FONDATION POUR LES ÉTUDES ET RECHERCHES SUR LE DÉVELOPPEMENT INTERNATIONAL

Working Paper 37 February 2012 Development Policies

Reconciling Trade and Climate Policies *

Nicole Mathys
Jaime de Melo

Nicole Mathys is Responsible for research program "Energy-Economy-Society" (www.ewg-bfe.ch) at the Swiss Federal Office of Energy, Berne. She is also Researcher and Lecturer at the University of Neuchâtel.

Jaime de Melo was Professor at the University of Geneva from 1993 to 2012. His research focuses on trade policies, on trade and the environment, on the links between regionalism and multilateralism. He is Senior Fellow at Ferdi since 2011. // **email** Jaime.demelo@unige.ch.

Abstract

The outcome of the 15th conference of the Parties to the UNFCCC in Copenhagen showed a shift from a top-down approach with a collective target favoring environmental objectives to a bottom-up accord favoring political feasibility. There is no meaningful binding agreement in sight, also because the global climate regime and the global trade policy regime appear to be on a collision course. Following a review of the challenges ahead, the paper argues that trade will have a second-order contribution to world-wide CO2 emissions. Evidence shows increasing carbon transfers through trade, but the magnitude of carbon leakage effects may be less than feared in some circles. … /…

JEL: F18, Q54, Q56
Keywords: Climate change, trade policy, carbon leakage

* Thanks to Petros Mavroidis, Patrick Messerlin, Richard Newfarmer and Gisèle Schmid for helpful comments on an earlier draft. This is a shortened and substantially revised version of de Melo and Mathys (2010). Mathys thanks the Swiss National Science Foundation (grant 100014-138625) and de Melo thanks the FERDI for financial support. All remaining errors are our sole responsibility.

… /… Trade policy, however, will play a role in implementing climate mitigation policies in three areas: maintaining an open trading system and hence boosting growth and facilitating technology diffusion; leveling the playing field for countries that do not mitigate and as a strategic instrument to bring compliance and participation. The paper concludes that a climate agreement with a few guiding principles and leeway where much initial mitigation would first take place unilaterally or in small groups, as under the early days of the GATT, is the most promising way ahead. This would help preserve an open trading system as well as environmental integrity.

1. Introduction

In spite of several decades of success, it is becoming increasingly clear that today's World Trading System (WTS), based on global policy coordination led by the "triad" (IMF/World Bank/GATT-WTO) may no longer be able to deliver the needed policy coordination to achieve sustained global growth including the catching up of the Least Developed Countries (LDCs). National economies are no longer linked only through trade and finance (including aid flows) as was assumed under the current global policy architecture. Physical interactions between national economies in the form of external effects, of which the most important is climate change, have started to grow since the 1980s. Climate mitigation has become the central global environmental issue, culminating in the 1994 agreement on the United Nations Framework Convention on Climate Change (UNFCCC). Yet, almost twenty years later, very little progress has taken place and the WTS — often heralded as the main engine of the world's spectacular growth of the past two decades — is under threat, notably because of the continuing difficulties at the Climate and trade (Doha) negotiations where the stalemate in these negotiations have the same losers: the least developed (LDCs) and other vulnerable countries.

Several observers view the shift at the December 2009 meeting in Copenhagen confirmed at the Cancun meeting in December 2010 from a top-down approach, with a collective target under the current Kyoto Protocol (KP), to a bottom-up accord as a move from an approach favoring environmental objectives to one favoring political feasibility. Under the latter approach there is no agreed standard for saying whether a country is, or is not doing its fair share to limit global warming. With the UNFCCC working by consensus, a meaningful binding agreement with a dispute settlement mechanism akin to the one in the WTO does not appear in sight by the end of the KP in December 2012. Many conclude that the global climate regime and the global trade policy regime, represented by the WTO, are on a collision course. Businesses fear about the mitigation policies affecting their competitiveness, and environmentalists fear that international trade will undercut the policies to reduce Greenhouse Gas (GHG) emissions. Both groups are appealing to the WTO for rescue. Hufbauer and Kim (2010) and others see a train wreck between climate change objectives and trade. One source of relative consensus is that damages will mostly fall on poor countries with little capacity at adaptation. Recent estimates put up to 80% of the damages from climate change would be in low latitude countries (Mendelsohn et al. 2006).

For a long time, trade and the environment have been odd bedfellows as environmentalists have claimed that the interests of the trade community would trump environmentalists concerns. First, globalization-induced increases in trade flows can magnify trade embodied pollution, as discussed in the abundant "pollution haven" literature. Second, improvements in technology make it increasingly easier to intensify the exploitation of natural resources, potentially exacerbating the depletion of natural capital. Recognizing the importance of these issues, the launch of the Doha Round explicitly recognized that environmental concerns would be fully taken into account during the negotiation round to address the fears that the gains from growth and globalization could be undermined by their environmental side-effects (it was dubbed the round for "developing countries and for the protection of the environment"). Pursuant to article 31 of the Doha mandate, WTO members have been asked to reduce or eliminate tariffs and NTBs (non-tariff barriers) on Environmental Goods and Services (EGS). Reviewing the lack of progress to date (countries have been unable to agree on either the approach to determine eligible goods or on a list of goods eligible for tariff reduction negotiations), Balineau and de Melo (2011) show that tariff reductions on goods that might qualify as EGS have not been greater than for other goods. They also estimate a small import response for those EGS that experienced substantial tariff reductions and conclude for a lack of 'mandate effect' since the initiation of the negotiations.

