *North America*, deregulation of rail and road occurred almost simultaneously, resulting in environmental improvements in many cases. Energy consumption for transport went down and intercity freight movements by rail increased relative to road.[82]

A completely different set of problems concerns pressures on fuel wood as a result of trade, meaning the threat to forests as a result of better transportation services. "The frontier of fuel wood production, initially 76 kilometres from the market, moves out to 130 kilometres"[83]. For an assumed transport price of 0.18 $/ton-km, wood prices don't increase enough. It would take a transport price of 0.36 $/ton-km in order to allow for substitution of wood by fuel. With current under-priced transportation, even gross perturbations of kerosene and gasoline prices "had almost no impact on the rate of woodland degradation"[84]. Many developing countries, including Nigeria and Indonesia, subsidize kerosene, in part to reduce pressure on forest resources.[85]

Finally, we would like to point out some less-known positive effects that general trade liberalisation may have in the transport sector. First, a larger market for more efficient transportation may spur technology developments in that area. Furthermore, electronic communication can create opportunities to avoid energy-intensive travel.[86] Kodak, for example, has made large progress in *teleconferencing*. Another example is *telecommuting*, which reduces travel by elimination of trips through working at home. A California pilot study found that vehicle miles travelled by telecommuters fell by 75 percent and freeway travel fell by 90 percent[87]. So the synergy of the electronics and communications technologies promise new ways for GHG abatement. But as always with new technologies, uncertainties – including unintended negative consequences – remain.

To conclude, we have to mention that *policy* has a key role to play. Many governments subsidize auto ownership or allow special tax treatment of expenditures associated with getting to work. More importantly, it is widely held that the market price of petroleum fuels "fails to reflect the costs of the damages these fuels do to the environment, including air pollution …"[88]. So the proper pricing of transport services must accompany trade liberalisation.[89] Policy options for reducing GHG emissions in the transport sector include: reducing mobility; improving modal energy intensities; improving energy efficiency; and changing transport's fuel mix. However, one has to bear in mind that consumer demand is highly inelastic and rises proportionately with income growth, if we believe past trends.[90] Given the current trends, it seems sensible to focus on the road sector. Yet that may be precisely the sector where a carbon tax has only limited effect, as Fells and Woolhouse show in a simulation of a UK tax.[91]

---

[81] OECD, 1997c:12.
[82] OECD, 1997c:13.
[83] Chomitz, 1999:107.
[84] Chomitz, 1999:109.
[85] Chomitz, 1999:103.
[86] Horrigan and Cook, 1998, http://www.wri.org/cpi/carbon/bytentro.htm
[87] Dower, Roger, *et al.*, 1997. (1997).
[88] Runge, 1994:24.
[89] Gabel, 1994:153-154, 169-170.
[90] OECD / IEA, 1997:14.
[91] Fells and Woolhouse:91.

Section 3: Energy

Energy has become "*the* economic issue of the decade [the 90's]"[92] because of increased environmental awareness, the emergence of international atmospheric pollution problems, and the emergence of deregulation and privatisation as policy issues. Countries are moving away from the concept of a single energy supplier towards a competitive environment for producing, transmitting and distributing energy. Trade liberalisation is the name of the game also in this sector. In 1996, for example, EU member states agreed to open the EU's electricity sector to competition, both through market reform and the relaxing of trade barriers. The relationship between a liberalized, competitive industry and climate change mitigation is still unclear due to the limited experience of countries in which liberalisation has occurred.

Key energy trends

Global energy use has increased by nearly 70 percent since 1971 – and trade certainly contributed to this – and is projected to increase more than 2 percent annually over the next 15 years. This would result in an increase of 50% in GHG emissions if no concerted effort were made to increase efficiency and reduce reliance on fossil fuels.[93] Fossil fuels today roughly supply 90 percent of the world's commercial energy; energy-related emissions account for more than 80 percent of CO_2 emissions[94]. Fossil fuel emission is growing most rapidly in developing countries.

Increased CO_2 emissions due to energy use contribute to the greenhouse effect. Furthermore, coal mining contributed 13 percent of global methane emissions in the early 90's[95].

Consequences of Trade Liberalisation and The Example of Coal

As with transportation, the energy sector is a key example for showing the problematic of *how* trade liberalization is implemented. Where the lack of internal liberalisation (market reform) already has adverse pollution effects, trade liberalisation exacerbates these market and policy failures. A 1992 World Bank study estimates worldwide primary fossil fuel energy *consumption* subsidies[96] alone at $230 billion.[97]. Removal of these subsidies would result in a net GDP gain of $36 billion/year.[98]

Let's take the example of the *coal sector*. Coal represents around 30 percent of the world's primary energy supply and 40 percent of carbon emissions from energy use.[99] Virtually all substitutes are more efficient and less pollutive, so we may expect full internal and external liberalisation to have positive environmental effects. But many *industrial* countries subsidize coal mining, in the EU by more than 150 percent.[100] Many *developing and transitional* countries directly or indirectly subsidize coal burning in the order of 30-50 percent of world prices[101]. "Coal policies have encouraged excessive production of coal in a number of industrial countries and excessive coal consumption in numerous developing and transition economies – when the opposite policies are what are needed…"[102] Anderson[103] calculated that if Western countries were to suppress *producer* price support but maintain the consumer price, global carbon and sulphur emissions would decrease. If, in addition, the former Communist bloc (China included) were to open its coal market, the environmental effects of trade liberalisation would theoretically be ambiguous, but very likely be positive. "In short, coal

---

[92] Fells and Woolhouse, 1996:3.

[93] World Resource Institute, http://www.wri.org/trends/emission.html

[94] World Resources Institute in collaboration with the United Nations Environment Programme, the United Nations Development Programme, and the World Bank, *World Resources 1996-97* (Oxford University Press, New York, 1996), pp. 328-330.

[95] Anderson and McKibbin, 1998:4, using World Resource Institute figures from 1996.

