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Trade in a 'Green Growth' Development Strategy
Global Scale Issues and Challenges

by
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Abstract

The paper surveys the state of knowledge about the trade-related environmental consequences of a country's development strategy along three channels: (i) direct trade-environment linkages (overexploitation of natural resources and trade-related transport costs);(ii) 'virtual trade' in emissions resulting from production activities; (iii) the product mix attributes of a 'green-growth' strategy (environmentally preferable products and goods for environmental management). Main conclusions are the following. Trade exacerbates over-exploitation of natural resources in weak institutional environments, but there is little evidence that differences in environmental policies across countries has led to significant 'pollution havens'. Trade policies to 'level the playing field' would be ineffective and result in destructive conflicts in the WTO. Lack of progress at the Doha round suggests the need to modify the current system of global policy making.

Key words: Environmental Goods, Natural Resources, Green Growth, Trade and Climate

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1 Preliminaries

A sustainable growth is a development strategy that meets the need of the current generation without hindering the ability of future generations to meet their own needs implying sufficient economic forces to offset the exhaustibility of finite resources (Bruntland report (UN, 1987)). A sustainable growth strategy must also recognize nature's limited ability to act as a sink for human activities, implying that the environment is itself a limited resource. Sustainable growth thus requires dealing with the by-products of human activity (solid pollutants, toxic pollutants, CO_2 emissions) as well as exhaustibility (fossil fuels and minerals, temperature changes) and renewability (fish, forests) in an economically meaningful time frame. A well-developed growth literature leading to the Hartwick (1977) rule has established that growth is sustainable in the face of declining natural capital when natural capital is not an essential input (i.e. it can be substituted by physical and human capital). Then, the rents from the exploitation of the resource have to be invested in building the substitutes (human and physical capital stock) needed to generate the continuous technological change that shifts the depletion point of the natural resource indefinitely.

Where then does trade enter into a 'green growth' strategy? From the perspective of a trade economist it begins with the 'Columbian exchange' when, starting in the 15th century, global trade transformed the planet into a single ecological system that has had a profound influence on ecological diversity and indirectly on the exhaustibility of natural resources. This transformation would not have occurred in the absence of international trade. Here I take a shorter-term and narrower perspective, asking how current and future trade and trade policies enter a green-growth development strategy. My focus is on reviewing evidence on how trade affects the quality of the environment defined to include local and trans-border pollution and the sustainable use of natural resources. A few preliminaries serve to set the contours of the debate.

In the case of pollution-intensive tradable manufacturing activities (e.g. the energy-intensive industries that are also heavy emitters of GHGs), the problem is the possibility of "outsourcing" the pollution. If the pollution damage is mostly local, such as SO_2 emissions, then internalizing the damage through the application of a corrective tax or a technological standard will, in principle, solve the problem except for the possibility that these polluting activities may migrate to "pollution havens" since trade-leakage allows firms to escape the reach of their governments' environmental policies. If the pollution is global (as in GHG emissions), while the corrective instruments are the same, the solution requires collective action.

In the case of natural resources, the effects of trade depend on the property rights regime. When these can be secured, trade will be welfare-increasing. When property-rights are ill-defined, or when there is open-access, international trade is likely to lead to over-exploitation or disappearance of the resource. Then a restriction on trade or a ban on trade in endangered species would be the appropriate policy in an environment where resources are open-access. To be effective, the policy requires cooperation from trading partners, as for instance, in the ban of trade in ivory. By contrast, an environmental policy to regulate local pollution does not require cooperation to the extent that "virtual trade in pollution" is limited.

A few environmental problems like climate change are truly global. In this case, collective action is necessary and, so far, little role has been attributed to international trade in solving them (not really fair: what about the ongoing discussion on BTAs, which could be acceptable under Article XX?), notably the climatechange problem. In effect, trade is of limited help in designing a global climate regime. First, it cannot resolve the property rights issue of who has the right to do what. Second, by implication, it is of limited help in determining how to implement the Common but Differentiated Responsibility (CBDR) principle enshrined in the 1994 United Nations Framework Convention on Climate Change (UNFCCC) in anticipation of the, yet to be taken, actions to internalize the global externality caused by climate change. Being a trans-border externality, courts have no jurisdiction to award rights. Power and political process determine implicit property-right outcomes.

Yet, trade can be a facilitator in designing policies for global public goods by widening the range of potentially beneficial outcomes in the negotiations and an open World Trading System will help technological diffusion of 'green growth' technologies. Trade can also play a strategic role in the exercise of transnational power via threatened or actual trade measures if the necessary cooperation is not forthcoming. Along more traditional lines, trade policies can be used to compensate for the competitiveness effects of differences in environmental policies across countries. Barrett (2003) reviews the literature on International Environmental Agreements and Ederington (2010) reviews the implications of linking trade and environmental agreements.

As emphasized by Whalley (2011), in a linked climate-trade-finance regime that goes beyond the current global policy coordination regime envisioned at Bretton Woods in 1944, climate now offers the prospect of potentially stronger trade disciplines beyond those negotiated at the WTO. Recognizing that the link between trade and environmental policies is more direct than when the Bretton Woods regime was set up raises the question of the appropriateness of negotiating trade and environmental policies separately and of how trade and environmental policies fit in the current global policy coordination architecture and whether this architecture is appropriate. Apart from concluding remarks in section 7, in spite of its emphasis on global issues, this survey does not deal with the architecture of the current global policy regime or the desirability of linking trade and environmental policies. Nor does it cover the role of an open World Trade System in facilitating technological transfer and adoption.

The paper emphasizes the empirical evidence (of what?) and is organized as follows. Section 2 presents three channels through which trade and trade policy have an impact on the sustainability of a growth strategy. Examples of how trade and trade policy operate across these channels are discussed in the following three sections. Section 3 discusses direct trade-related pressures on the environment: over-exploitation of natural resources in weak institutional environments and environmental damage caused by transport activities. Section 4 reviews evidence on the twin effects of leakage and border-tax adjustments for local and global pollutants arguing that these might be less than what has been supposed. Section 5 addresses the problems associated with the likely capture by powerful groups of GHG emitters that will result in inefficient policies that will be passed on to consumers who, in turn, will resist these policies.

The concluding sections turn to global issues. Assuming that a green-growth development strategy requires removing barriers to trade on products that are either environmentally preferred or help in the management of the environment, section 6 documents the deep conflicts in perceptions about environment friendliness during the Doha Round and the lack of unilateral reductions in barriers to trade in environmental goods and services. Section 7 concludes with remarks on the adequacy of the current system of global policy-making in which environmental and trade policies are odd bedfellows.

2 Natural Resources, the Environment, and Trade: channels of interaction

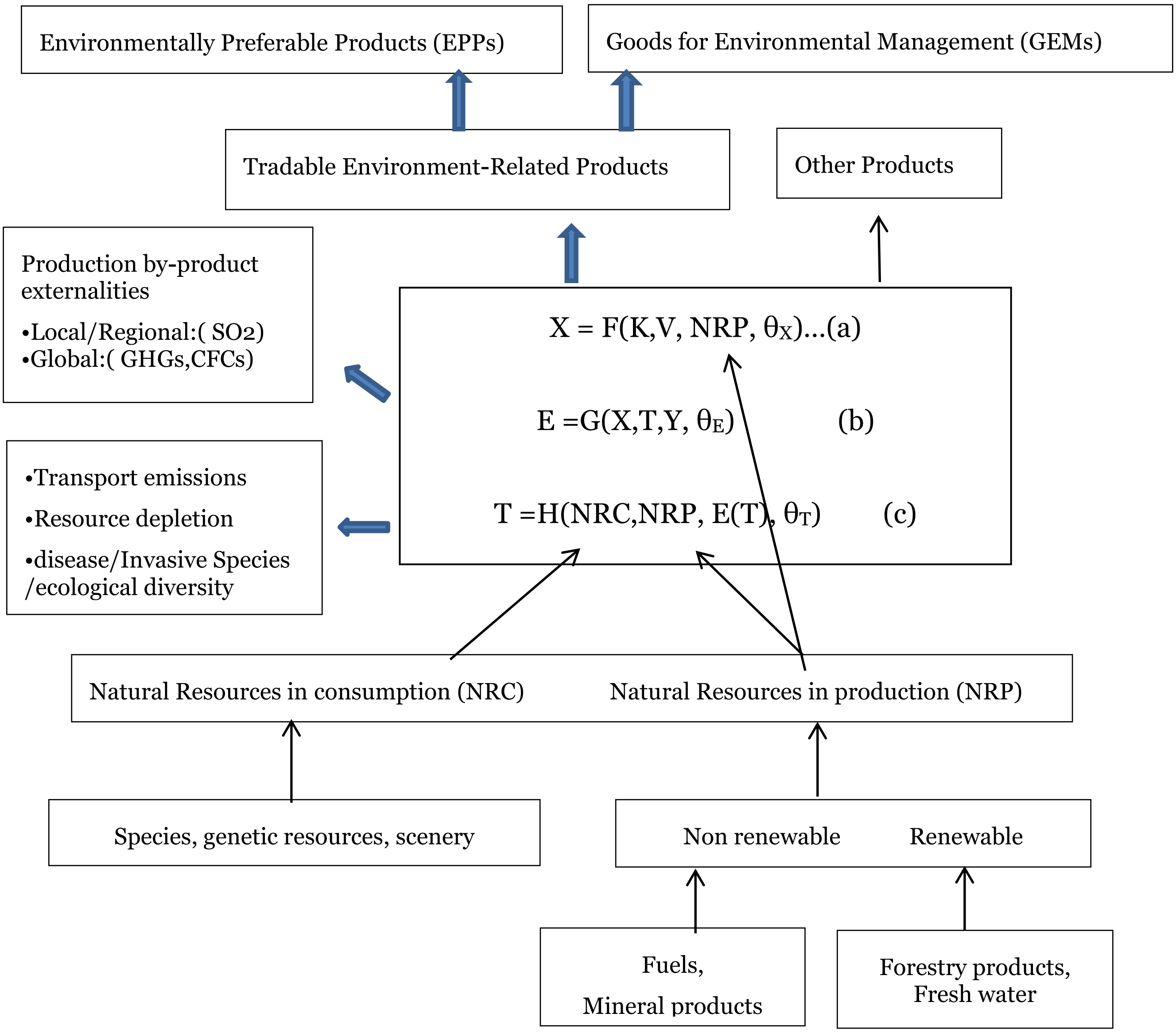
Figure 1 isolates three channels of interaction between a development strategy and its environmental implications and where trade enters into these links. The first is in the pattern of production: does the development strategy manage adequately the environment, and does it produce goods and services that are 'environmentally-friendly'? The second channel works through the by-product externalities that inevitably accompany human activities, externalities that are becoming increasingly global. The third channel covers the direct effects of trade on the environment.