This paper takes stock of the challenges ahead taking as a point of departure the observation that the trade negotiations and the environmental negotiations both face the same problem: providing a 'public good' whose supply requires widespread participation and compliance.[1] Drawing on this analogy, we note that the environmental negotiations can learn from the past evolution of the World Trading System, first under the GATT, then under the WTO, where much progress took place under unilateral reductions in barriers to trade (over half of the reduction in tariff barriers since the inception of the GATT took place on a unilateral basis; Messerlin (2010)). Yet, there is a fundamental difference with respect to the compliance that is necessary to bring about collective action in the case of climate change policies: as reminded by Barrett (2010), trade is bilateral, so that trade agreements can be more easily enforced by a strategy of reciprocity. By contrast, climate change mitigation is a global public good where reciprocity is a weak enforcement tool. Enforcing sanctions on non-participants is rarely in the interest of those who have to impose sanctions because they also incur costs in the process. Moreover while trade liberalization implies rather certain and relatively short-run gains, effects from climate change mitigation efforts are very uncertain and materialize only in the very long run. It is not surprising, then, that the KP did not include trade sanctions as an enforcement mechanism.

Section 2 discusses the (lack of) progress so far, the need to address equity issues, and how trade measures might affect the outcome of climate mitigation policies. Section 3 turns to quantification and argues that trade and trade policy will have small direct effects on CO_2 emissions, even though emission transfers from developing to developed countries through trade have been increasing. It further examines evidence on leakage effects from a carbon tax. Because of the weakness of mitigation efforts so far, we first look at ex-post leakage in the case of SO_2, a pollutant that is prevalent in the same sectors as CO_2. We then report on the estimates (mainly ex-ante) for CO_2 emissions questioning the likely accuracy of these estimates. Section 4 closes with thoughts about some lessons that the multilateral trading system could offer to the Climate Change negotiators.

2. The Challenges Ahead

[1] Surveys on trade and the environment (e.g Jayadevappa and Chhatre (2000), Copeland and Taylor (2004), World Bank (2007, 2008), WTO-UNEP (2009)) have mostly emphasized the physical linkages occasioned by the pollution content of trade and the role of trade policies to 'level the playing field'.

Emission growth has not slowed down since concerns about climate change surfaced around 1990. Since GHGs stay in the atmosphere for over a century, their stock is therefore increasing. Much of the growth in emissions comes from the catch-up of Brazil, China and India (the "G3"). As with almost everything else on climate, where the only 'certainty is uncertainty', orders of magnitude of the marginal damage are largely unknown, but there is now broad consensus that damage from emissions will increase at least until stabilization in the stock is achieved. Per capita emissions (PCE) have stabilized for the three high-income heavy per-capita emitters-- Australia, Canada and the US (the "E3")--in spite of GDP and population growth, though at levels about four times higher than the 'safe' levels compatible with a global warming below 2 degrees. Differences in PCE are huge across country groupings and the E3 have a long way to go to reduce their PCE to the OECD-26 group average. CO_2 emissions however fell sharply during the two oil price spikes of the 1970s, suggesting that a tax on the price of fossil fuel would lead to a fall in emissions (Ordas and Grether (2011) identify significant structural breaks in PCE around the oil price hikes).

2.1 Implementing equity criteria

The UNFCCC framework calls for "common but differentiated responsibilities" in addressing climate change as well as long term flexibility in implementation. In particular, any successful climate change regime will have to address burden-sharing and any broadly supported agreement would have to rely on some equity criteria.

Reviewing the literature on equity concerns, Mattoo and Subramanian (2010) distinguish between four possible equity-based allocation mechanisms of emission rights: i) equal per capita emissions; ii) inversely related to historic responsibility for emissions; iii) inversely related to ability to pay; iv) directly related to future development opportunities. They compute the corresponding emission allocations using data for fifty countries, historical emission data back to 1970 and GDP per capita as a measure of the ability to pay and apply the analysis both on emission levels and on emission changes (using a business-as-usual baseline). They also consider the 'traditional' 80-20 burden sharing formula which would correspond to an equal division across the estimated 9 billion people in 2050 implying that every citizen has an equal right to pollute the global sink, i.e. an equal right to emissions. These alternatives cover the perceptions across a broad range of countries, i.e. in the press in the US, the focus is on China's total emissions exceeding those of the US while in China and India, the focus is on per capita emissions. Mattoo and Subramanian (2010) find that most proposals are broadly equitable, by imposing smaller emission cuts on poor countries with the exception of the 80-20 rule that shows to have a relatively strong status quo bias. Interestingly, India receives more emissions per capita under historic and GDP based allocation than under per capita allocation because of his low GDP per capita.

Taking convergence in per capita emissions (PCE) as an equitable target, Spence (2009) computes emission paths over a 50-year period. He shows that PCEs would have to decline by 4% per year in the E3 (Australia, US and Canada) and by 2.6% per year in the other high-income countries (mostly the OECD 26). Spence (2009) shows that the trajectories towards a convergence in PCE imply participation by all but the slow-growing low-income countries implying that fast growing developing countries should 'graduate' from their current status under KP by being installing a cap on emissions.

Birdsall and Subramanian (2009) propose an alternative metric i.e. the right to have access to energy (rather than the right to pollute) and that history should be the guide. This means that people should have access to the same energy at comparable incomes per capita. However, developing countries should meet their energy needs with current technology frontier (not the technology of the developed countries earlier on at the same stage of development). Mattoo and Subramanian (2010) conclude their analysis by acknowledging the difficult situation in a world with a shrinking carbon-budget and conflicting interests. They suggest shifting the emphasis of international cooperation towards generating a low-carbon technology revolution where equity would have a different role. It would push forward the contributions of different countries in generating a low-carbon technology revolution so as to enlarge the pie with the hope of reconciling the development needs with climate change goals.