[96] Production subsidies were not taken into account. Preliminary indications from studies by the World Bank, the OECD and others, are that, worldwide, subsidies to energy *production and consumption* amount to hundreds of millions of US dollars, and that removal of these subsidies would result in substantial reductions in CO_2 emissions. Source: OECD, 1997a:7.

[97] Cited in OECD, 1997a:63.

[98] OECD, 1997a:64.

[99] Anderson and McKibbin, 1998:2,4, using World Resource Institute figures from 1996.

[100] Anderson and McKibbin, 1998:8.

[101] Panayotou, 2000:35.

[102] Anderson and McKibbin, 1998: Abstract.

[103] 1992.

liberalisation in this situation is both financially and ecologically friendly"[104]. A 1998 Anderson and McKibbin study also concludes that a combined reform would reduce global emissions by around 8 percent by 2005 compared to the situation with no coal policy reforms.[105]

The estimated reduction in pollution through the removal of production subsidies, price supports and budgetary supports in Germany, Japan, the UK, France, Spain and Turkey is shown below.

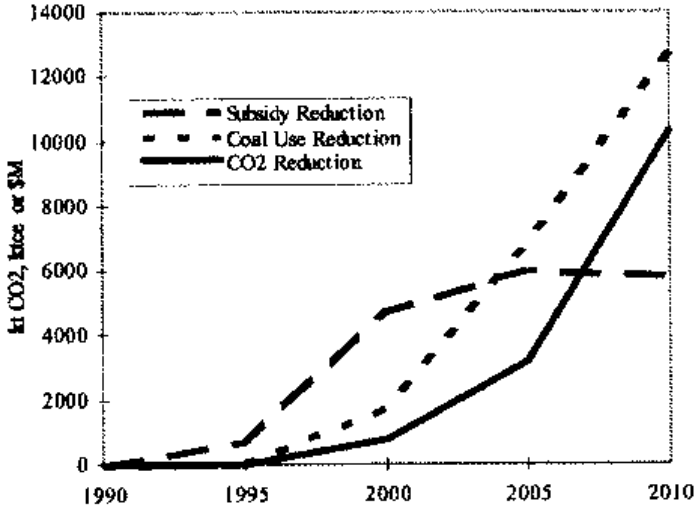

Figure 3 Reductions in subsidy, coal use, and carbon dioxide emissions, 6 OECD countries. Source: OECD, 1998:39.

Empirical proof of the beneficial effect of the reduction or removal of market distortions in the coal sector can be found in China and the UK. China has seen a 25% decline of coal consumption between 1997 and 1999, which is – amongst other factors – attributed to reductions in coal production subsidies and a shift to natural gas for residential cooking and heating.[106] In 1998, China's CO_2 emissions dropped by 3.7% as a result of a cut in annual coal subsidies, despite an economic growth of 7.2%[107]. In the UK, which already has a highly deregulated coal sector, energy market developments and projections indicate a rapid reduction in coal use and its associated environmental impacts over the period 1990 to 2010 (although a subsequent increase is possible).[108]

However, a very important note of caution has to be added: If a subsidy reform is *only implemented in developed countries*, an increased demand for low-cost imported coal from the rest of the may result.[109] This increased demand would lead to a shift in production to countries with lower costs or lower environmental standards, resulting in a net increase in global greenhouse gas emissions[110].

So the effects of trade liberalisation on climate change in the coal sector depend on the internal deregulation of the coal sector. Ideally, internal liberalisation (market reform) should precede external liberalisation as to avoid changes in patterns of trade that bring more pollution. One also has to be aware that internal liberalisation changes the relationship between government and industry, and hence the instruments available to governments for climate change mitigation. "The *laissez faire* approach to energy, which appears to be increasingly in favour, is an imperfect policy unless the obstacles to the economically efficient operation of the market are smoothed"[111]. Wells and Woolhouse distinguish several solutions to market failure: replacing the market (traditional command-and-control policy[112]); encouraging the market to operate more efficiently via a system of incentives and costs[113]; as well as

---

[104] Anderson, 1992:149.
[105] Anderson and MicKibbin, 1998:24-25.
[106] Dunn, 2001:89.
[107] French, 1999:105.
[108] OECD, 1997a:53.
[109] OECD, 1997a:26.
[110] OECD, 1997a:9.
[111] Fells and Woolhouse, 1996:5.
[112] Which is much easier to implement where a state monopoly is still present.
[113] The infamous Polluter Pays Principle formulated by the OECD in 1972.

extending the application of property rights and creating a new market.[114] No single policy tool is, according to Wells and Woolhouse, generally superior to the other.

Furthermore, there are also subsidies with beneficial implications on climate change: subsidies that support the use of nuclear energy, hydroelectric power, renewable energy sources, and energy efficiency investments.[115] Finally, there may be other positive environmental benefits of trade liberalisation. The technology effect may result in more energy efficiency, e.g. through a revival of generation and distribution of electricity by Direct Current (DC), which is more efficient in many ways.[116] But for this to happen, the technical configuration of electricity systems would have to change, which would only be possible on a timescale of 20 to 25 years. As we have seen in *Section 2*, electronics and communications products also have a potential to save energy and reduce GHG emissions.[117]

To conclude this section, trade (external) liberalisation without internal liberalisation in the energy sector seems to be detrimental to the atmosphere. Internal liberalisation alone is almost certain to bring a substantial decrease in GHG emissions. The net effect of combined internal and external liberalisation is ambiguous: Resources are allocated more efficiently, but at the same time, a drop in prices may increase demand. But given the proportions of the market failures in this sector, we may expect the composition and technology effect to dominate the scale effect in this case. Nonetheless, it seems again reasonable to suggest accompanying *policy measures* that privilege energy production with non-fossil fuels.

[114] Fells and Woolhouse, 1996:7-10.
[115] OECD, 1997a:9.
[116] Patterson and Grubb, 1996.
[117] Horrigan and Cook, 1998, http://www.wri.org/cpi/carbon/bytentro.htm

Section 4: Agriculture and Forestry

So far we have concentrated on sectors where trade liberalisation has consequences on the *emission* of GHGs. Now we move our attention to the effects of trade liberalisation on a natural *sink* of GHG.