The pattern of production (a). Whether a country is pursuing a 'green-growth' development strategy depends first on its product mix and on the production processes it uses (energy from fossil fuel or from renewables). Production activities (relation (a)) distinguish between tradable environment-related products and other products. For the tradable environment-related products and services, their impact on the environment depends on whether their production helps manage the environment better (Goods for Environmental Management – GEMs such as pumps for air pollution control) or if they are environmentally preferable products (EPPs such as solar panels). For both GEMs and EPPs, reducing barriers to trade for these goods (or subsidizing the production of clean energy) is good for the environment.[1] This could take place in the context of multilateral trade negotiations (as under the Doha Round) or at a less ambitious plurilateral level (as in the case of several plurilateral agreements, e.g. the Information Technology Agreement signed under the Uruguay Round). However, as discussed in section 6.2, these goods are difficult to identify and little progress has occurred under the current multilateral negotiations.

Natural resources can be categorized as non-renewable (fuels, mineral products), or renewable (forestry products, fresh water). Goods are produced with natural resources in production (NRP). These are the raw materials that enter production (relation (a)). Natural resources also enter directly as natural resources in consumption (NRC such as fish, biodiversity and genetic resources). Both NRC and NRP may be characterized by poorly-defined property-rights which may be exacerbated because they are traded (relation (c)). In both cases, the appropriate policy consists of correcting the externality at source (e.g. establishing property rights or applying production/consumption taxes) and if the entire production is traded (e.g. ivory) a trade tax or trade ban is also the first-best policy. Difficulties in implementing the appropriate policy can be due to property rights or open-access (often the case for NRC, i.e. endangered species) or for strong vested interests reflected in lobbying activities (often the case for NRP, i.e. fossil fuels).

[1] Policy levers are captured by θ_X in relation (a) and θ_T in relation (c). Examples of policies would be taxes/subsidies on fossil fuels, subsidies on renewable energies or on biofuels, trade taxes or trade bans on endangered species.

Figure 1: Natural Resources, the Environment, and Trade



(a) X= Output; K= physical and human capital; V=Intermediate inputs, NRP= Natural resources in production; θ_X=Output-related policies (e.g. taxes or subsidies on fossil fuels)

(b) E= output-related emissions; Y=per capita income; θ_E= caps/taxes on emissions

(c) T= environment-related Trade; NRC=natural resources in consumption; E(T)=Emission related to transport; θ_T=border taxes

GHG= Green-house gases; CFC=chlorofluorocarbons; SO= Sulfuric oxides;

Strong geographic concentration is a key characteristic of many natural resources. Close to 90% of world proven oil reserves are concentrated in 15 countries, and the same pattern holds for non-ferrous metals and other mineral products. All the world's largest industrial economies are net importers of these goods typically concentrated in the 'South'. The resulting 'North-South' trade gives rise to the traditional gains from trade between countries with different factor endowments: countries rich in natural resources will export the services of these factors in exchange for the services of human and physical capital. However because of their exhaustibility or slow rate of renewal, the traditional gains from trade can be overshadowed by the depletion of these resources in the exporting country due to trade-related over-exploitation and result in tensions between countries. [2]

'Virtual' trade in fresh water is an example of gains from trade in natural resources. It is a renewable resource that is essentially non-traded and very concentrated geographically. Water enters into the production of agricultural products, especially crops and, like electricity, is traded indirectly. In spite of the distortions created by the implicit subsidy to water usage around the world--as water is rarely priced at opportunity cost-- it is estimated that the gains from trade in water-intensive agricultural commodities saves around 20% of total water use, i.e. is equivalent to a 20% yearly increase in the world's supply of water.[3]

By-product externalities (b). The second channel through which trade affects the environment is indirect. Since close to half of world production is traded, the (usually negative) externalities related to the production activities described above add on to the negative impacts of production itself. . The determinants of these externalities are summarized in relation (b). They include the scale of activity, income per capita, Y, which is taken here as a proxy for environmental policies, composition effects related to the pattern of specialization, and technique effects. Insofar as trade 'causes' growth, there is a scale effect leading to a deterioration of the quality of the environment. Trade can also accelerate the adoption of 'clean' techniques of production, as a more open trade regime increases the adoption of clean technologies.[4] Antweiler, Copeland and

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[2] Because natural resources are indispensable inputs for production and are also necessary for maintaining a high quality of human life, their unequal distribution across countries is also a source of friction. Contrary to most industrial and agricultural products, where importing countries seek protection from imports, countries abundant in natural resources seek to restrict their exports. It is estimated that export taxes are twice as likely in natural-resource sectors than in other sectors and export taxes from natural resources are a third higher than their share in total trade (WTO (2010, section D)). The reasons for restraining exports of natural resources include fiscal needs, rent-shifting, the desire for diversification through processing of raw materials by keeping prices low for downstream activities and protecting the environment.

[3] For reference, water subsidies are estimated at $55 billion, almost all in non-OECD countries while non-nuclear energy subsidies are estimated at $300 billion with 2/3 in non-OECD countries. With 80% of fresh water entering agricultural production, pricing water at opportunity cost would drastically change the pattern of comparative advantage in agricultural products across countries and would lead to less water-intensive consumption patterns. Taxing the water content of exported agricultural products would be second-best even though exporters would likely improve their terms-of-trade. In any case, it would be strongly opposed by farmers.

[4] Most evidence on the two-way causality between trade and growth points in a causality from a more open trade regime to higher growth (see e.g. Frankel and Romer (1999) and Wacziarg and Welch

Taylor (2001) and others have proposed and implemented decompositions of the pollution content of trade trying to establish whether or not trade is 'good for the environment'. Section 4 discusses the evidence.

Application of second-best theory again recommends that these externalities be corrected at source, i.e. that corrective taxes, θ_E, be applied on industries that pollute. For local pollutants, such as SO2, corrective measures (e.g. the US Clean Air Act of 1990) have been applied successfully and the question for the role of trade in environmental policy is the extent to which these industries can migrate to avoid environmental measures. The review of evidence in section 4 suggests that fears of 'pollution havens' have been exaggerated in the case of local pollutants. As to global pollutants like GHG emissions, few measures have been applied, so the evidence is indirect.

Direct Trade-Environment Linkages (c). Besides the production pattern and the related production externalities, direct effects of trade on the environment constitute a third channel. Three effects are singled out in relation (c). First, trade requires international transport which itself pollutes the environment. Ideally, life cycle analysis taking into account trade-related emissions would determine if trade, as opposed to local production, is friendlier towards the environment. Second, trade alters the profitability of harvesting natural resources. In the absence of corrective measures, often made difficult by poorly-defined property rights, these resources can be depleted more rapidly than would be optimal in the case of non-renewable resources, and overexploited in the case of renewable resources (e.g. fishing). Applying second-best theory would call for the corrective measure being applied in production, but since these natural resources are often entirely exported, export taxes, θ_T, are equivalent to a domestic measure. Third, trade affects a country's ecology as invasive species and the spreading of diseases are directly related to international trade. These aspects will not be discussed here.[5] Nor will I cover other trade activities like the prospects of 'green tourism', which can provide strong impetus to improve the management of natural resources and the environment.

Under each channel, accompanying policies can improve the quality of the environment (policies that correct externalities) or worsen it (policies that create distortions). In each case, because of the magnitude of the externalities or distortions, substantial rents are created that impede the implementation of the efficient policies (e.g. carbon taxes, removal of subsidies on fishing). Direct linkages through which trade affects the management of natural resources are discussed in section 3.

3 Direct Trade-Environment Linkages

Many natural resources are renewable over time according to biological processes (influenced by trade but not covered here). Their depletion by harvesting activities has

(2008)). A large empirical literature exploring the trade-productivity reviewed in Keller (2010) suggests that in addition to R&D expenditures and spillovers, technical progress comes through imports.

[5] How invasive species brought about (often involuntarily) by trade have led to our 'single' ecological system is described in Mann (2011). Fischer (2010) discusses how the characteristics of species (sedentary or migratory, pests or not, a local or global resource stock) will affect resource management, and hence the choice of trade policy.

been largely driven by international trade made possible by the huge fall in transport costs for natural resources. [6] The multilateral trade system poses a double fear for the management of natural resources. First, by erasing borders, trade liberalization and other reductions in international transaction costs (including facilitating the transfer of technologies that raise the productivity of harvesting) contribute directly to the increasingly untenable pressure on resource stocks. Second, as discussed in section 5, obligations attached to WTO ownership can hamstring governments in their attempts to manage their resources by disallowing trade-restrictive measures, or, more simply, countries may be unable to reach an agreement on the necessary actions to be taken.