2.2. Trade Measures to Address the Kyoto Failure

Low participation and lack of compliance were the two main failures of KP. This calls for a new architecture and it is interesting that early on during the negotiations for the KP, several commentators observed that insufficient attention had been paid to its architecture which was "deep and shallow" rather than "broad, then deep" (see e.g. Schmalensee (1998)). The lack of a compliance mechanism has often been noted (e.g. Barrett (2008, 2010)) and compared with the hugely successful Montreal Protocol (MP) that addresses ozone depletion and where trade sanctions were an integral part of the Protocol. Members of an international agreement can establish trade sanctions for non-participants who do not comply. This has the advantage that new principles could be drawn up for a climate change treaty rather than relying on the current complicated rules set up at the WTO that govern the use of border adjustment measures to address competitiveness effects. The comparison with the MP is instructive even though checking compliance is much easier for ozone depleting emissions, where emitters of CFC gases were few and highly concentrated. Also the benefit-cost calculus of preventing ozone depletion is far more favorable than for climate change, where the dimension of the problem is much larger. Hence, applying trade sanctions under the climate change context would also be far more complicated and controversial.

Barrett (2008) argues that it would be preferable to build an architecture that would lean towards a system of treaties where the use of trade sanctions would be easier to target and hence, would be more effective, i.e. a more powerful deterrent to bring about compliance. Initially, only a handful of high emitters of CO_2 would be covered under the new set of rules since building such an agreement might be easiest with few participants. This approach however, would come at a cost since a substantial amount of trade might then take place among non-participants making it more costly (and hence less credible) for participants to apply the agreed-upon sanctions to non-participants.

For example in a sectoral treaty on aluminum, one could imagine that countries with aluminum producers that would use the Söderberg rather than prebake technologies - for which it is easier to treat volatile wastes - would receive a trade sanction. For steel, however, it is more difficult to establish the carbon footprint. Moore (2010) shows how difficult it would be to get the necessary support to implement a border tax adjustment for the steel industry. These difficulties would carry over to the use of trade sanctions in a sector treaty.[2]

Trade will also come in because of the necessity to separate where abatement takes place from who bears the costs of abatement. Marginal costs of abatement differ widely with many 'no-regrets' energy-saving opportunities in developing countries. Under those circumstances, a global or regional carbon credit trading system (CCTS) building on an improved Clean Development Mechanism (CDM) introduced under the KP will be necessary. Implementing the CDM involves not only trade in credits but also trade as technology transfer. Reviewing technology transfer in CDM projects, Dechezleprêtre et al. (2011) find that technology transfer is more likely if the country is more open to trade, results confirmed by Schmid (2011) with a more accurate measure of trade policy in recipient countries. An open trading system under which credits and intellectual property rights (IPRs) are respected would be essential for the success of climate mitigation policies. An open trading system would also be essential for the functioning of a CCTS since the cross-border exchange of permits is an international trade transaction that is subject to MFN (most favorite nation) treatment and hence to WTO rules.

Trade would further enter because of the issue of 'carbon leakage' and the pressure for border measures (border tax adjustments or BTAs) to address competitiveness issues. BTAs are likely to be ineffective in helping mitigation policies as they would be up for capture by protectionist interests and so far the importance of leakage effects is controversial (see section 3.2 and Droege(2011)). In any case, it is clear that the pressure for countervailing action against countries that in effect "subsidize" their industries by not correcting the externality due to CO_2 emissions will be great as countries will be progressing at different speeds in their mitigation efforts. Pressure for BTAs has already surfaced under the mild cuts of the KP. This option was contemplated by the EU (via the carbon content) against the US who did not participate in KP and was also considered in US legislation process (via the purchase of emission permits by importers). It is hard to imagine that this pressure will not be concretized in the future with trade wars as a real possibility as the parties involved fight for rents resulting from a rising carbon price. Besides the legality issue at the WTO, the use of BTA (i.e. of trade policy) is further complicated by the fact that carbon intensities vary greatly across countries. Since the MFN clause calls for equal treatment for products across partners, if trade policy were to be effective, it would have to discriminate across partners and not only across products, putting climate policies in direct conflict with the WTO. Carbon free-trade

[2] Applied at a sector level also, a distinction could be drawn between 'bad' subsidies for fossil fuels, and 'good' subsidies to encourage R&D on clean technologies.

areas might then be the route followed if countries continue to want to use trade taxes as part of their climate policies.[3] Ironically, trade restrictions to 'level the playing field' that will invite retaliation are likely to be used precisely because they have not been used strategically in the design of the agreement in the first place.

3. The Importance of Trade Policies in Climate Mitigation

At first sight, growth will be more important in determining the amount of emissions than international trade which will be an effect of minor importance. So if climate policies reduce emissions, it will be mostly via the effects of these policies on growth rather than via the effects that would result from trade policies aimed at curbing emission growth.[4] Suppose that full carbon pricing (say 100$ per ton of CO_2) were adopted by a domestic carbon tax to meet a safe target emission reduction.[5] If all countries participated, there would be three direct effects: (i) a shift across energy sources away from fossil fuels; (ii) a shift away from manufactures (which are relatively more intensive in carbon than non-traded goods) towards non-traded goods; (iii) a shift in the composition of trade towards less-energy manufactures. For instance for OECD countries around 70% of national income is produced in services and 15-25% in manufacturing. So the potential to use trade policy to shift resources out of manufacturing is limited by the relative size of the traded sector. As pointed out by Dong and Whalley (2009), trade policy to reduce emission intensity which would mainly change the composition of trade would be a third-order effect.

3.1 Emission Transfers through Trade

The Kyoto protocol covering the period 2008-2012 has put a cap on GHGs emitted during the period within countries (including offshore areas over which the country has jurisdiction). The same underlying principle applies to the European emission trading system. This territorial-based accounting system presents a problem as it ignores that countries are physically connected through trade and the place of consumption and the place of production might be very distant. So, just as international trade is often described as the transfer of factor services (e.g. labor abundant countries are usually net exporters of the services of labor), international trade is also a way to transfer externalities between countries, in this case CO_2 emissions. One can thus compute a country's Balance of Emissions Embodied in Trade (BEET, Muradian et al. 2002)[6], often expressed as a percentage of production-based emissions. A positive (negative) BEET means that the country is a net importer (exporter) of CO_2 emissions in its trade bundle. Saying it differently, it consumes more

---

[3] Brewer (2004) gives an early comprehensive discussion of the legality of climate policies at the WTO. De Melo and Mathys (2010, 2011) and Tamiotti (2011) review the uncertain WTO-legality of border measures and conclude that current rules appear inadequate to deal with the leakage issues raised by CO_2 emissions. On the basis of a review of Appellate Body decisions on environmental disputes at the WTO, Horn and Mavroidis (2011) conclude that the WTO regime represents no major obstacle to those aspiring to use border tax adjustments.