Link of Agriculture and Forestry to Climate Change

Forests need CO_2 to grow, especially in the early phase of their development. They can store large amounts of CO_2. Due to this fact, they are also negatively related to the greenhouse effect in two ways[118]:

On the one hand, forests are a source of CO_2 released into the atmosphere when they are cut. Deforestation and other land-use changes are the second-largest source of carbon emissions.[119] According to the Food and Agricultural Organization, the world has lost 450 mio hectares of tropical forest to logging, agricultural development and human settlements between 1960 and 1990[120].

On the other hand, "deforestation contributes indirectly to global warming by reducing the available biomass that binds CO_2"[121]. In the northern hemisphere, forests are currently a "net sink"[122] "Expected growth in plantation area will absorb more carbon, but likely continuation of current deforestation rates will mean that the world's forests remain a net source of carbon dioxide emissions and a contributor to global climate change."[123] Inversely, reforestation, afforestation (and enhanced forest growth by CO_2 fertilization) temporarily provides for more carbon sinks and act against climate change.

According to Hillary French from the Worldwatch Institute[124], the causes of deforestation include a rise in global timber trade, fuel wood gathering, the felling of trees for domestic use, and the transformation of forests into agricultural and grazing land. Land use change is a particularly important subject in the context of trade liberalisation; so we will briefly discuss it in this Section. New agricultural land can be used either for exports (cash crops, livestock) or for subsistence agriculture.[125]

In addition to the release of CO_2 through deforestation and the resulting reduction of carbon sinks, a further source of GHG can be intensive livestock operations and rice cultivation in many countries, because this results in increased emission of methane (CH_4). Soil erosion may also release CO_2.

Consequences of Trade Liberalisation

Trade barriers can contribute by themselves to climate change. Exports of agricultural products are often taxed in developing countries, which drives down the domestic prices and thus the opportunity cost[126] of forests. Furthermore, high import duties on food increase pressure to convert forest to farmland[127]. Price controls aimed at providing the urban poor with affordable food are also frequent in developing countries. This may drive some farmers to work marginally productive and ecologically sensitive lands and clear forests.[128]

The comparative advantage of developing countries in agricultural products means that trade liberalization can potentially affect their forest resources. In this context, agricultural subsidies in developed countries play a crucial role. In most industrial countries, the agricultural sector is highly protected through tariffs against developing countries. In 1996, Western industrialized countries

---

[118] Jepma and Munasinghe, 1998:40.
[119] Jepma and Munasinghe, 1998:234.
[120] Drawn from the website of the World Resources Institute: http://www.wri.org
[121] Nordström and Vaughan, 1999:17.
[122] Absorbation rates exceed respiration rates.
[123] World Resource Institute, 2000, http://www.wri.org/wr2000/pdf_final/chapter2/forest/2.17_takingstock.pdf
[124] French, 2000:20.
[125] Population pressure is a major reason for deforestation.
[126] Perceived returns of the available alternatives. The opportunity cost of converting forests into other usage, for example farmland, is the foregone return of the forest.
[127] Nordström and Vaughan:17.
[128] McConnell, 1999:32.

invested app. $302 billion of supports into the agricultural sector[129]; average tariffs remain around 40 per cent[130]. Subsidies and direct payments to farmers provide for further market distortions in the "North". This means that land-abundant developing countries can't put their comparative advantage into practise, and that the industrial countries practise a chemically intensive agriculture. As mentioned in the above paragraph, also countries in the "South" punish farmers through price control and taxes.

Anderson did extensive research on the effect of trade liberalisation on agriculture. He found that complete liberalisation would hardly change, but re-localize output.[131] The North with a relative comparative disadvantage in agriculture would decrease agricultural output (and the related use of chemicals), could use the land more for housing, and for aesthetic and recreational purposes (possibly even afforestation). The rest of the world would increase agricultural output, increase chemicals and use more land for farming.

The relevant question for the effect on climate change is the possible land use change *as a result of trade liberalisation*.

Werner G. Raza shows adverse effects of trade liberalisation on Bolivia's environment. His case study shows a massive burning of rainforests due to the abandonment of exhausted land after the neo-liberal turn-around in 1985. This was mostly initiated by commercial farming, both for agriculture and cattle breeding.[132] After 1989, Bolivia became a net exporter of agricultural products. Timber exports also increased.[133] However, the results for an individual country need not be true for the world as a whole.

Tisdell makes another pessimistic assessment. He claims that market extensions and globalisation are creating pressures for socio-economic change in agricultural communities on marginal lands in Asia. "Rapid expansion in the demand for natural resources (due to increased market access and globalisation) can result in their inappropriate exhaustion if they remain open-access property."[134]

Anderson is optimistic: "Studies, together with the large body of evidence suggesting the *price elasticity* of aggregate agricultural supply response is generally less than unity … would lead one to be confident that agricultural trade liberalisation *per se* is unlikely to bring forth wholesale destruction of tropical rain forests"[135]. He goes on to say that "It is possible for those economies to *guarantee* their welfare improves by introducing the optimal environmental policy at the time of liberalisation, such as a tax on land clearing if the externality results from deforestation."[136] Empirical studies have, indeed, mostly confirmed that the extra output almost exclusively stems from the more *intensive* use of farmland. Price changes in agricultural products don't affect the land area devoted to agriculture too much; and the rise in farmers' incomes decreases the use of forest as an energy source.

Unfortunately, there are other compelling reasons to cut forests: high prices for tropical timber, tax incentives that encourage the felling of forests to develop grazing lands and mines[137], population pressure, etc.