3.1 Trade-related Pressures on Natural Resources

When opening a natural resource (e.g. timber or buffalo hides) to trade, the resource price becomes determined on international markets and is no longer self-regulating (or self-regulated?). If the resource stock is not managed optimally, opening to trade is likely to exacerbate a pre-existing open-access problem (Bulte and Barbier (2005), Copeland and Taylor (2009)). If all rents from resource extraction are dissipated by over-exploitation, then the country will be made worse off by trade. There are also secondary effects. Shifting production towards resource-intensive sectors may have general equilibrium 'resource curse' effects, as employment in manufacturing--where there may be economies of scale or spillover benefits for growth--falls. [7]

Following Chichilnisky (1994), a large theoretical literature has explored the possibility that weak governance in the South can confer an "apparent" comparative advantage in trade in a natural resource. If, in addition, the North cannot manage resources optimally either, unless recovery rates are sufficient, stocks in the North could also be driven to collapse. Example are the 19th Century slaughter of buffalo in the US to sustain the European demand for hides (Taylor (2011)) and currently fisheries, a global common pool resource that has seen all-round overexploitation (Moltke (2011)). Remarkably, as discussed in section 6, in spite of accumulated evidence for over forty years, the international community has been unable to take the needed measures to improve the management of fisheries.

Asymmetry of resource-management regimes across countries means that global resources with "enclosed" property rights will be better sustained by trade while putting pressure on the remaining "unenclosed" resources. Copeland and Taylor (2009) identify three factors that will contribute to determining whether higher resource prices brought about by trade will lead to better management of the resource rather than the return to evading enforcement. The first factor is the ability of the resource to generate competitive returns (representing the opportunity cost of labor in other activities) without resource exhaustion. The second is the level of regulatory

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[6] According to WTO, over the period 1870 to 1990, transport costs of natural resources have fallen by 90% (WTO (2010, section D)

[7] By affecting the relative price of agricultural land, international trade in natural resources also affects biodiversity which may rise, fall or change in composition across partners. Species with a lower replenishment rate are likely to succumb to pressures from trade. The management of migratory wildlife also creates problems for the preservation of habitat across jurisdictions. Some natural resources are pests while others have complementary impacts on biodiversity. These ecological effects of trade in natural resources are not covered here. Bulte and Barbier (2005) develop several models that show the ambiguous role of opening up to trade in the typical second-best situation characterizing natural resources. Also see Fischer (2010) and WTO (2010, section C)

power to manage the natural resource. This power is likely to be low in many resource-abundant countries. Finally, the third factor is the size of the labor supply. It should not be too large so as to avoid increased returns to cheating as the probability of being caught falls. If natural resources were not geographically concentrated, an opening to trade could then lead to an all-around increase in welfare as comparative advantage would then lie in the North (i.e. the country with a better property rights regime) and the fall in the resource price in the South would lead to an improvement in the property rights regime in the South as the returns to cheating would fall (Copeland and Taylor (2009)).

However, this welfare-increasing outcome from opening to trade or from trade liberalization is unlikely because of the great geographical concentration of natural resources in low-income countries reflecting the pattern that high-income countries are overwhelmingly net importers of natural resources (WTO (2010, p.49). In addition, in low-incomes countries, the ability to enforce property rights is likely to be weakened by the lobbying and corruption made possible by the rents associated with the extraction of natural resources). In sum, it is difficult to dispel the possibility that trade in natural resources exported by poor countries, --especially for resources with low replenishment rates--will do more harm than good. Trade would then lead to a loss of natural capital and to negative 'genuine savings', possibly resulting in an unsustainable development path. In this case, cooperation from importing countries (presumably with better institutions) would help alleviate the resource curse problem.

A large (and still-growing) empirical literature tries to identify the presence of a robust 'natural resource curse'. This, however, need not be the case (see the summaries in Lederman and Maloney (2007) and Van der Ploeg (2011)). When explored comprehensively across channels and across countries, the findings are varied, with the outcome dependent on the institutional set-up and other determinants unrelated to trade (e.g. geography or fractionalization of the population).[8] Perhaps less emphasized is the finding that natural riches engender institutional weaknesses as groups attempt to capture rents (Mehlum, H., K. Moene and R. Torvik (2006)). This curse-via-politics is largely endogenous to the political environment and not subject to improvements by governments in power who have a vested interest in blocking institutional change. Resourcerich agents can also block the trade reforms that would reduce distortions and improve the management of natural resources. For example, drawing on the Doing Business data, in a large sample of 133 countries, Amin and Djankov (2008) find that the proclivity to undertake micro-reforms that reduce trade distorting regulation is much lower in countries whose exports are more concentrated in abundant natural resources. [9]

3.2 Transport-Related Emissions

[8]The early literature mistakenly used resource dependence as a measure of resource abundance. When this distinction is made the 'resource curse' effects found in the early literature are dampened (Brunnschweiler and Bulte (2008)). Evidence shows that resource dependence and institutional quality are negatively correlated (Isham et al.). The outcome of natural resource abundance and performance also depends on the institutional setting (Bhattacharya and Hodler (2008)).

[9] Collier and Hoeffler (2004) were the first to give evidence that conflicts are more likely to be driven by greed to get hold of the rents than by grievances due to ethnic or religious conflicts. Bulte and Brunschweiler (2009) contest this result suggesting that conflict increases dependence on resource extraction (captured by the share of primary exports) while resource abundance (measured by resource stocks) is associated with a reduced probability of civil war.

The elasticity of trade to world income has increased from around 2.0 in the 1960s to 3.7 in the 2000s (Freund (2009)). For environmentalists, this is evidence that international trade is a direct contributor to deterioration of the environment. Transport costs (national and international) account for approximately 13% of global CO_2 emissions with about two-thirds of the emissions related to manufacturing activity. With the relocation of manufacturing activity to Asia, shipping volume has increased by 50% over the past 20 years. Shipping now accounts for about 90 percent of the volume of global trade and about 3 percent of global CO_2 emissions. Also, oceangoing ships use bunker fuel and so emit about 15 percent of global nitrogen oxides and between 5 and 8 percent of global sulfur oxide emissions, all contributing to respiratory illnesses, cardiopulmonary disorders and lung cancers, particularly among people who live near heavy ship traffic (70% of emissions are within 400 km of land).[10]

Two studies give orders of magnitude of transport-related GHG emissions related to international trade. Using detailed emissions for 7 sectors and 62 countries covering the period 1990 to 2000, Grether et al. (2010) compute an order of magnitude of the contribution of trade to SO_2 emissions. Having defined a no-trade equilibrium, adding up emissions coming from trade-related composition effects and trade-related transport activities, they estimate that global worldwide SO_2 manufacturing emissions were increased through trade by 16 percent in 1990 and 13 percent in 2000.[11]

Cristea et al. (2011) produce a more systematic 'bottom-up' estimate of trade-related emissions (emissions from producing what is traded, i.e. traded goods in manufacturing activities, plus transport-related emissions from international transport disaggregated according to mode of transport). They show that, world-wide, one third of trade-related emissions come from international transportation with a great variation in contribution across countries. For example, their world share estimates for (output) [exports, imports] are: China (20.8%) [3.5%, 6.7%]; India (4.9%) [0.6%,1.5%]; U.S. (12.0%) [32.5%, 10.7%]. These estimates reveal the great reliance of the US on air cargo which is the most emission-intensive mode of transport. [12] Thus, when one takes into account emissions from international transport, the US emission per dollar traded

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[10]. The US EPA estimates that applying a 400 km buffer zone along Canadian and US coastlines would save up to 8300 lives a year by 2020 (IHT April 26, 2010 "Controlling Pollution from Ships") As expected, there was a strong opposition from Asian exporters to the proposal of a tax on fuel for shipping by the EU even though the proposal stated that the proceeds would be rebated to developing countries. There is also a strong opposition from the US when the EU announced it would impose a carbon tax on all flights in and out of the EU because US exports mostly use air transport.

[11] Their estimate is in two steps. First, they define an anti-monde in which countries are forced to produce what they consume in the trade equilibrium. International trade then increases emissions by 10% in 1990 and by 3.5% in 2000, the fall is largely a reflection of the all-around decline in emission-intensity. Second, they consider emissions caused by international transport. Using a rough decomposition by mode of transport, they estimate that international-trade related emissions accounted for about 5-9% of total SO_2 manufacturing emissions. Adding trade and transport-cost related emissions, their estimates suggest that SO_2 transport-related emissions have gone from accounting for roughly one third to three quarters of total trade-related emissions over the 1990-2000 period.

[12] Estimates draw on GTAP data so they include only CO_2 emissions from fossil-fuel combustion, cement production and gas flaring. Differences in emissions across transport modes are substantial. Taking an estimate of their emission averages per tonnes-km (t-km) of transport services (table 3) gives the following estimates across transport modes (CO_2 grams per t-km in parenthesis): maritime (≈10g/t-km); land (≈70g/t-km); air (≈700g/t-km).

is higher than for India or China, but lower for regions that are distant from their trade partners (e.g. South America).