[4] Between 1978 and 2000 China multiplied its per capita income by a factor of 8. If it maintains this growth rate, between 2000 and 2050, its per capita income would increase by a factor of 30.

[5] Using difference in difference techniques for Northern European countries that apply carbon taxes (less than \$50/tCO_2), Lin and Li (2011) find a significant negative effect on emissions for Finland, but an insignificant effect for Denmark, Sweden and the Netherlands which suggests that a tax of \$100/tCO_2 may be needed to elicit a significant reduction in emissions.

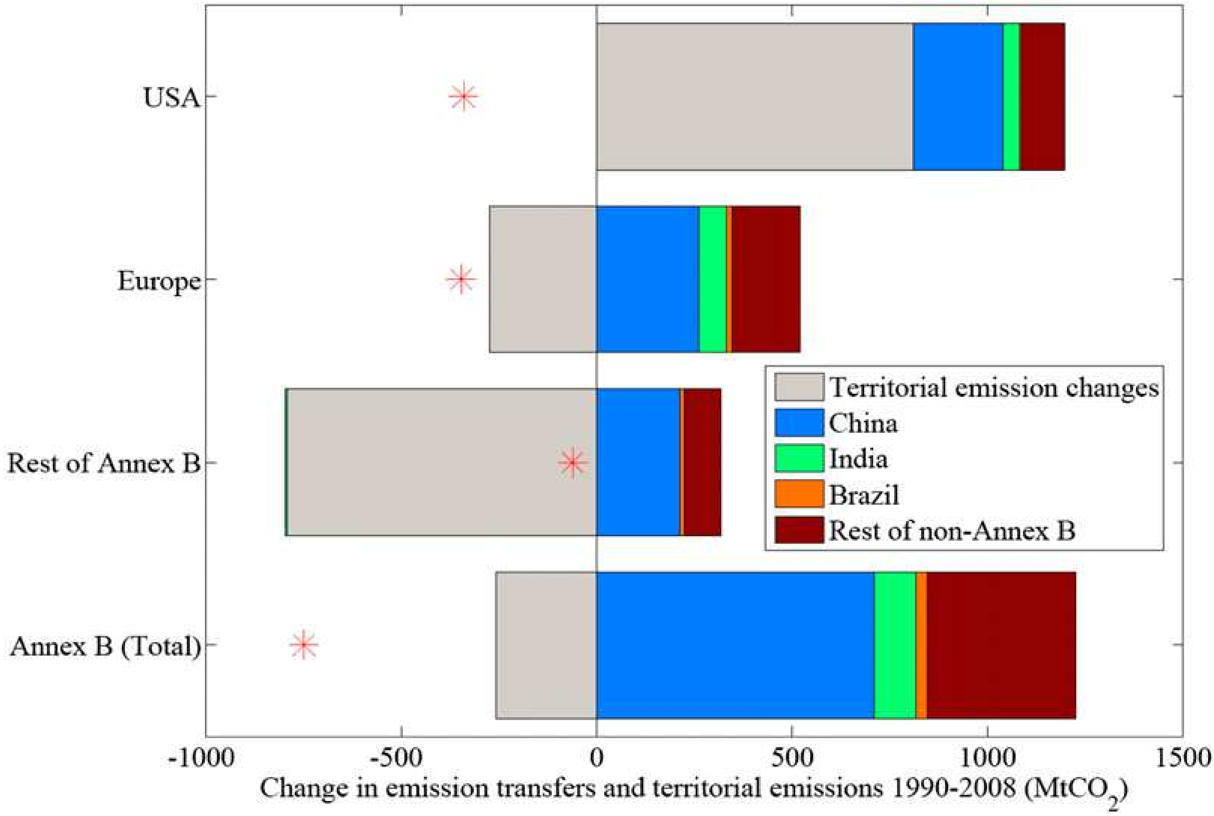
[6] Another metric used is the the pollution terms of trade (Antweiler 1995 and Grether and Mathys 2009).

(less) CO_2 emissions than it produces. Taking into account indirect emissions via inter-industry linkages, international trade and transport make up roughly 23% of production-based emissions in recent years (see Davis and Caldeira 2010).

Drawing on a data base for 113 countries and 57 sectors over the period 1990-2008, Peters et al. (2011) show that emissions from the production of traded goods has grown from 20% to 26% of global emissions implying a relatively large net transfer of emissions through trade. Figure 1 below depicts their estimates (reduction pledges are indicated with stars), broken down for Annex-B countries (developed countries with binding constraints under the KP) and the USA which did not sign the KP (but had pledged to reduce emissions by 7% from 1990 levels before withdrawing).

The United States has increased emissions by 17% and the change in emission transfers with non-Annex B countries (developing countries that did not have a cap on territorial emissions under KP) has additionally supported increased consumption. With a 6% reduction in territorial emissions, Europe is close to meeting its Kyoto Protocol target (-8%). However, the additional net emission transfers from non-Annex B countries are larger than these reductions. The rest of Annex B countries have had a substantial reduction in territorial emissions (−16%), mainly because of the collapse of the Russian Federation and Ukraine in the early 1990s. The total net CO_2 emission reduction of 0.3 Gt CO_2 (3%) in Annex B countries from 1990 to 2008 is much smaller than the additional net emission transfer of 1.2 Gt CO_2 from non-Annex B to Annex B countries.