Externalities

Let us assume that internal and external liberalisation occur at the same time. With the transformation of forestland into agriculture, the marginal return of agriculture falls and the marginal return of forests rises. So even if some land use change occurs, it should be limited by these basic economic factors. However, there is a *difference between private and social returns* of forests, "the social return being higher because of various 'non-commercial' values, such as carbon sinks"[138]. In other words, there is a

---

[129] UNEP / IISD, 2000:52.
[130] UNEP / IISD, 2000:52.
[131] Anderson, 1992:161.
[132] Raza, 1999:252.
[133] Razza, 1999:254.
[134] Tisdell, 1999:171.
[135] Anderson, 1992:166. [Emphasis added]
[136] Anderson, 1992:154.
[137] Anderson, 1992:166. For example, until the late 80's, Brazil granted tax concessions and subsidies to farmers and ranchers to clear the forests in the Amazon. Source: Pearce and Warford, 1999:122.
[138] Nordström and Vaughan, 1999:17.

"missing market", which some authors like Chichilnisky[139] and Dasgupta[140] link to the absence or ill-definition of effective property rights in developing countries. According to this theory, when developing countries compete with developed countries, which have well-defined property rights, developing countries have a perceived comparative advantage in resource extraction. This leads to over-exploitation of the resource. "Externalities arise when property rights in a resource are not readily defined; in consequence, they may play an important role in determining the depletion rates of both exhaustible and renewable resources"[141].

However, Dasgupta states that "in many cases of externalities it may be impossible (or at any rate difficult) to *define* property rights, let alone establishing them legally and then enforcing them"[142] The atmosphere is one such example, where excludability is difficult to achieve. One promising mean might be tradable pollution permits.

Another set of problems arises from the fact that people tend to be risk-averse and therefore prefer to consume sooner rather than later. "The problems associated with the non-existence of a suitable set of forward markets may well be more important … than those arising from externalities"[143].

Industrial agriculture

There is another way in which trade, agriculture and climate change are linked. Some environmentalists claim that due to trade liberalisation, energy intensive (and therefore generally GHG intensive) *industrial agriculture* is spread to countries like China, India or Mexico. "As the Uruguay Round GATT and other trade agreements have forced countries to open their agricultural markets to foreign competition, small producers in developed and developing countries can no longer compete against their industrial counterparts."[144] Menotti argues that these developing countries would be better off sticking to traditional agriculture, which operates on a small scale with little or no fuel inputs. It is further argued that industrial agriculture, offering fewer jobs, leads to urban migration and a more energy-intensive life in the cities[145]. We may react to this critique on two levels. Firstly, if externalities *were* internalised, there is no reason to believe that the environment will be overly damaged; and if this internalisation does not exist due to the non-existence of markets or property rights, trade barriers are only the second best policy. Secondly, trade barriers to conserve "traditional methods" may mean cementing poverty of subsistence farmers in developing countries.

Effect of accelerated trade liberalisation in wood products

At the failed Seattle Ministerial Conference of the WTO, a number of governments, including the US, Canada, New Zealand and Indonesia, have pressed for accelerated trade liberalisation in wood products. In the context of our discussion, we would like to briefly examine what may be the effects of such a policy.

A US-government sponsored study[146] compares the effects on timber harvest to the effects anticipated from the Uruguay Round liberalisations. The study finds that accelerated trade liberalisation will increase *aggregate world trade* in forest products by a maximum of 2 per cent, with aggregate timber harvest increasing by 0.5 per cent. Large increases are projected in Australia, Chile, China, Finland, Indonesia, Malaysia, New Zealand and Sweden. Large decreases are projected for Mexico and Russia. The study finds that the concentration of primary forests is likely to decrease, while secondary forests and plantations are likely to increase. Amongst the positive changes, the expansion of the forest area or the restorations of vegetation on degraded land are pointed out.

---

[139] 1994.
[140] 1979.
[141] Dasgupta, 1979:472.
[142] Dasgupta, 1979:48.
[143] Dasgupta, 1979:472.
[144] Menotti, 2001:5.
[145] Trade does not seem to be a major factor here, but rather exacerbates other problems like subsidies, industrial development projects, corruption, population pressure, lack of property rights, fuelwood demand, domestic wood harvest and consumption.
[146] Office of the United States Trade Representative / Council on Environmental Qquality, 1999.

Another study[147] points out that about half of the world's forests are inaccessible for economic exploitation. "The evidence suggests that further reductions in tariffs on forest products are likely to generate only very modest increases in worldwide trade and production, and thus the increased harvest pressures on forests due to tariff reductions should be quite modest"[148]. But also in this study, harvest increases of about 0.4 to 0.7 per cent are projected[149]. The small impact of preceding tariff reductions on the tropics is also mentioned.[150]

Sizer *et al.* say that trade liberalisation can be beneficial for forest conservation and sustainable management of forests but *only if* "domestic forest conservation policies are well developed and implemented"[151]. The problem lies with subsidies as well as weak environmental laws or enforcement.[152] As long as these market and policy failures are in place, there is concern about overexploitation of tree species, trade pressure on less-protected forests, shifts to plantations, expanding trade with countries that subsidize logging, and the spread of invasive species. "Unless countries that export forest products improve forest protection policies, laws, and practices, further trade liberalisation poses a significant threat to efforts to conserve and sustain ably manage forests"[153]. The effect of an acceleration of tariff elimination is expected to be low due to the already quite low tariffs, but some products and markets could be significantly affected. These impacts could include increased plywood exports from Indonesia, for example.[154]

We conclude with Anderson's general proposition that "because there are more efficient policy instruments than trade policies for preserving the natural environment, trade liberalisation not only need never be put off for environmental reasons, but its benefits can be enhanced if appropriate environmental instruments are introduced at the time of liberalisation"[155]. Trade liberalisation can contribute to a more efficient allocation of agricultural resources with a minimal danger for the world's forests if proper policy measures are put into place. So-called perverse subsidies not only have detrimental effects on the environment, but also on government finances, world market prices, and on competition. . "There is great scope for so-called "win-win" policies in this area, whereby subsidy reduction or removal is good for both the economy and the environment."[156]

As to the problem of missing markets for the forest's services, a possible solution may be internationally tradable "forest" permits equal to the annual amount of biomass forests can absorb. They should be allocated to each country's share of biomass. "The result would not only be a halt to deforestation (and global warming by design), but also a process of reforestation that would eventually take us to the socially optimal division of land between the different categories of usage"[157]. A 2nd best policy like trade measures may not necessarily stop deforestation, but may even provides an increased incentive for land conversion.