Interestingly, the growth of Regional Trade Agreements has led to a change in modal transport as deep integration across partners has led to greater trade with adjacent partners with a shift to rail and road modes of transport. Currently, the average tariff for land-adjacent partners is 1% and 5.5% for non-adjacent partners. Multilateral trade liberalization would then result in a shift in transport mode towards aviation and maritime transport. Thus, when Cristea et al. simulate the effect of free trade, they find that aviation and maritime transport grow relative to land transport as trade shifts towards more distant partners, CO_2 emissions related to output grow by 0.4% and transport-related emissions grow by 8%.

Among others, a green-growth development strategy would benefit from a change in technology in maritime transport. Drawing on the successful MARPOL treaty on discharging waste at sea, which successfully imposed a new double-hull technology on tankers, Barrett (2008) suggests that the network characteristic of transport technology, which has the characteristic of a 'tipping-point' treaty, could be exploited to design a sectoral treaty to reduce GHG emissions. Because of the network characteristic of transport technology, a threshold in participation would lead to full participation. However, because of the differences in the intensity of transport modes across partners, reaching an agreement would be difficult.

4 Pollution Havens, Trade Leakages and Border tax adjustments

Environmentalists fear that, by reducing transport costs and trade barriers, globalization would shift "dirty" goods (products that cause mostly local pollution) from the 'North' to the 'South' leading to an increase in the pollution content of imports (PCI) of the North according to the "Pollution haven hypothesis" (PHH) and to a worldwide increase in the production of dirty products since these are now produced in the South with more pollution-intensive techniques. For local pollutants, environmental measures and reductions to trade barriers have however not lead to significant shifts in production towards countries with lax environmental policies. For global pollutants causing climate change, such as the accumulation of greenhouse gases in the atmosphere, little effort at curbing emissions has been undertaken so that we mostly rely on ex-ante simulations. I review both types of pollutants, starting with the local one.

4.1 Pollution Havens?

The existence of pollution havens rests on the assumption that the polluting industries can migrate. Yet, this is unlikely to be important in practice since the more tradableenergy-intensive and heavily polluting industries are also largely weight-reducing industries. Smelting non-ferrous metals (and the processing of paper from wood) usually takes place close to extraction sites to avoid transport costs (Ederington et al 2005). Grether and de Melo (2004) estimate a bilateral-trade gravity model for each one of the 'dirty' industries and an aggregate of 'clean' industries.[13] They find a

[13] SO_2 and CO_2 emission patterns across industries are very similar as the same six industries are the main emitters for both gases: petroleum products, pulp and paper, non-ferrous metals, iron and steel,

consistently higher coefficient for the distance coefficient for dirty industries. This, and the fact that extraction in natural-resource-based industries cannot migrate, suggests that transport costs would deter relocation of much processing to countries with lower regulation standards, making energy-intensive polluting industries unlikely to be footloose. [14]

Suppose, however, that pollution-intensive industries can migrate. To fix the terms of the debate about the pollution haven hypothesis (PHH), consider the following simple hypothetical example. Two countries, North (N) and South (S), produce two goods, a `dirty' and a (completely) `clean' good under perfect competition in a Heckscher-Ohlin framework, with pollution per unit of output of the dirty good being initially identical in N and S so that both countries are the same in all respects except that N has a higher income per capita than S. Let environmental quality be a normal good. Stricter environmental standards in N will lower emissions per unit of output and abatement costs will raise the unit price of the dirty good in N. N will then import the dirty good and hence its trade will be "embodied" with emissions (i.e. $PCI_{NS} > 0$),. Conversely, S will import the clean good from its partner and in this setting with no intra-industry trade $PCI_{SN} = 0$. The literature refers to this environmental-policy induced effect as the pollution haven (PH) effect and to the emissions embodied in trade as “virtual trade in emissions” or as the “balance of emissions embodied in trade” (BEET). In this particular example, $BEET_N>0$ and $BEET_S=0$. A reduction in trade barriers, will lead S to specialize in the production of dirty products as S has a comparative advantage in dirty products due to the environmental policy in N. Globalization thus increases PCI_{NS} in conformity with the PHH (some of the previously dirty production in N is now carried out in S probably under less-stringent environmental standards). If the dirty industry is capital intensive and N is relatively well-endowed in capital, then if N and S had the same environmental policies, we would only observe a Factor endowment (FE) effect as N would have a comparative advantage in dirty products. Taking the two effects together, under the plausible assumption that the FE effect reduces the PCI and the PH effect increases it, globalization will obey the PHH if PH is positive and dominates the FE effect.

In a Heckscher-Ohlin world, increasing Foreign Direct Investment (FDI) would lead to an increase in PCI_{NS}. World trade, however, is increasingly fragmented, in great part as a result of globalization that has reduced transaction costs. Taking into account outsourcing, the presence of FDI could however, lead to a decline in PCI_{NS}. Consider a model with a continuum of intermediates as in Feenstra and Hanson (1996) where intermediates are ranked by decreasing pollution-intensity and the location of production between N and S depends on relative production costs (inclusive of pollution taxes). As shown by Dean and Lovely (2010), FDI to the South (often directed

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chemicals, building material – cement. These are energy-intensive industries and hence heavy emitters of CO_2. The coefficient of correlation between CO_2 and SO_2 emissions is higher than 0.9 for UK industries for the average over 1990-2000.

[14] Using data on SO_2 emission intensities Grether et al. (2009) estimate that over the period 1990-2000 SO_2 emissions fell by 9.8% with a technique effect contributing to a fall by 14% while the scale effect contributed to an increase in emissions of 9.5%. Between-country shifts contributed to a reduction of 2.4% and between-sector shifts within countries to another reduction of 3%. Dean and Lovely (2010) also decompose changes in the pollution intensity (air and water) of Chinese exports and imports during 1995-2004 and find a small composition effect and a larger effect from the shift towards cleaner production processes.

towards 'special economic zones' producing goods for export) will lower the cost of capital and shift comparative advantage along the continuum of goods towards less pollution-intensive activities. Hence, in this setting, contrary to the standard PHH debate, FDI lowers PCI_{NS}.

Grether et al.(2011) provide a first global test of the PHH hypothesis with data for a large sample of countries and industries.[15] They estimate the contribution of the PH and FE effects to the total PCI where, for each pollutant, the total (TOT) PCI is given by 1+TOT= (1+FE)(1+PH) where "1" is the share of PCI that is unrelated to differences in environmental policies or to differences in endowments. Some of their estimates are reported in figure 2a.

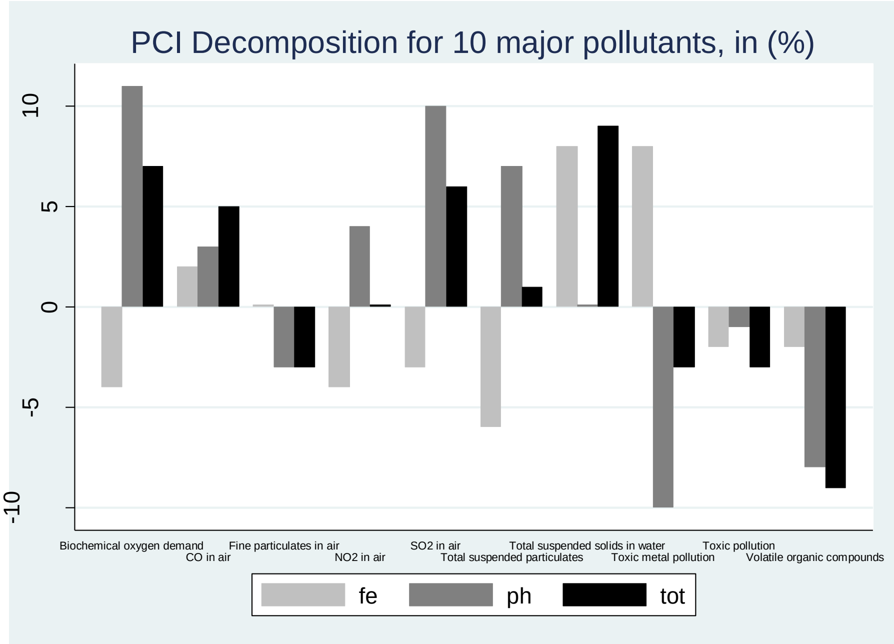
Several results stand out. As expected, the PH effect is almost always positive and the FE effect is negative. For four out of 10 pollutants the PHH is vindicated. However, the net contribution of these effects is always small, between 5% and 10% of the total effect confirming in a large sample of countries that factors other than environmental policy are important in determining the competiveness. Their large sample also reveals the importance of composition effects across groups of countries. Thus even though the FE and PH effects are important in North-South (NS) and SN trade, much trade is accounted for by intra-regional NN trade among Northern countries. However, with an increase in SS trade in recent years, the contribution of the PHH to the PCI would be expected to increase.

Dean and Lovely (21010) compare the pollution-intensity (water and air pollution) of Chinese overall trade (exports and imports) with the pollution-intensity of processing trade (i.e. exports and imports coming from the special economic zones, i.e. export processing zones). The results reported in figure 2b show that while there is a general reduction in the pollution intensity of trade, it is lower for processing trade. When controlling for endogeneity of the share of processing trade in overall trade and other factors (capital intensity, labor intensity, income, tariffs, barter terms-of-trade), their panel estimates (1995-2004) in first-difference show that pollution intensity is inversely correlated with the share of processing trade. While the sample is small (36 observations), their results support the importance of several channels emphasized in the debate. Kuznets effects appear to be significant (lower pollution intensity is associated with income growth). Tariff reductions (entry into WTO and a decline in tariff protection of 75 percent) are positively associated with reductions in the pollution intensity of exports. Their results also support the role of FDI in reducing the pollution-intensity of Chinese trade. The pollution intensity of exports is lower the larger the share of processing exports and the larger the share of FDI in total investment. They conclude that their results could suggest evidence that, over the period, foreign investors brought greener technologies than their local counterparts.