Figure 1: Net Change in Territorial Emissions (1990-2008)



Source: Peters et al. (2011, figure 3)

Note : Estimates exclude emissions related to land-use change. Annex-B are the developed countries participating under KP. Emission transfers between Annex-B countries have been removed. Europe represents Annex-B EU-27 plus Croatia, Norway, Switzerland. (*) are pledges for reduction under KP (including non-signatory US). See Peters et al. (2011) for corresponding percentage figures. All annex B countries are importers of emissions, mostly from China. Positive changes in transfer values represent net importers of emissions.

The results in the study by Peters et al. (2011) show that a significant and growing share of global emissions are from the production of internationally traded goods and services. International trade thus has adverse unintended consequences for climate policy as feared by environmentalists. Three remarks are noteworthy. First, the UNFCCC territorial-based rules are misleading as developed countries reporting stabilized emissions are not necessarily contributing to a reduction in global emissions. Second, in many cases, increased consumption in Annex-B countries has exceeded reduction in production-related emissions so that, contrary to what is reported in UNFCCC statistics, Annex B countries have continued to contribute to the growth in emissions. This is why a successful treaty should put a cap on the consumption rather than on the production of emissions, as was the case in the MP. Third, developing countries that derive growth from international trade can be expected to continue opposing joining a successor to the KP while developed countries will be likely to apply border taxes.

Indeed, if developed countries put a non-discriminatory carbon tax on all imports, the burden will fall mostly on developing countries. 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 CO_2 is a tax on developing countries. It also explains why, some countries, like China are already starting to tax their exports of CO_2 intensive goods since it is better to collect the tax oneself than hand over the revenue to foreigners.[7]

Given the importance of carbon-intensive exports by developing countries to developed countries, the trade policy lever to bring about compliance can be expected to exert some leverage in bringing about emission reductions in countries like China. Whalley (2011) noted that China, already subject to most Anti-dumping cases at the WTO and to trade actions in safeguards and unilateral trade remedy in the US (section 301/clean technology), might be willing to contemplate more substantial climate mitigation commitments in exchange for firmer disciplines.

3.2 Estimates of Direct Carbon Leakage

The trends in figure 1 show an increasing transfer of CO_2 emissions via trade from developing to developed (i.e. from non-participants to the KP participants). Given that very little has been done to increase the price of carbon among the KP participants (under the ETS, emission permits for carbon have almost continuously been in over-supply - see Morris (2011) for the latest estimates), one can say that these patterns largely reflect demand-driven leakage rather than policy-induced leakage. Direct (or policy-induced) leakage effects (known as the 'pollution haven' effect in the trade and environment literature) occur as a result of mitigation policies to reduce GHG emissions. Emission-intensive industries could simply relocate to countries, where mitigation efforts are less stringent. This effect can take place either through a reallocation of market shares or through increased investment towards unconstrained industries. By increasing the cost of emission-intensive goods through climate policy, the derived demand for carbon intensive inputs (e.g. oil) is reduced, in turn reducing potentially the price of oil on world markets (indirect effect). This indirect effect would also shift comparative advantage towards countries that are not implementing a climate policy. In both cases, the effectiveness of GHG mitigation would be reduced.

Instructive predictions about the likely effects of a rise in the price of carbon can be gleaned by looking at the case of SO_2. Although SO_2 is responsible for acid rain, a regional phenomenon, SO_2 and CO_2 emission intensities are in fact highly correlated across industries. The coefficient of

[7] Since 2007, China has implemented export tariffs ranging from 5 to 25% on carbon-intensive products including iron, steel, coke and cement, thereby diffusing the US intentions of imposing a border tax. See the comment by Hu in Brainard and Sorkin (2009).

correlation is higher than 0.9 for UK industries for the average over 1990-2000 (see also de Melo and Mathys (2011)). Not surprisingly, the same six industries are the main emitters for both gases: petroleum products, pulp and paper, non-ferrous metals, iron and steel, chemicals, building material – cement). These are energy-intensive industries and hence heavy emitters of CO_2. Therefore it is worthwhile to review studies based on "dirty" industries to get a feeling for the likely leakage under potential climate change mitigation policies.

Importantly the more tradable among these sectors are 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 these dirty industries and an aggregate of 'clean' industries and find a consistently higher coefficient for the distance coefficient for dirty industries[8]. This, and the fact that extraction in natural-resource based industries cannot migrate easily, suggests that transport costs would deter relocation of much processing to countries with lower regulation standards.

Other work has also tried to detect pollution-haven effects in the case of SO_2 where national attempts at controlling acid rain could have led to leakage. Using concentration data, Antweiler, Copeland and Taylor (2001), estimate that if an increase in trade openness generates a 1% increase in income and output, then pollution will fall approximately by 1%.

Using emission intensities –which is a more appropriate measure of the pollution content of trade than concentrations of SO_2 in the air--Grether et al. (2010) calculate the pollution content of imports (among other pollutants for SO_2 emissions) at the country level and estimate the relative effect of environmental regulation versus relative factor abundance and other control factors. Differences in environmental regulation and capital endowments are both significant determinants of the pollution content of imports. Their estimates suggest that they cancel each other out, so that the net effect at the world wide-level is small. Insofar as SO_2 is comparable to CO_2, estimates suggest that leakage effects would be small. In addition, reduction in emissions came through the technique effect, pointing towards the (obvious) necessity to develop clean sources of energy in the struggle to mitigate CO_2 emissions.

Simulation-based ex-ante estimates usually produce larger numbers. De Melo and Mathys (2010) review the results from these studies, either industry partial equilibrium or general equilibrium estimates, the latter usually from Multi-Region General Equilibrium (MR-GE) models. Most are concerned either with the leakage rate resulting from the application of a carbon tax or with the efficiency of border tax adjustments (BTA) to dampen leakage. Estimates vary greatly across countries and across sectors. For example, electricity is non-tradable so it will not be subject to direct leakage, although indirect effects are at work. To take another extreme example, aluminum can be considered very tradable in the sense that aluminum products from different origins are

[8] The elasticity is in the range -1.10 to -1.40 except for non-ferrous metals (-.95) while the average for clean industries is -0.82.

very close substitutes--in the limit, aluminum is homogenous like white sugar. Thus switching from the standard imperfect substitution "Armington" assumption universally embodied in GE models to one of perfect substitutes along with increasing returns to scale (rather than a constant returns to scale technology) in an otherwise standard model increases the leakage rate of meeting the KP emission targets in that sector from 20% to over 100%. High leakage rates above 30% are also obtained in linear-programming estimates with a large number of processes when domestic and foreign-produced goods are assumed to be perfect substitutes. Most MR-GE models predict that carbon leakage mainly works through interactions in world energy markets (second channel mentioned above) and that for this channel, the comparison with SO_2 is rather weak (see Gerlagh and Kuik, 2007).