---

[147] Sedjo and Simpson, 1999.
[148] Sedjo and Simpson, 1999:17.
[149] Sedjo and Simpson, 1999:17.
[150] Sedjo and Simpson, 1999:17-18.
[151] Sizer *et al.*, 1999:3.
[152] Sizer *et al.*, 1999:3-4.
[153] Sizer *et al.*, 1999:18.
[154] Sizer *et al.*, 1999:18.
[155] Anderson, 1992:167.
[156] Fredriksson, 1999:x.
[157] Nordström and Vaughan, 1999 :18.

Conclusion: Trade liberalisation and the Protection of the Climate System

"If there is a relationship between increased trade and increased production of physical goods, the idea that we can simply increase trade without further exacerbating the changes in climate which are already under way, needs to be thrown overboard immediately"[158]. This statement by *Friends of the Earth* need not be true. We have tried to point out some of the multiple, complex and important links between trade liberalisation and anthropogenic climate change. Even though this research outline can only be superficial and incomplete, we try to draw certain provisional conclusions:

- *The proposition of many environmentalists that trade (or, more generally, growth) only has negative effects on the environment is unfounded*. Trade can have both positive and negative effects. On the one hand, trade can increase efficiency of resource use, can help spread environmentally friendly technology, and can create the income necessary to act on environmental protection. On the other hand, the increased scale of economic activity may lead to irreversible damage for the ecosystems, and existing market and policy failures are exacerbated by trade liberalisation.

- In the past, trade liberalisation has contributed to an increase in transport activities and transport distances and to an increase in the use of fossil fuel energy. There is enough evidence to believe that *trade liberalisation has had the indirect effect of contributing to anthropogenic climate change*. With the evidence available at the moment, we have to conclude that the *scale* effect has – so far – dominated the composition, technology and income effect. This need not be the case for the future, if the inverted U-shape hypothesis is true for greenhouse gases.

- *Trade by itself is not a root cause of anthropogenic climate change*. Therefore, trade barriers can only be a second best policy. The first best policy would directly attack the numerous market and policy failures that directly or indirectly contribute to climate change. "If … there are market failures (such as unpriced or under priced resources or unaccounted for externalities) or policy failures (such as environmentally-harmful subsidies) that are not removed, … freer trade [will] not maximize social welfare"[159]. So-called 'perverse subsidies' in agriculture, forestry, energy, transportation and fisheries – subsidies that are inefficient according to economic theory and that hurt the environment at the same time – are estimated to be between $500 billion to $1.5 trillion a year[160]. Dragun emphasizes that *market reform* should take place *before* trade liberalisation in order to prevent the creation of a comparative disadvantage.[161] However, adopting the first best policy may be very costly and difficult due to the problem of collective action.[162] Very often, a government chooses between a second best (trade) policy and no policy at all.[163]

- Even if countries would not trade, they would still be ecologically interdependent. Ecosystems know no political boundaries. But "the ongoing dismantling of economic borders *reinforces the need to cooperate on environmental matters*, especially on transboundary and global environmental problems"[164].

- As we have seen, *trade and environmental policies need not be contradictory*. However, these two fields of policy are still treated if not as contradictory, then at least as separate policy issues. "Trade liberalisation is – *per se* – neither necessarily good or bad for the environment. Its effects on the environment … depend on the extent to which environment and trade goals can be made complementary and mutually supportive. A positive outcome requires

---

[158] http://www.foei.org/campaigns/ClimateChange/trade_debt_climate.html
[159] Panayotou, 2000:3.
[160] UNEP / IISD, 2000:49.
[161] Dragun, 1999:13.
[162] Runge, 1994:26.
[163] Charnovitz, 1999.
[164] Nordström and Vaughan, 1999:1.

appropriate supporting economic and environmental policies"[165]. Runge outlines a "doctrine of balance"[166] between trade and environment, with the following four principles[167]:

1) In general, trade targets should be matched with trade instruments, and environmental targets with environmental instruments.

2) In general, trade policies should aim to reduce trade barriers while remaining environmentally neutral.

3) In general, environmental policies should be trade-neutral.

4) National governments should be encouraged to pursue similar trade and environmental objectives

These provisional conclusions have important ramifications for future efforts to pursue trade liberalisation. Panayotou recommends that the WTO call a "Green Round" in order to "coordinate joint action on the elimination of environmentally damaging subsidies and internalisation of environmental costs"[168]. Others, like Hillary French, advocate the creation of an effective World Environment Organization. Neither a "Green Round" nor a WEO are likely things to happen in the near future. But informed environmentalists may find out at future trade liberalisation rounds that they have more in common than they would like to admit with classical economists.

[165] UNEP / IISD, 2000:2.
[166] Runge, 1994: 7.
[167] Runge, 1994:29-30.
[168] Panayotou, 2000:39.

Bibliography

Sources and Reports

Brown, Lester R., *et al*. (2001). *State of the World 2001*. New York: Norton.

Brown, Lester R., *et al*. (2000). *State of the world 2000.* New York: Norton.

Dower, Roger, *et al.* (1997). *Frontiers of Sustainability: Environmentally Sound Agriculture, Forestry, Transportation, and Power Production*. Washington, D.C.: World Resources Institute.