[15] By concentrating on one country, usually the US (e.g. Ederington et al. (2005)), previous estimates were not really testing the PHH. Grether et al. split a sample of 48 countries for 79 3-digit industries for each one of 10 pollutants to estimate bilateral trade and the PCI of imports in a gravity framework, decomposing the total PCI into three components: a "deep" determinant (normalized to one) captured by the traditional variables in the gravity model (distance and dummy variables) unrelated to differences in endowments and to differences in environmental policies

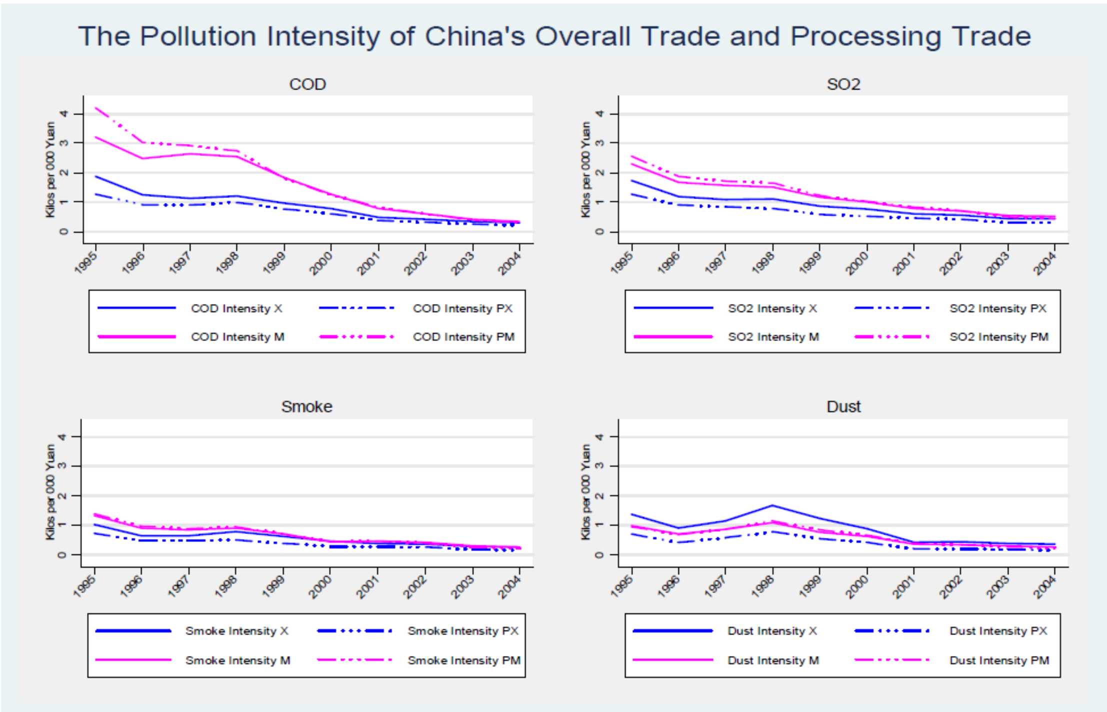
Figure 2: The Pollution Intensity of Trade

Figure 2a: The Pollution- Haven Hypothesis for 10 major Pollutants, 1987



Source: Grether et al. (2011) figure 2.
Note: TOT is the sum of the FE and PH effect expressed as a percentage of the PCI attributed to the fundamental determinants of bilateral trade.

Figure 2b: The Pollution Intensity of China's Trade



Source: Dean and Lovely (2010, figure 11.5)

In sum, while there is evidence that trade has resulted in the transfer of CO2 emissions to low-income countries according to comparative advantage (see below), there is little evidence that environmental and trade policies have validated the PHH.

4.2 Climate Change Mitigation, Leakages and Border tax Adjustments

Comparative-advantage-based shifts in CO2 emissions. Throughout the Kyoto Protocol (KP) negotiation period (1990-2008), CO2 emission transfers from developing to developed countries through trade were 1.2 Gt, an estimate that exceeded the target of KP1 emission reductions (Peters et al. 2011) indicating that, as feared by environmentalists, virtual trade in carbon has adverse unintended consequences for climate policy. Other estimates also conclude that the pattern of trade between developed and developing countries has been shifting with a rising import-export ratio of energy-intensive products in high-income OECD countries (especially the US) and the opposite in low and middle-income countries (especially China).[16] The upshot is that, contrary to what is reported in the production-based UNFCCC statistics, Annex B countries have continued to contribute to the growth in emissions.

These estimates suggest three remarks. First, the territorial-based caps under the KP have thus far allowed Annex B countries to meet their target because of their positive BEET, so that any cap on emissions should be on consumption and not on production (as under the Montreal Protocol). Second, developing countries whose exports are carbon-intensive can be expected to continue opposing joining a successor to KP. Third, the importance of carbon-intensive exports by developing countries to developed countries suggests that countries like China might be willing to undertake more substantial climate-mitigation commitments in exchange for firmer trade disciplines that would guarantee them access to carbon-intensive markets in the OECD.[17]

Policy-induced leakage estimates. The above estimates can be considered passive or comparative-advantage based (as opposed to policy-induced and subject to leakage). Turning to policy –induced leakage estimates, Kee et al. (2010) use a gravity model to estimate the effects on exports of OECD countries of carbon taxes and energy-efficiency standards, both captured by dummy variables using 3-digit ISIC data for manufacturing exports over the period 1988-2005. They find no evidence of a loss of competitiveness for energy-intensive industries when exporting countries impose a carbon tax, but a significant reduction in bilateral trade the year that efficiency standards are applied, whether the efficiency standard is applied by the exporting or by the importing country. They conclude that this evidence suggests that subsidies and exemptions to the energy-intensive industries must have compensated for the

[16] See World Bank (2008, figures 2.2,2.3,2.4)

[17] Using a Leontief-type multi-region input-output model, similar to the method used by Peters et al. (2011) in their calculations, Atkinson et al. (2010), compute first-order effects from applying a 50$/ton tax on the carbon content of imports across all countries. They estimate that this tax would amount to an export tax rate of around 10% for China's exports across destinations. In comparison, EU exports would face an average export tax rate of 1.2% and the US of 3.1%. This just confirms that taxing CO2 is a tax on developing countries. It also explains why, some countries, like China are already starting to tax their exports of CO2 intensive goods since it is better to collect the tax oneself than to hand over the revenue to foreigners.

disadvantages imposed by the carbon tax, a plausible interpretation in view of the powerful lobbying activities by these industries. Another study on carbon imports estimates that the volume of trade "caused" by KP is small and that close to half of carbon savings due to the KP signature have been offset by increases in non-signatories.[18]

The limits of trade policy to mitigate GHG emissions. In OECD countries, around 70% of national income is produced in services and only 15-25% in manufactures, limiting any effect of trade policies on reduction in emissions on the production side. Besides, emission intensities often vary more across countries within an industry than across industries, implying that using trade policy to correct for differences in carbon policies would call for country-directed rather than industry-level measures (Dong and Whalley (2010)). Such measures would be in violation of the MFN treatment at the WTO unless they were part of a Regional Trade Agreement (RTA).[19]

Global multi-regional general-equilibrium trade (MR-GE) models have been used extensively to answer several questions on climate mitigation policies: (i) damage estimates necessary to elicit participation in cooperative agreements and required compensation to bring about participation; (ii) emission reductions from carbon taxes and leakage rates from sub-global carbon taxes, and; (iii) the incidence of Border Tax Adjustments (BTAs) to compensate for differences in carbon taxes. [20]

In principle, international trade expands the bargaining set for reaching a cooperative climate agreement, but small countries will not participate unless they receive compensation because of the sharing of benefits with non-participants. Cai et al. (2009) analyze the participation decision in a skeleton MR-GE model in which temperature change caused by CO2 emissions related to consumption enter negatively in the consumer's utility function.[21] In this set-up, lower consumption has two effects on welfare. It increases welfare directly through a lower rise in global temperature and indirectly through reduced demand for imports, which improves the country's terms-of-trade. Calibrating the utility function parameters on the Stern (2005) damage estimates, they show that a 10% damage (i.e reduction in GDP) from a 1% reduction in consumption would be necessary for the US or China to participate in a treaty if they

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[18] Drawing on data for 38 countries (26 of which have ratified Kyoto), and 12 sectors over the period 1995-2005, Aichele and Felbermayr (2010) examine the impact of different GHG policies on trade flows and emissions. They estimate that carbon imports are on average 12% higher if the importer has ratified Kyoto and his trading partner not. Confirming previous work, the effect is most important in energy intensive industries, where robust evidence for carbon leakage was found for seven sectors. Their findings suggest that, even though the volume of trade "caused" by Kyoto is rather small, on average about 40% of carbon savings due to the ratification of the Kyoto protocol has been offset by increasing emissions in non-committing countries.

[19] Dong and Whalley (2010) examine reasons for carbon-motivated RTAs and requirements for WTO compatibility of such agreements (no selective actions against high-emitting countries and the possibility of invoking article XX to avoid covering all trade). Then, these RTAs could include extension of preferences to low-emission products, but also BTAs to offset anti-competitive effects. As under the Montreal Protocol , the RTAs could also include penalties against those who do not join the agreement.

[20] De Melo and Mathys (2010, appendix) review the results from simulation models, focusing mostly on MR-GE models, all assuming CED product-differentiation by country of origin (the 'Armington' assumption) which produces strong terms-of-trade effects of any change in trade policy.