Once one adopts the standard "Armington" imperfect substitute assumption, leakage rate estimates fall substantially. In the MR-GE models, in the absence of a border tax adjustment, estimated leakage rates are in the 10%-20% range. The importance of participation comes out clearly when leakage rates are compared under different participation scenarios. If the EU (or the US) cut emissions individually by 20%, the leakage rate is around 35% but it is only 20% when both cut emissions together.

These models also provide estimates of the effects of border tax adjustments (BTA) to prevent carbon leakage. Estimates suggest that a border tax adjustment will reduce 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 thereby leading it to increase its volume of imports. The models also give estimates of the different BTAs that have been proposed in the political debate. One of the proposals 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. Another proposal would be to tax imports on the basis of the carbon content of imports (US legislation allows to oblige importers to buy emission allowances equivalent to the carbon content of imports). Mattoo et al. (2009), estimate that if industrial countries reduce emissions by 17% without applying a BTA, manufacturing exports by developing countries remain unchanged but 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.

Because so little has happened in terms of raising the price of carbon, we have little ex-post evidence on the effects of climate change policies on trade and on leakage.[9] A notable exception is Aichele and Felbermayr (2010). Drawing on data for 38 countries (26 of which have ratified Kyoto), and 12 sectors over the period 1995-2005, they examine the impact of different climate 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

[9] Ex-post analysis of CO_2 price data for 1999-2006 for the EU ETS did not reveal a structural change in trade flows (Reinaud, 2008). A similar finding was obtained for the refinery sector (Lacombe, 2008).

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.

An open world economy has however an important potential to facilitate technological transfers.[10] Di Maria and van den Werf (2008) and Acemoglu et al (2009) argue that effective long run carbon leakage might be smaller than the results from the above studies, because induced technological change might have a positive effect. Using panel data in a gravity model, Mazzanti and Costantini (2010) analyze the effect of energy and environmental policy in the EU on export dynamics of four sectors over the period 1996-2007. Including patent data, they find that the overall effect of energy policy is not in conflict with export competitiveness. Khanna and Zilberman (2001) find that removing trade policy distortions would increase the adoption of energy efficient technologies at electric power plants in India. Using a political economy framework, Lovely and Popp (2011) study the adoption of regulations limiting emissions of SO_2 at coal-fired power plants in 39 developed and developing countries. They find that increased openness to trade makes it more likely that countries will adopt more stringent environmental regulations because it increases access to cost-reducing abatement technologies and this effect is stronger than pressure from any losses in international competitiveness. However studying the Chinese auto sector Gallagher (2006) finds that new technologies are only adopted if there is indeed an incentive to adopt them, i.e. a corresponding environmental regulation in place.

Overall, these results give some support for the Porter hypothesis (Porter and van der Linde 1995), which states that good designed stricter environmental regulation can have a 'halo' rather than a 'pollution haven' effect by inducing efficiency and encouraging innovation.

4. Final Reflections: Lessons from World Trade for Governing Climate Change

Reflecting on the Rio (1992) climate conference outcome, as the KP was under negotiation, Prime Minister Bruntland said: "We knew the Basic Principles on which to build: cost-effectiveness, equity, joint implementation and comprehensiveness.; but not how to make them operational" (cited in Schmalensee (1998)). Fifteen years later with the KP nearing its end and negotiations for a successor agreement under way, what have we learnt? Certainly one would add that cost-effectiveness has to go beyond flexibility mechanisms: it requires participation and compliance as shown by the success of the MP (see Barrett (2008) and de Melo and Mathys (2010) box 1)). Are there any other lessons for the design of climate-related trade policies from the evolution of the World Trading System, first under the GATT, then under the WTO? Here are a few guiding principles for consideration.

---

[10] Keller (2010) reviews empirical research on the link between trade and technology spillovers and uses a model of FDI, trade, and endogenous technology transfer. He finds evidence for technology spillovers through international trade and the activity of multinational enterprises.

An agreement 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 and, indeed, it is the straightjacket imposed by the Single Undertaking and the Dispute Settlement mechanism under the WTO that has been largely the cause for the stalemate at 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)). If this approach applies to climate policy, 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.

Towards a Green code. In spite of its difficulty of adoption carbon taxes levied on domestic CO_2 emission should be strongly encouraged because of its transparency, its efficiency and its alleviation of compensatory transfers.[11] Likewise, though 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 a carbon tax 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. It is likely however, that this sensible approach would 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.

As to the principles for guiding trade policies, first the most favored nation (MFN) and national treatment (NT) principle would seem to offer the best joint disciplines on the two threats discussed here: carbon tariffs and carbon border taxes. 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 was 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 and the 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).

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 in the EU and US are 'non actionable'. These should be eliminated while subsidies carefully targeted to meet climate

[11] For detailed arguments in favor of a carbon tax see Frankel (2008), Hufbauer et al (2009) and Messerlin (2010).

objectives (e.g. for R&D in clean energy) should be allowed. This will not be an easy task, but it should 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 could still take place in a small group, which would be an easier route than a 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 requires unanimity, would be by-passed.