IPCC (2001). *Third Assessment Report. Summary for Policy Makers*. Geneva: IPCC. http://www.usgcrp.gov/ipcc/wg1spm.pdf

UNDP (2000). *Human Development Report 2000*, http://www.undp.org/hdr2000/english/HDR2000.html

UNDP (1999). *Human Development Report 1999. Globalisation with a Human Face*, http://www.undp.org/hdro/99.htm

UNEP (2000). *Global Environment Outlook 2000*, http://www.grida.no/geo2000/ov-e/ov-e.pdf

Internet Sources

Earth Justice, http://www.earthjustice.org/

Encyclopaedia Britannica, http://www.eb.com/

Friends of the Earth, http://www.foe.co.uk/

Intergovernmental Panel on Climate Change (IPCC), http://www.ipcc.ch/

International Centre for Trade and Sustainable Development, http://www.ictsd.org/

International Forum on Globalisation (IFG), http://www.ifg.org/

International Institute for Environment and Development, http://www.iied.org/

International Institute for Sustainable Development (IISD), http://www.iisd.org/

Organization for Economic Cooperation and Development, http://www.oecd.org/

United Nations Environmental Programme, http://www.unep.org/

Untied Nations Framework Convention on Climate Change, http://www.unfccc.de/

World Trade Organization, http://www.wto.org/

Worldwatch Institute, http://www.worldwatch.org/

Books

Anderson, Kym, and Richard Blackhurst (1992). *The Greening of World Trade Issues*. New York, London: Harvester Wheatsheaf.

Dasgupta, Partha S. and Geoffrey M. Heal (1979). *Economic Theory and Exhaustible Resources.* Cambridge: Cambridge University Press.

Dragun, Andrew K. and Clem Tisdell (ed.) (1999). *Sustainable Agriculture and Environment. Globalsation and the Impact of Trade Liberalisation.* Cheltenham: Edward Elgar.

Esty, Daniel C (1994). *Greening the GATT: Trade, Environment, and the Future*. Washington: Institute for International Economics.

Fells, Ian and Lisa Woolhouse (1996). *Global Warming. A guide to market-based controls on the energy sector*. London: FT Energy Publishing.

Fredriksson, Per G. (1999a). *Trade, Global Policy, and the Environment*. World Bank Discussion Paper No. 402. Washington, D.C.: The World Bank.

French, Hilary (2000). *Vanishing Borders: Protecting the Planet in the Age of Globalisation.* Washington: W.W. Norton & Company.

Horrigan, John B. and Liz Cook (1998). *Taking a Byte Out of Carbon: Electronics Innovation for Climate Protection. Electronic Innovation for Climate Protection*. Washington, D.C.: World Resources Institute.

Jepma, Catrinus J. and Mohan Munasinghe (ed.) (1998). *Climate Change Policy. Facts, Issues, and Analyses*. Cambridge: Cambridge University Press.

Lin, Chia-Li (2000). *Environmental impacts of trade liberalisation and increased international investments.* University of Pennsylvania.

Luterbacher, Urs and Detlef Sprinz (eds.) (2001). *International Relations and Global Climate Change*. Cambridge, MA: MIT Press.

McConnell, Irene (1999). *Trade and the Environment: Defining a Role for the World Trade Organization*. Toronto: University of Toronto.

Meadows, Donella H, *et al*. (1972). *The Limits to Growth: A Report for the Club of Rome's project on the predicament of mankind*. New York: Universe books.

OECD (1994). *The Environmental Effects of Trade*, Paris: OECD.

OECD (1995). *Foreign direct Investment, Trade and Employment*, Paris: OECD.

Pearce, D. and J. Warford (1993). *World Without End: Economics, Environment, and Sustainable Development*. Oxford: Oxford University Press.

UNEP / IISD (2000). *Environment and Trade. A Handbook*, http://www.iisd.org/pdf/envirotrade_handbook.pdf

Articles and Studies

Anderson Kym and Warwick J. McKibbin (1998). "Reducing Coal Subsidies and Trade Barriers: Their Contribution to Greenhouse Gas Abatement", from: *Environment and Development Economics*, October 2000, 5(4), pp. 457-82.

Anderson, Kym (1992). "Effects on the environment and welfare of liberalizing world trade: the cases of coal and food", from: Anderson, Kym, and Richard Blackhurst (1992). *The Greening of World Trade Issues*. New York, London: Harvester Wheatsheaf. pp. 145-172.

Anderson, Kym and Anna Strutt (1996), "On Measuring the Environmental Impact of Agricultural Trade Liberalisation", Chapter 11 in *Agriculture, Trade, and the Environment: Discovering and Measuring the Critical Linkages*, edited by M.E. Bredahl, N. Ballenger, J.C. Dunmore, and T.L. Roe, Boulder and London: Westview Press.

Antweiler, W, *et al*. (1998). „Is Free Trade Good for the Environment?". Discussion Paper No. 98-11, Department of Economics, University of British Columbia, Canada.

Barbier, Edward B. (1997). "Introduction to the Environmental Kuznets Curve Special Issue", Environment and Development Economics (Special Issue: The Environmental Kuznets Curve), Vol. 2(4), pp. 369-81.

Beghin, John, *et al*. (1999). "Trade, Environment and Public Health in Chile: Evidence from an economy-wide model", from: *Trade, Global Policy, and the Environment*. World Bank Discussion Paper No. 402. Washington, D.C.: World Bank. pp. 35-54.

Biermann Frank (2000). "The Case for a World Environment Organization.". Heldref Publications. Vol. 42 No. 9. pp. 22

Chander, Prakesh and A. Khan (1999). "International Treaties on Trade and Global Pollution". John Hopkins University. http://www.core.ucl.ac.be/services/psfiles/dp9903.pdf

Charnovitz, Steve (1999). "World Trade and the Environment: A Review of the New WTO Report". http://www.gets.org/gets/library/admin/uploadedfiles/World_Trade_and_the_Environment_Review_of_the_.htm

Chichilnisky, G. (1994). "North-South Trade and the Global Environment", American Economic Review, September, pp. 851-74.

Chomitz, Kenneth M., *et al*. (1999). „Fuel Prices, Woodlands, and Woodfuel Markets in the Sahel: An integrated economic-ecological model", from: *Trade, Global Policy, and the Environment*. World Bank Discussion Paper No. 402. Washington, D.C.: World Bank. pp. 101-114.

Coase, R. (1960). "The Problem of Social Cost", from: *Journal of Law and Economics*, Vol. 3, October, pp. 1-44.