[21] The utility function is a Cobb-Douglas over goods and over temperature change deviations from a ceiling temperature beyond which all activity ceases. Since production activities are not modeled, damage is calibrated on consumption changes.

are linked through trade. In the absence of trade, the damage would have to be close to 50%.[22] In a follow-up, Tian and Whalley (2010), estimate that transfers of 150$ billion per year would compensate the BRICS for their participation in an across-the-board reduction in emissions of 30% over a fifty-year period

Carbon taxes to reduce emissions will lead to a shift from tradables towards non-tradables as the latter are less energy-intensive. For example, Pigott et al. (1992) estimate that an 80% reduction in CO_2 emissions compared to their 1990 level across regions would reduce world trade by 50%, suggesting an elasticity of trade to CO_2 of (minus ?) two-thirds. Factoring in the greater substitution possibilities across energy sources in the longer term, a guess-estimate would be that a 10% reduction in CO_2 emissions could result in a 3% reduction in world trade. In practice, not all countries will apply carbon pricing. A typical model estimate is that, in the absence of a border tax adjustment (BTA), estimated leakage rates are in the 10%-20% range. For example, if the EU (or the US) were to cut emissions individually by 20%, the leakage rate would be around 35% but it is only 20% when both cut emissions together (Boehringer et al. 2010).

MR-GE models have also been used to provide estimates of the effects of border tax adjustments (BTAs) to prevent carbon leakage. The estimates suggest that a BTA reduces leakage by half. The reason for the relative inefficiency of a BTA is that a tax on the CO_2 content of imports has a strong terms-of-trade effect in favor of the country that imposes the BTA, leading to a change in comparative advantage.

The models also give estimates of the different BTAs that have been proposed in the political debate. A first proposal circulated in the US would be to adjust the price of imports by applying the CO_2 tax in the US to the total (direct and indirect) carbon content of imports, perhaps along with a relief from paying the tax for exporters. A second proposal would be to tax imports on the basis of the carbon content of imports (US legislation would oblige importers to buy emission allowances equivalent to the carbon content of imports). Mattoo et al. (2009), estimate that if industrial countries were to reduce emissions by 17% without applying a BTA, manufacturing exports by developing countries would remain unchanged but would fall by about 2% under the first proposal, and by 15% under the second proposal. Should developed countries try to impose across-the-board taxation on imports based on their carbon content, there would be a collision between developed and developing countries at the WTO.

5 Implementation Difficulties: Political Economy Considerations

It is estimated that a tax of $100 per ton of CO_2 would be necessary to keep any global temperature rise to around 2^{o} C generating annual rents close to a trillion dollars and that the annual fossil fuel subsidies that should be eliminated are worth over $400 billion. These estimates are of an order of magnitude never seen in the international system. Acting on both measures continues to face strong opposition and any serious action against climate change will have to face up to contestable rents far beyond those that have ever been at stake in the world trading system. The failed negotiations to deal with fishery subsidies and climate change show the inadequacy of the current subsidy

[22] Most models show that a 50% reduction in CO_2 emissions would reduce GDP by 2-3%.

rules and the resistance to take the measures necessary for a green-growth development strategy provided by special and differential treatment (S&DT) or the Common but Differentiated Responsibility (CBDR) principles at the climate change negotiations.

5.1 Natural Resources

Market imperfections and institutional failures, both of which impede the full internalization of the true social value of the environment, have often been aggravated by government interventions. This phenomenon has been amply documented by the so-called 'perverse subsidies' including energy subsidies, water subsidies, almost all fishing subsidies, and most recently subsidies for bio-fuels. Credit and fiscal incentives for activities such as livestock and land conversion in forest areas contribute to a loss of biological diversity that can be exacerbated by trade. As with all market imperfections, second-best theory would call for the removal of subsidies accorded to the oil industries and the costing of fossil-fuel extraction (fracking, deterioration of physical infrastructure, contamination of acquifers) that would go a long way towards raising the profitability of other, more efficient, renewable energies.[23] But most of these subsidies which have global implications for a green-growth development strategy regrettably continue to be "non-actionable" under the GATT.

Particularly interesting is the case of fisheries, a natural resource that shares some of the same characteristics as climate, but that has the advantage of being "observable" since fish stocks have been known to be declining since the early seventies. Resolving the overexploitation of fisheries requires: (i) improvement in the management of fisheries by giving/selling secure and enforceable rights to fisherman to solve the open-access problem; (ii) reform the subsidy system which boils down to eliminating virtually all subsidies to the industry.[24]

After the failed Seattle negotiations where fishery subsidies were prominent on the agenda, they reappeared in article 28 of the Doha ministerial "…participants shall also aim to clarify and improve WTO disciplines on fishery subsidies, taking into account the importance of this sector for developing countries". Three years into the negotiations, major fishing countries who had developed a dominant position in the industry acquiesced that most subsidies were indeed harmful as the Hong Kong ministerial recognized explicitly that governments should strengthen disciplines on subsidies including through "the prohibition of certain fisheries subsidies that contribute to overcapacity and over-fishing", subject to S&DT for developing countries (Von Moltke, 2011, p. 154). But progress on defining *de minimis* rules for S&DT to exclude the large fishing nations (China, Peru and others) met with fierce resistance and no agreement could be reached. In the end, agreeing on compensation in fisheries

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[23] Worldwide, according to the International Energy Agency (2011), subsidies to renewable energies are estimated at 67$billion and the corresponding figure for consumption subsidies for fossil fuels (including for biofuels) at 400$ billion. Across the EU where taxation is decided at the national level, the gap in the price of electricity is still around 4 to 1 (Nordstrom (2009)).

[24] Worldwide, fisheries account for 170 million jobs and generate revenues of around $85 billion per year with subsidies in the 25-35$ billion range, all of which (except those for management) contribute directly or indirectly to overexploitation. About 37% of fish catch is traded internationally. Details in Von Moltke (2011, chps. 1 and 2)

has proved as elusive as the application of Common but Differentiated Responsibility (CBDR) principle under Kyoto.

5.2 Climate change

Just as in the case of fisheries, dealing with rent transfers nationally and internationally will dominate efficiency considerations both because the bulk of the electorate is opposed to a carbon tax and because high GHG emitters are powerful groups in the energy, construction, transportation and manufacturing sectors.[25]

The political-economy of implementing a carbon border tax would, however, be extremely difficult, as illustrated by Moore (2010) for the steel industry, a heavy CO2 emitter for which it is difficult to evaluate the carbon footprint in the final product. He shows that none among the possible border adjustments would meet the necessary economic, political, environmental, legal, and administrative constraints needed to gain the necessary support for implementation. These constraints are: (i) domestic firm buy-in; (ii) foreign firm buy-in; (iii) administrative capability; (iv) adherence to WTO rules (articles I on non-discrimination and III on national treatment; and (v) incentives for CO2 reduction by foreign firms. Since several technologies are available to produce steel, it would be necessary for the country wishing to impose a border adjustment to firms in foreign countries to distinguish among foreign firm types. The complicated administrative procedures implied by any choice of border adjustment raises the spectre of adopting a system of rules of origin that would attempt, through bureaucratic means, to identify the true source of products whose origin is unclear from their physical characteristics. Such a system would in all likelihood be captured by lobbies as has been the case for rules of origin in the context of preferential market access (see Cadot and de Melo, 2007).

Mathys and de Melo (2011) discuss the exceptional sensitivity of these rent transfers in the political debate in the EU and the US and take the promotion of biofuels as an example of rent capture in action and of a perverse incentive. [26] Getting support for mitigation policies under a cap may then prove to be very costly. Mathys and de Melo conclude that, just as anti-dumping was the price to pay for countries to sign up to the Single Undertaking as part of the Uruguay round grand package, free allowances (or very limited auctioning) may be the political price to pay in the application of mitigation policies. As in the case of biofuels, such support would result in large transfers from consumers to producers. In a study of the ETS cap, Demailly and Quirion (2008) estimate that a 15 per cent reduction in CO2 emissions under free allowances would raise the net profit margin of industries under the cap by seven percentage points, an increase coming from a 10 per cent fall in consumer surplus. And of course, aluminium, which is highly tradable (i.e. very substitutable across suppliers), is not covered in the emission cap since, even with free allowances, the possibility to

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[25] Messerlin (2011) draws the parallel between climate and water policies, arguing that both communities face the same foes (protectionist pressures from strong lobby groups, e.g. steel producers and farmers) and friends (exporters of environmentally-friendly products) in their quest to pursue the efficient policies (remove water subsidies and tax carbon).

[26] Even though estimates suggest that at most half a dozen sectors might be subject to significant carbon leakage, 164 sectors (sub-sectors) have been considered by the EU Commission as exposed to "significant risk of carbon leakage" meaning that they would be up to get 100 percent free allocations. Messerlin (2010) notes that these are the sectors that have succeeded in obtaining contingent-protection measures at the WTO.

raise prices and pass on the costs to consumers would be very limited. As to total leakage estimates, the authors estimate these to be small, at 8%.