A Polycentric Approach. Support for an approach with much leeway also comes from the experience of providing public goods at the local and regional levels. Drawing on the extensive experience of the provision of national and environmental public goods, Ostrom (2009) argues that, without denying the global nature of the problem, much progress on climate change can be achieved by actions at multiple scales (the household, the region, the country). Ostrom (2009) argues that this approach is precious in building the trust that is necessary to achieve the collective action that is still so elusive for climate change. In fact, currently all progress is taking place at the local and national levels rather than at the multilateral level. For example, Wheeler and Shome (2010) estimate that India which is seriously considering a goal of 15 percent of renewable energy in its power mix by 2020 could affect the shift from coal-fired plants to renewables at a cost of 50$ billion. They note that India is contemplating this option despite the absence of any meaningful international pressure to cut emissions and no guarantees of compensatory financing, and argue that the government has concluded that it should promote clean power anyway, in order to develop an internationally competitive supplier industry, to bolster energy independence, and to help limit climate change because it will pose dire threats to India itself.

This decentralized approach at the national and regional levels has the advantage of building confidence and it is emerging because we are in a fragmented world with no dominating power able to internalize gains that would result from a climate in which temperature would not rise by more than 2 degrees. The multilateral trading system had easier beginnings as the US was the hegemon that was able to secure the first steps needed to move ahead. The hope is that the multilateral system which has withstood several shocks successfully including the rise of regionalism will be able to do so and contribute to the needed success of emerging climate mitigation policies.

References

> Acemoglu D., Aghion Ph., Bursztyn and D. Hemous (2012), American Economic Review, "The environment and directed technological change", forthcoming.

> Aichele, R. and G. Felbermayr (2012) "Kyoto and the Carbon footprint of Nations", *Journal of Environmental Economics and Management*, forthcoming.

> Antweiler, W., B. Copeland and S. Taylor (2001),"Is Free Trade Good for the Environment? " *American Economic Review*, Vol. 91(4), pp.877-908.

> Antweiler W. (1996),"The Pollution Terms of Trade", *Economic Systems Research*, Vol. 8(4), pp. 361-365.

> Atkinson G., K. Hamilton, G. Ruta and D. van der Mensbrugghe (2010), "Trade in 'Virtual' Carbon", World Bank Policy Research Working Paper 5194.

> Baldwin, R. (2010), "Understanding the GATT's Wins and the WTO's Woes", CEPR Policy Insight #49.

> Balineau, G. and J. de Melo (2011), "Stalemate at the Negotiations on Environmental Goods and Services at the Doha Round", FERDI working paper P28, available at: http://www.ferdi.fr/Documents-de-travail.html

> Barrett, S. (2008), "A Portfolio System of Climate Treaties", Discussion Paper 08-13, Harvard Kennedy School.

> Barrett, S. (2010) "Climate Change and International Trade: Lessons on their Linkage from International Environment Agreements", prepared for the Conference on Climate Change, Trade and Competitiveness: Issues for the WTO, Geneva, 16-18 June 2010.

> Birdsall, N. and A. Subramanian (2009) "Energy Needs and Efficiency, Not Emissions: Re-framing the Climate Change Narrative", World Bank, WP#187.

> Brainard, L. and I. Sorkin (2009), eds. "Climate Change, Trade and Competitiveness: Is a Collision Inevitable?" *Brookings Trade Forum 2008/2009.*

> Brewer T. L. (2004), "The WTO and the Kyoto Protocol: Interaction Issues", Climate Policy, 4 (1), pp. 3-12.

> Copeland, B.R. and M.S. Taylor (2004), "Trade, Growth and the Environment", *Journal of Economic Literature*, Vol. 42, pp. 7-71.

> Davis S. J. and K. Caldeira (2010), "Consumption-based accounting for CO_2 emissions", PNAS early edition, doi:10.1073/pnas.0906974107.

> Dechezleprêtre, A., Glachant M., Hascic I., Johnstone N., and Y. Ménière, (2011), "Invention and transfer of climate change mitigation technologies on a global scale: A study drawing on patent data," *Review of Environmental Economics and Policy*, Vol. 5(1), pp. 109-130.

> Di Maria C. and E. van den Werf (2008), "Carbon leakage revisited: unilateral climate policy with directed technical change", *Environmental and Resource Economics*, Vol.39 (2), pp. 9-15.

> Dong, Y. and J. Whalley (2010) "Carbon, Trade Policy, and Carbon Free Trade Areas", *The World Economy,* Vol. 33(9), pp. 1073-1094.

> Droege S. (2011), "using border measures to address carbon flows", *Climate Policy*, Vol. 11(5), pp. 1191-1201.

> Ederington J., Levinson A. and J. Minier (2005),"Footloose and Pollution-Free", *Review of Economics and Statistics*, Vol. 87 (1), pp. 92-99.

> Frankel, J. (2008), "Global Environmental Policy and Global Trade Policy", DP #08-14, Harvard Project on International Climate Agreements.

> Gallagher, K.S. (2006), "Limits to leapfrogging in energy technologies? Evidence from the Chinese automobile industry," *Energy Policy*, Vol. 34, pp. 383-394.

> Gerlagh R. and O. Kuik (2007), „Carbon Leakage with International Technology spillovers", Nota di Lavoro 33.2007, FEEM.

> Grether J.-M., N.A. Mathys and J. de Melo (2012), "Unravelling the world-wide pollution haven effect", *Journal of International Trade and Economic Development,* Vo. 21(1), pp. 131-162

> Grether, J.-M. and J. de Melo, (2004), "Globalization and dirty industries: Do pollution havens matter?" in R.E. Baldwin and A. Winters eds., *Challenges to Globalization: Analyzing the Economics*, University of Chicago Press, pp. 167-208.

> Grether J.-M. and N.A. Mathys (2009), "Measuring the Pollution Terms of Trade with Technique Effects", mimeo, University of Neuchâtel.

> Horn, H. and P. Mavroidis,(2011), "To B(TA) or not to B(TA): On the Legality and Desirability of Border Tax Adjustments from a Trade Perspective", *The World Economy*, Vol. 34 (11), pp. 1911-1937.