Cole, Daniel H. (1999). ”New Forms of Private Property: Property Rights in Environmental Goods", from: Bouckaert B. and G. DeGeest (eds.) (2000). *II Encyclopedia of Law and Economics*. http://allserv.rug.ac.be/~gdegeest/1910book.pdf

Cole, Daniel H. (2000). "Clearing the Air: Four Propositions about Property Rights and Environmental Protection”. Duke Environmental Law and Policy Forum 103, p.103-130. http://www.law.duke.edu/shell/cite.pl?10+Duke+Envtl.+L.+&+Pol'y+F.+103

Cole, Mattew A. and Anthony J. Rayner (2000). “The Uruguay Round and Air Pollution: Estimating the Composition, Scale and Technique Effects of Trade Liberalisation”, from: *The Journal of International Trade and Economic Development*, 9(3), pp. 339-354.

Cole, Matthew A. (2000). “Air Pollution and ‘Dirty’ Industries: How and Why Does the Composition of Manufacturing Output Change with Economic Development?”, from: *Environmental and Resource Economics*, No. 7, pp. 109-123.

Cole, Matthew A., A.J. Rayner, and J.M. Bates (1997). “The Environmental Kuznets Curve. An Empirical Analysis”, from: *Environment and Development Economics* (Special Issue: The Environmental Kuznets Curve), Vol. 2(4), pp. 401-416.

Copeland, B. and S. Taylor (1994). “North-South Trade and the Environment”, from: *Quarterly Journal of Economics*, August, pp. 755-87.

Copeland, Brian R. and M. Scott Taylor (2000). “Free Trade and Global Warming: A Trade Theory View of the Kyoto Protocol”. http://www.ssc.wisc.edu/econ/archive/wp2004.pdf

Cosbey, Aaron (1999). “The Kyoto Protocol and the WTO”.Report of the IISD/RIIA meeting held at the WTO's Third Ministerial Conference, Seattle, December 1999. http://iisd1.iisd.ca/pdf/kyoto.pdf

Dasgupta, Susmita, *et al*. (1999). “Pollution and Capital Markets in Developing Countries", from: *Trade, Global Policy, and the Environment*. World Bank Discussion Paper No. 402. Washington, D.C.: World Bank. pp. 141-159.

Dean, Judith M. (2000). “Does Trade Liberalisation Harm the Environment? A New Test”. Policy Discussion Paper No. 0015. Centre for International Economic Studies, Adelaide: University of Adelaide.

Dragun, Andrew K. (1999). “Trade Liberalisation, Agriculture and Sustainability”, from: Dragun, Andrew K. and Clem Tisdell (ed.) (1999). *Sustainable Agriculture and Environment. Globalsation and the Impact of Trade Liberalisation.* Cheltenham: Edward Elgar. pp.7-21.

Dunn, Seth (2001). “Decarbonizing the Energy Economy”, from: *State of the World 2001*. New York: Norton, pp. 83-102.

Eliste, Paavo and Per G. Fredrikson (1999). “The Political Economy of Environmental Regulations, Government Assistance, and Foreign Trade”, from: *Trade, Global Policy, and the Environment*. World Bank Discussion Paper No. 402. Washington, D.C.: World Bank. pp. 129-139.

Ervin, David E. (1999). “Toward GATT-Proofing Environmental Programmes for Agriculture”, from: *Journal of World Trade*, 33(2), 1999. pp. 63-82.

Esty, D. and D. Geradin (1998). “Environmental Protection and International Competitiveness: A Conceptual Framework”, from: *Journal of World Trade*, Vol. 32(3), June, pp.5-46.

Fredriksson, Per G. (1999b). "The Political Economy of Trade Liberalisation and Environmental Policy", *Southern Economic Journal* 65(3): 513-525.

French, Hilary (1999). “Trade vs. Environment”, from: *Defenders*, Winter 1999/2000, p. 36.

Friends of the Earch International (2000). “Trade, Climate Change and the Ecological Debt”. March 2000. http://www.foei.org/campaigns/ClimateChange/trade_debt_climate.html

Grossman, G.M. and A.B. Krueger (1995). “Economic Growth and the Environment”, from: *Quarterly Journal of Economics*, Vol. 110(2), pp. 353-77.

H. Landis Gabel (1994). “The Environmental Effects of Trade in the Transport Sector”, in: OECD, *The Environmental Effects of Trade*, Paris: OECD.

Ishikawa Jota and Kazuharu Kiyono (2000). “International Trade and Global Warming”. June 2000. Waseda University / University of Tokyo. http://www.e.u-tokyo.ac.jp/cirje/research/dp/2000/2000cf78.pdf

Justus, Debra (1997). “Electricity Sector: Market Reform”. Working Paper 18 of the International Energy Agency. http://www.oecd.org/env/docs/cc/wpaper18.pdf

Justus, Debra (1997). “Policies and Measures for Common Action”. Working Paper 18. International Energy Agency, November. http://www.iea.org/ieakyoto/docs/pmca/finalsum.pdf

Kanemoto Yoshitsugu (2000). “Global Warming and Transport Policies”. University of Tokyo. http://www.e.u-tokyo.ac.jp/cirje/research/dp/2000/2000cf71.pdf

Kuznets, S. (1955). “Economic Growth and Income Inequality”, American Economic Review, Vol. 45(1), pp.1-28.

Luterbacher, Urs and Carla Norrlöf (2001). “The Organization of World Trade and the Climate Regime”, from: Luterbcher, Urs and Detlef Sprinz (eds.) (2001). *International Relations and Global Climate Change*. Cambridge, MA: MIT Press. pp. 551 – 587.

Mani, Muthukumara and David Wheeler (1999). “In Search of Pollution Havens? Dirty industry in the world economy, 1960-1995”, from: *Trade, Global Policy, and the Environment*. World Bank Discussion Paper No. 402. Washington, D.C.: World Bank. pp. 115-128.

Menotti, Victor (2001). “Globalisation’s Implications for Climate Change”. Unpublished paper of the International Forum on Globalisation.