6 Natural Resources and Environmental Goods and Services (EGS) in the Multilateral System

Ideally, implementing the logic of figure 1 which identifies EPPs and GEMs, would be done following a detailed analysis of the environmental footprint of a product, of how it was produced and consumed. This would tell us if the product was compatible with a green-growth strategy. [27] But such an analysis on a large scale is still largely beyond our capabilities, even though voluntary labeling is informative and has the potential to influence consumption choices. In any event, negotiations in the multilateral system about policies to protect the environment have, so far, been acrimonious. [28]

6.1 Natural Resources

Article XX (paragraph (g)) of the GATT allows exceptions to treaty obligations for measures "relating to the conservation of exhaustible natural resources", understood to include renewable resources that may be depleted (e.g. the conservation of species and also clean air). Several international treaties related to resource conservation have included trade provisions. These have ranged from bans (e.g for endangered species), to recommendations to help protection of the wildlife habitat to diversification of renewable resources (timber).[29] These trade restrictions have rarely been applied most of the time because these treaties were not designed in a way to solve the free-rider

[27] Brenton et al. (2009) survey results from carbon-accounting and carbon-labeling studies. They show that it is especially difficult to generalize for agricultural products in which many low-income countries have a comparative advantage (e.g. when delivered to the consumer, roses grown in Kenya emit about 20% of CO2 emissions compared to those grown in Holland). For the US, Weber and Peters (2009) show that while carbon accounting is important for a handful of energy- intensive activities (refineries, coke & gas, iron & steel, non-ferrous metals, chemicals, building materials (cement), pulp and paper)-- which account for between 60% and 90% of total emissions in the US-- carrying out a carbon footprint analysis would be very challenging and highly contestable if it were to be implemented.

[28] At the launch of the Doha round, dubbed the Round for the LDCs and for the environment, WTO members were explicitly mandated to address fisheries subsidies (art. 28) and to reduce trade barriers on Environmental Goods and Services (EGS) (art.31).

[29] These include the Convention on International Trade in Endangered Species (CITES), the International Tropical Timber Agreement (IITA), and the Convention on Biological diversity (CBD). For CITES, trade enters as a ban for endangered species while for CBD, trade can help preserve conservation but it can also be a threat for biodiversity. For the IITA, trade is to help manage diversification of timber forests. Barrett (2003, chp. 6) notes that about one in seven Multilateral Environment Agreements includes trade restrictions. Some enter directly to achieve the treaties objectives (plant or animal preservation, prevention of involuntary imports of hazardous wastes. Others enter for strategic reasons, for example to bring cooperation or participation (Montreal Protocol on CFCs or the International Commission for the Conservation of Tuna). In the case of the North Pacific Fur Seal Treaty, trade restrictions were to deter entry. In some cases, trade enters informally to discourage free-riding (e.g. parties to the International Whaling Convention were urged, but not required to ban imports from non-parties).

problem associated with common-pool resources since, in the process, the punisher would have been punished. [30]

With respect to natural resources, trade bans can increase poaching as the price goes up because of remaining illegal activities. This is why some have suggested reselling the confiscated products to satisfy demand and drive down prices. Or, in the case of storable products like horn or ivory, governments could stockpile the confiscated products and threaten to dump the products on the market if prices get too high (Kremer and Morcom (2000)).

Perhaps the most celebrated disputes regarding the conservation of natural resources are the "shrimp-turtle" and "tuna-dolphin" disputes, both involving the US. In the "shrimp-turtle" case, the Appellate Body ruled against the US as it had banned imports of sea turtles from certain areas (but not from others in the Caribbean) that were not using turtle excluder devices (TEDs). In the Tuna-dolphin case involving the US and Mexico (under the GATT (1991)), the US lost the case when it argued that tuna could only be imported, if it was caught in purse-seine nets, jurisprudence that was overturned later in the shrimp-turtle decision which in effect ruled that processes and production methods (PPMs)--such as requirements for TEDs --could be invoked by WTO members for contingent protection. Technically, Shrimp-Turtle did not explicitly approve the use of non-product related production and process methods (NPR-PPMs), but it did provide that they could in certain circumstances be justified under the GATT's article XX exception clauses.

6.2 Environmental Goods and Services

Some of the difficulties in identifying the effects of trade on the environment came to light when at the Doha Ministerial, WTO members were invited to make submissions that would help define a "universe" of 'environmental goods' that would be open to negotiated reductions in trade barriers. [31] To begin with, there are no provisions in the WTO legal system related specifically to environmental goods and services (EGS), except for the application of the MFN clause and a general interdiction against the use of quantitative restrictions, rules that apply to all goods and services. Second, in spite of drawn out negotiations under the Doha Round, there is no agreed-upon definition of what an 'environmental good' or an 'environmental service' is. Obstacles faced in classifying EGS are summarized in Figure 3 which shows two broad categories: on the left, Goods for Environmental Management (GEM), and on the right, Environmentally Preferable Products (EPPs).

On the left belong products whose use is to improve the management of the environment. GEM include "pollution management" services (e.g. tubes, pipes, filters) and "resource management" products such as renewable energy equipment (towers

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[30] A well-publicized case is whaling where the International Commission on Whaling (ICW) banned commercial whaling in 1986. Iceland appealed to the IWC to be allowed limited whaling for 'scientific purposes'. When the US threatened to ban imports of fish from Iceland, at the next IWC meeting, Iceland's representative threatened to oust US forces from a NATO base in Iceland. Then Iceland got its way.

[31] The gains from an open world trade regime is evident in the renewable energy sector. Supply chains involving many countries in the provision of specialized services and many components in the solar PV sector are sourced in different countries. See the case studies in ICTSD(2011, chp4).

and lattice masts for wind turbines). These goods generally have multiple end-uses, only part of which serves environmental purposes.

Environmentally Preferable Products (EPPs) on the right-hand-side are single-use products that produce less environmental damage either in their production, their use or their disposal. Examples would be an energy-efficient washing machine or the use of low-emission technology in aluminum production (e.g. Pre-bake rather than So(ö?)derberg technology).

Multiple end-uses. A finer HS classification specifying "ex outs" (goods which are not separately identified at the 6-digit level of the HS system and that have to be identified in national tariff schedules at the 8- or 10-digit level) could help solve the specificity problem. It also highlights the inadequacy of the current HS system for dealing with climate mitigation policies.

Relativism This applies to EPPs and refers to the fact that we lack agreed criteria to judge what is "environmental friendly". Apart from the divergence in preferences (conceptions of the "environment"), this is also due to the hurdles facing the completion of a life-cycle assessment (LCA) as a same good may be used and disposed of in different ways. For other goods or human activities, criteria are lacking because of scientific knowledge gaps (particularly for those goods differentiated by Process and Production Methods (PPM) for which the impact is "indeterminate". An example is the doubtful gains from the use of bio-fuels to save on energy and reduce CO2 emissions (Mathys and de Melo (2011)). This problem is all the more critical when knowledge that was thought to be stabilized could be challenged periodically (for example, some studies have found that environmental impacts of recycling processes can offset the benefits of recycling). Scientific knowledge progress is also related to another form of relativism, namely the "changing technology frontier": today's cleanest available technology will change as technological progress occurs. This problem is critical for trade liberalization as it would imply regular updates of the list of goods that would benefit from tariff exemptions (Steenblik (2005)).

Attributes Disclosure. Even if problems related to relativism were solved, some EPPs differ in non-observable attributes (which include not only products that are differentiated by Product and Process or Production Methods (PPMs) whose disclosure mechanism can be very costly when attributes are not observable in the final product (e.g. efficient third-party certification for "credence goods").[32] This implies that multilateral liberalization for many EPPs would further require an international standard and certification process, harmonization of which would be difficult and controversial.

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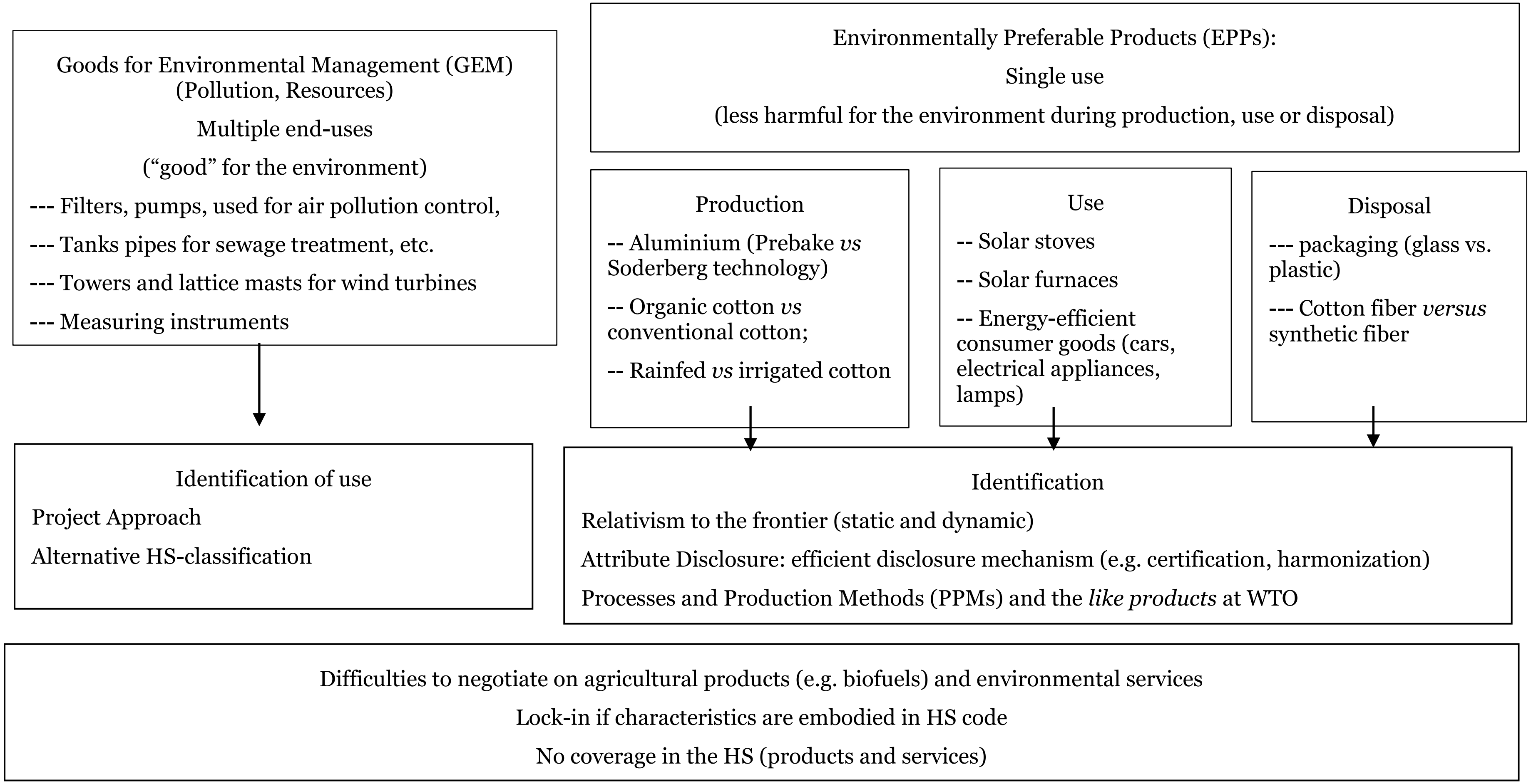
[32] "Credence goods" refers to those goods whose attributes cannot be observed before their purchase ("search goods", e.g. the price of tuna) or their consumption ("experience goods", e.g. the taste of tuna). For example, consumers cannot know if tuna have been fished in dolphin-safe conditions before, during, or even after consumption. Credence characteristics thus require other mechanisms than repeated purchases and reputation.