> Hufbauer, G., S. Charnovitz, and J. Kim (2009), *„Global Warming and the World Trading System"*. Washington, DC: Peterson Institute for International Economics.

> Hufbauer, G. and J. Kim (2010) "Climate Change and Trade: Searching for Ways to Avoid a Train Wreck", paper presented at the 2nd TAIT conference, WTO.

> Jayadevappa R. and S. Chhatre (2000), "International trade and environmental quality: a survey", *Ecological Economics*, Vol. 32, pp. 175-194.

> Kellenberg D. K. (2008), "A reexamination of the role of income for the trade and environment debate", *Ecological Economics*, Vol. 68, pp. 106-115.

> Keller, W. (2010) "International Trade, Foreign Direct Investment and Technology Spillovers" in *Handbook of the Economics of Innovation*, edited by B. Hall and N. Rosenberg, Elsevier North-Holland.

> Khanna, M. and D. Zilberman (2001), "Adoption of energy efficient technologies and carbon abatement: the electricity generating sector in India", *Energy Economics*, Vol. 23, pp. 637-658.

> Lacombe R. (2008)," Economic Impact of the European Union Emission Trading Scheme: Evidence from the Refining Sector", MIT Masters Thesis.

> Lin B. and X. Li (2011), "The effect of carbon tax on per capita CO_2 emissions", *Energy Policy*, Vol. 39, pp. 5137-5146.

> Lovely, M. and D. Popp (2011), "Trade, technology and the environment: Does access to technology promote environmental regulation?", *Journal of Environmental Economics and Management*, Vol. 61(1), pp. 16-35.

> Mattoo A. and A. Subramanian (2010), "Equity in Climate Change", Policy Research Working Paper 5383, World Bank.

> Mattoo, A., Subramanian A., D. van der Mensbrugghe and Jianwu He (2009) "Reconciling Climate Change and Trade Policy", World Bank Policy research discussion paper 5123.

> Mazzanti M. and V. Costantini (2010), "On the green side of trade competitiveness?", FEEM working paper 94.

> Melo, J. de, and N. Mathys (2010), "Trade and climate change: the challenges ahead", CEPR DP 8032.

> Melo, J. de and N. Mathys (2011), "Trade and Climate Change Policies after the Crisis" chp. 23 in M. Haddad and Ben Sheperd eds. *Managing Openness: Trade and Outward-Oriented Growth after the Crisis,* The World Bank.

> Mendelsohn, R., A. Dinar and Williams (2006), "The Distributional Impact of Climate Change on Rich and Poor Countries", *Environment and Development Economics*, Vol. 11, pp. 1-20.

> Messerlin P. (2010), "Climate change and trade: from mutual destruction to mutual support", World Bank Policy Research Working Paper, No. 5378.

> Messerlin P. (2011), "Climate, Trade, and Water: A Grand Coalition?" *The World Economy*, Vol. 34 (11), pp. 1883-1910.

> Moore, M. (2010) "Implementing Carbon Tariffs: A Fool's Errand?", World Bank Working paper 5359.

> Morris, D. (2011) "Buckle Up! Tighten the Cap and Avoid the Carbon Crash" at http://www.sandbag.org.uk/site_media/pdfs/reports/Sandbag_2011-07_buckleup.pdf

> Muradian, R.; O'Connor, M.; Martinez-Alier, J. (2002), "Embodied Pollution in Trade: Estimating the 'Environmental Load Displacement' of Industrialized Countries", *Ecological Economics*, Vol. *41*, pp. 51–67.

> Ordás Criado C. and Grether J.-M. (2011), "Convergence in per capita CO_2 Emissions: a Robust Distributional Approach", *Resource and Energy Economics*, Vol. 33(3), pp. 637-665.

> Ostrom, E. (2009), "A Polycentric Approach for Coping with Climate Change", WPS #5095, World Bank.

> Peters G. P, J. Minx, C. Weber, and O Edenhofer (2011), "CO_2 embodied in international trade with implications for global climate policy", Proceedings of the National Academy of Sciences, http://www.pnas.org/content/early/2011/04/19/1006388108

> Porter, M. and C. van der Linde (1995), "Towards a New Conception of the Environmental-Competitiveness Relationship", *Journal of Economic Perspectives*, Vol. 9, pp. 97-118.

> Reinaud J. (2009), "Trade, competitiveness and carbon leakage: challenges and opportunities", Energy, Environment and Development Programme Paper 09/01.

> Schmalensee R. (1998), "Greenhouse Policy Architecture and Institutions", in William D.

> Schmid, G. (2011), "Technology Transfer in the CDM: The Role of Host-Country Characteristics", WPS 11102, University of Geneva.

> Spence, M. (2009), "Climate Change, Mitigation, and Developing Country Growth", WP#64, Commission on Growth and Development.

> Tamiotti L. (2011), "The legal interface between carbon border measures and trade rules", *Climate Policy*, Vol. 11 (5), pp. 1202-1211.

> Whalley, J. (2011) "What Role for Trade in a Post 2012 Global Climate Policy Regime", *The World Economy*, Vol. 34 (11), pp. 1844-1862.

> Wheeler D. and S. Shome (2010), "Less smoke, more mirrors: where India really stands on solar power and other renewables", Working Paper No. 204, Center for Global Development, Washington, D.C.

> World Bank (2007), "Warming up to Trade? Harnessing international trade to support climate change objectives", The World Bank, Washington, DC.

> World Bank (2008), "International Trade and Climate Change: Economic, Legal, and Institutional Experiences", The Word Bank, Washington DC.

> WTO-UNEP (2009), "Trade and Climate Change", WTO Secretariat, Geneva.

FERDI

Créée en 2003, la **Fondation pour les études et recherches sur le développement international** vise à favoriser la compréhension du développement économique international et des politiques qui l'influencent.

Contact
www.ferdi.fr
contact@ferdi.fr
+33 (0)4 73 17 75 30