Nordström Hakan, and Scott Vaughan (1999). *Trade and Environment* (Special Studies #4). Geneva: WTO. http://www.wto.org/english/tratop_e/envir_e/environment.pdf

OECD (1997a). “Reforming Coal and Electricity Subsidies”. Annex I Expert Group on the United Nations Framework Convention on Climate Change. Working Paper No. 2. Paris: OECD. http://www.oecd.org//env/docs/cc/gd9770.pdf

OECD (1997b). “Reforming Coal and Electricity Subsidies”. Policies and Measures for Common Action. Working Paper 2. Paris: OECD. http://www.oecd.org/env/docs/cc/gd9770.pdf

OECD (1997c). “Freight and the Environment: Effects of Trade Liberalisation and Transport Sector Reforms”. Paris: OECD. http://www.oecd.org/env/docs/gd97213.pdf

OECD (1997d). “The Climate Implications of Agricultural Policy Reform”. Policies and Measures for Common Action. Working Paper 16. July 1997. Paris: OECD. http://www.oecd.org/env/docs/cc/wpaper16.pdf

OECD (1998). "Future Liberalisation of Trade in Environmental Goods and Services: Ensuring Environmental Protection as well as Economic Benefits”. Joint Working Party on Trade and Environment. Paris: OECD. http://www.oecd.org/env/docs/comtdenv9837.pdf

OECD / IEA (1997). *Transport, Energy and Climate Change*. Energy and Environment. Policy Analysis Series. Paris: OECD.

Office of the United States Trade Representative / White House Council on environmental Quality (1999). “Accelerated Tariff Liberalisation in the Forest Products Sector: A Study on the Economic and Environmental Effects”. http://www.ustr.gov/releases/1999/11/forest.html

Office of the United States Trade Representative and the White House Council on Environmental Quality (1999). “Accelerated Tariff Liberalisation in the Forest Products Sector: A Study of the Economic and Environmental Effects”. http://www.ustr.gov/releases/1999/11/forest.html

Panayotou, Theodore (1997). “Demystifying the Environmental Kuznets Curve: Turning a Black Box into a Policy Tool”, Environment and Development Economics (Special Issue: The Environmental Kuznets Curve), Vol. 2(4), pp. 465-84.

Panayotou, Theodore (2000). *Globalization and Environment*, CID Working Paper No. 53, July 2000, http://www2.cid.harvard.edu/cidwp/053.pdf

Panayotou, Theodore, and J.R. Vincent (1997). “Environmental regulation and competitiveness”, from: *Global Competitiveness Report*, Geneva: World Economic Forum.

Patterson, Walt and Michael Grubb (1996). „Liberalizing European Electricity: Impacts on Generation and Environment“. The Royal Institute of International Affairs. http://www.riia.org/briefingpapers/bp34.html

Porter, M. and C. van der Linde (1995). „Toward a New Conception of the Environment-Competitiveness Relationship“, from: *Journal of Economic Perspectives*, Vol. 7, pp. 313-329.

Raza, Werner G. (1999). “Trade Liberalisation Impacts for Sustainable Development: Bolivian Raw-Material Exports 1980 – 1997”, from: Dragun, Andrew K. and Clem Tisdell (ed.) (1999).

Sustainable Agriculture and Environment. Globalsation and the Impact of Trade Liberalisation. Cheltenham: Edward Elgar. pp. 245-269.

Runge, C. Ford (1999). "A Conceptual Framework for Agricultural Trade and the Environment: Beyond the "Green Box", in: *Journal of World Trade*, 33(6), 1999. pp. 47-68.

Sachs, Jeffrey D, and Andrew Warner (1995). "Economic Reform and the Process of Global Integration", from: *Brookings Papers on Economic Activity*. pp. 1-118.

Sedjo, Roger A. and R. David Simpson (1999). "Tariff Liberalisation, Wood Trade Flows, and Global Forests". Resources for the Future, Discussion Paper 00-05.

Sizer Nigel, David Downes and David Kaimowitz (1999). "Tree Trade: Liberalisation of International Commerce in Forest Products: Risks and Opportunities", from: *Forest Notes*, November 1999, World Resources Institute, http://www.wri.org/wri/

Strutt, Anna, and Kym Anderson (1999). "Will Trade Liberalisation Harm the Environment?: The case of Indonesia to 2020", from: *Trade, Global Policy, and the Environment*. World Bank Discussion Paper No. 402. Washington, D.C.: World Bank. pp. 13-32.

Suri, V. and D. Chapman (1998). "Economic Growth, Trade and Energy: Implications for the Environmental Kuznets Curve", from: *Ecological Economics*, Vol. 25, pp. 195-208.

Tisdell, Clem (1999). "Co-evolution in Asia: Markets and Globalisation", from: Dragun, Andrew K. and Clem Tisdell (ed.) (1999). *Sustainable Agriculture and Environment. Globalsation and the Impact of Trade Liberalisation.* Cheltenham: Edward Elgar. pp. 171-200.

Torres, Héctor Rogelio (1999). "The Trade and Environment Interaction in the WTO: How Can a 'New Round' Contribute?", in: *Journal of World Trade*, 33(5), 1999. pp. 153-167.

Van Veen-Groot, Daniëlle B. and Peter Nijkamp (1999). "Globalisation, transport and the environment: new perspectives for ecological economics", from: *Ecological Economics*, no. 3, vol. 31, pp. 331–346.

WWF International (1998). "Developing A Methodology for the Environmental Assessment of Trade Liberalisation Agreements". A WWF International Discussion Paper, August 1998. http://www.panda.org/resources/publications/sustainability/wto-papers/method_download.doc

Media Reports and Press Releases

Chandler, Clay (2000). "GM to Make Small Cars in China; Buick Sail, Similar to Opel, will be Aimed at Mittle Class". Washington Post. 24 October 2000. Page E01.

Pimm, Stuart L. (1997). "The Value of Everything", from: *Nature*, 15 May 1997.

World Resource Institute, Press Center (1998). "Electronics industry reduces greenhouse gas emissions through innovations; plays constructive role in climate protection efforts". Press Release, Washington, D.C., 22 July 1998. http://www.wri.org/press/bytenr01.html