Figure3: Identifying and Classifying Goods Related to the Preservation and Management of the Environment



Source : Balineau and de Melo (2011 figure 1)

Like Products and labeling in the WTO. Closely related is the problem of like products so that the promotion of trade in EGs would not create unnecessary restrictions to international trade (contrary to GATT art. XI). This problem affects goods which differ in their PPMs without being modified in their final physical characteristics (in that case PPMs are referred to as "non-product-related" PPMs), as WTO members generally cannot discriminate arbitrarily among products based on the way they are produced. For instance, while some governments may want to discriminate between wood products derived from sustainable grown forests from other wood products, they cannot do so if the unlikeliness of these two types of wood products is not established. An exception is the EC-asbestos case where the Appellate Body ruled against Canada that countries could ban imports of asbestos-containing products (WTO WT/DS/135/AB/R).

Increasingly labeling is used to distinguish products as being grown organically, respecting fair-trade rules to show their carbon's footprint. In the case of some natural resources, labeling can be effective. For example in its recent ruling on September 15, 2011 on a dispute brought by Mexico against the US on a "dolphin-safe" label for tuna products, the majority of the panel ruled that a label may in effect be mandatory for a product to claim that it has a certain characteristic---here dolphin friendly. Given that Mexico had revamped its fleet to satisfy the "non-injury" label requirements agreed to in the Agreement on the International Dolphin Conservation Program (ADICP) to which both Mexico and the US were signatory, this in effect was shutting out Mexican tuna from the US market. [33] The upshot is that for clearly identifiable products (tuna, ivory), labeling can be a powerful tool. If this decision is brought up to the Appellate Body and is upheld, it would, in effect, recognize mandatory labeling as non-discriminatory.[34] The case also shows the potential for conflicts over labeling for environmental concerns.

Because of these problems and because of conflicting views on the definition of EGS, after close to ten years of submissions, countries have been unable to agree on the approach to liberalize EGS (developed countries preferring a list approach and developing countries, a project approach). Over 400 products were submitted by developed countries in 13 lists with minimal overlap across lists. Working from a 'core list' of 26 products, Ballineau and de Melo (2011) find that low-income countries specialized in 'end-of-pipe' products using imported clean technologies have the lowest (15%) share of tariff lines with zero tariffs. These are the countries that would gain the most from a reduction in protection. Moreover, the gap in tariff rates between EGs and other goods has remained constant over the last decade, leading them to conclude that the lack of a 'mandate effect' during the negotiations.

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[33] The ACIDP Treaty has been hugely successful reducing greatly dolphin mortality by 99 percent, yet a series of Federal Court rulings in the US prevented the US Department of Commerce from applying the "non-injury" label agreed by all signatories of the ADCID rather than a "fishing method" approach indicating that, via the AB ruling, consumers have in effect rendered the voluntary standard, a mandatory regulation. This opens the door to consumers' buying power to influence the production methods of partners.

[34] It is expected that the US will appeal the decision to the Appellate Body. See Wilke and Schloemann (2011).

7 Concluding Remarks: Trade Policies for a Green Growth Strategy

The current architecture for global policy making rests on the Bretton Woods institutions: the IMF, the World Bank, and the WTO. These institutions were designed to manage interactions between countries that did not involve the physical linkages that have been growing since the early 1960s. The failure to make progress in the negotiations on EGS and on reforms of fishery subsidies in the current Doha Round leads one to question whether we have the right global architecture to handle trade and environment polices for a green-growth strategy. Besides participation by all parties involved, are there any lessons from the evolution of the World Trading System for the design of green-growth trade policies? Here are a few for consideration.

A regional approach with leeway. Looking back at the early days of the GATT, participation was among a small group of countries where negotiation was easier than under the now unwieldy WTO where unanimity is required for all major decisions. The GATT thus made progress towards free trade with agreements that bound nations in ways that did not impinge on their national sovereignty. It is indeed the straightjacket imposed by the Single Undertaking and the Dispute Settlement Mechanism under the WTO that has been largely the cause of the stalemate in the Doha round. It is now widely believed that the live-and-let-live approach under the GATT was the key to its success in delivering the global public good provided by the current World Trading System (Baldwin (2010)). Applying this insight to environment and trade policies, it is likely that the shift to a bottom-up approach has greater chances of success than the previous top-down approach under the KP. Many environmental issues are likely to be better dealt with at the regional level. An example is the many environmental directives under Maastricht Treaty which allows the European Commission to make legally binding decisions for member states. States can still renegotiate, or even withdraw from the Union, so that while their sovereignty has been diluted, their essential rights remain intact. Through a succession of decisions, the incentive for member states to exercise rights has been reduced. Given the large discrepancies in emission intensities across countries within a given sector, it is likely that a regional approach where emission intensities are more similar would be implemented more easily.

Guiding policy principles. If possible, carbon taxes should be levied on domestic CO2 emissions with the objective of converging towards a unique carbon tax. This approach by price incentives should continue to be strongly encouraged because of its transparency, its efficiency and its alleviation of the requirement of compensatory transfers. Likewise, if a Carbon Credit Trading System (CCTS) is adopted, although not required, auctioning of permits should be encouraged, trade-related GHG measures should be limited, like-products should be defined at a broad enough level of aggregation (4-digit HS for Hufbauer et al., 2009) and the modalities for border adjustments and the management of the CCTS should be flexible. Countries that would subscribe to such a "green code" would benefit from a "peace clause" so as to avoid being subject to WTO disputes. This sensible approach may, however, be difficult to implement as all activities would want to qualify for "green space status" and the request for flexibility could easily lead to a made-to-measure rather than to a transparent code, although implementation at a regional level would have greater chances of success.

As to the principles for guiding trade policies, first the MFN and NT (national treatment) principle would seem to offer the best joint disciplines on the two threats discussed here: carbon tariffs and carbon border taxes. Since carbon tariffs are calculated on a country basis rather than on a product basis, goods with different CO_2 intensity would get charged the same tariff. Emerging countries would want the MFN to be preserved. Developed countries would want to keep the option of imposing carbon border taxes (exports do not pay the carbon tax, but the tax is paid at the rate of the carbon tax in the importing country much like the VAT is administered across countries with different domestic taxes). Thus developed countries would like to preserve the NT principle. So the non-discrimination principle of the WTO enshrined in the MFN + NT principle would be the best compromise even though there is clear room for abuse. Non-discrimination would be the best compromise because, as argued by Messerlin (2011), border taxes have lower discriminatory capacity than contingent instruments available at the WTO (anti-dumping, antisubsidy and antisafeguards). Also, with the growing importance of outsourcing in world trade, any border tax should be calculated on an ad-valorem basis and on the basis of the CO_2 content in value-added (and not on the gross value of the trade flow), though this complicates considerably its application.

Other elements of the WTO rules, especially those on subsidies would need to be modified. Currently, the huge subsidies on oil as well as the farm subsidies, including on fisheries, water, and biofuels are either 'non actionable' or have not been challenged at the WTO. These subsidies should be eliminated while subsidies appropriately targeted to meet climate objectives (e.g. for R&D in clean energy) should be allowed. This will not be an easy task, but it needs to be tackled. Likewise, export taxes which are distortionary and are allowed under the current WTO rules should be banned (an export tax on CO_2 intensive products is a subsidy to the domestic consumption of these same goods).

Under this approach, with these 'simple' rules, much progress would be more likely to take place in a small group of countries, which would be an easier route than a Multilateral Treaty. As mentioned above, unilateral reduction in tariffs was the way most progress was made in the early rounds of trade negotiations. Of course, unilateral action is certainly easier to envisage in the case of tariff reductions where most gains are internalized than under GHG emissions where all gains are equally shared so that the need for collective action is much greater. Under this simpler architecture, in the initial steps forward, the UN process, which still requires unanimity, would be by-passed.

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