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Trade Policy to Control Climate Change: Does the Stick Beat the Carrot?

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Summary: Trade and climate change policies are closely related. We consider in a general equilibrium model the role of trade restrictions and energy-efficient technology transfers for the stabilisation of the Kyoto climate coalition. We find that a trade restriction policy leads to economic losses for a large number of countries and would not be suited to convince the United States to return to the Kyoto Protocol. The technology transaction via trade, however, induces major positive economic effects for participating economies as well as considerable reductions in emissions. Therefore, the claim that trade restrictions should be used as a stick to force countries to cooperate in climate change control is not supported in this study. Rather, the benefits of R&D spill-overs should be used as an incentive to promote participation.

Zusammenfassung: Internationaler Handel und Klimapolitik sind eng miteinander verknüpft. Mithilfe eines allgemeinen Gleichgewichtsmodells untersuchen wir, welche Rolle Handelseinschränkungen sowie Transfers von energieeffizienten technischen Innovationen für die Stabilisierung der Klimapolitik unter dem Kyoto-Protokoll spielen können. Handelseinschränkungen führen zu einer Verschlechterung der Handelsbilanz für die Mehrzahl der Länder und Regionen weltweit. Sie sind daher nicht geeignet, die USA zu einer Rückkehr in die Klimakoalition zu bewegen. Der Transfer neuer Technologien führt hingegen zu positiven ökonomischen Effekten in den beteiligten Ländern und darüber hinaus reduziert er auch stärker die Emissionen. Die Forderung, Klimaschutz durch Handelsrestriktionen zu erzwingen, kann somit nicht unterstützt werden. Vielmehr sollten technologische Kooperationen als Anreiz eingesetzt werden.

1 Introduction

The links between climate change policy measures and international trade policy have been the subject of detailed analyses and discussions (see e.g. Brack 1997, Brack et al. 2000, Buck and Verheyen 2001). An important aspect is how trade and climate change policies could be designed and managed to become mutually beneficial. This issue is also part of the current Doha-Round agenda of the World Trade Organization (WTO) because WTO members need to clarify the relationship between trade rules in multilateral environmental agreements and the obligations under world trade law as administered by the WTO.[1] Our paper focuses on climate-related trade policies, i.e. on trade measures as a means to implement and enforce climate protection as agreed upon in the Kyoto Protocol

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1 For the relationship between MEAs and WTO rules, the Doha Declaration (2001) states the following: "31. With a view to enhancing the mutual supportiveness of trade and environment, we agree to negotiations, without prejudging their outcome, on: (i) the relationship between existing WTO rules and specific trade obligations set out in multilateral environmental agreements (MEAs). The negotiations shall be limited in scope to the applicability of such existing WTO rules as among parties to the MEA in question. The negotiations shall not prejudice the WTO rights of any Member that is not a party to the MEA in question."

(1997). Our major question is whether trade policy should be used to contribute to international climate control and how it compares in terms of economic costs to R&D transfers.

The Kyoto Protocol (1997) aims at a global reduction of greenhouse gas (GHG) emissions. Preceding the Russian ratification of the Kyoto Protocol in November 2004, the complete withdrawal of the U.S. in 2001 had endangered the coming into force of the agreement. This conflict had pronounced the diverging national interests, the different judgements and the different levels of risk aversion within the group of industrialised countries, who are the major emitters of GHGs, as well as between industrialised and developing countries. The international agreement on fighting climate change suffers from free riding incentives. While the signatories to the Kyoto Protocol form a climate coalition, all other emitters can profit from the coalitions' efforts without bearing abatement costs. The United States, who have the largest share in world-wide GHG-emissions, claim to avoid considerable economic costs by not joining the Kyoto Protocol (Bush 2002). Therefore, the additional incentives, including trade restrictions, which could help stabilise and increase the climate coalition have been subject to a large number of analyses (see e.g. Carraro 1997, Barrett 2003, Kemfert 2004). We add to this literature by analysing the terms of trade effects from trade restrictions, such as general trade cuts, specific trade restrictions and trade-induced R&D transfers using the General Equilibrium Model WIAGEM. The WIAGEM model is an integrated assessment model that couples a general equilibrium model of the global economies with a climate model and an ecological impact model (Kemfert 2002a, Kemfert 2002b). Especially, we look at the incentive that trade measures yield for the United States to return to the Kyoto climate coalition.

We find that general trade cuts lead to lower emissions, but would affect very unevenly the different world regions, due to the diverse import and export shares. On the other hand, an increase in environmental technology trade, especially the inflow of energy efficient investment into China, Latin America, Asia[2] and Sub-Saharan Africa, could positively affect the terms of trade of these regions via a self-enforcing process. Moreover, introduction of trade restrictions for U.S. imports imposed by members of the Kyoto coalition does not offer the necessary “stick” to make the U.S. return to the Kyoto Protocol. Using the R&D “carrot” instead yields by far the better results in economic terms but also with respect to emissions.

The next chapter discusses the relationship between trade and climate change including the legal aspects of WTO-rules and climate policy rules as laid out in the Kyoto Protocol. We calculate terms of trade effects from trade restrictions and from R&D trade for the Kyoto climate coalition in chapter 3. In chapter 4 we briefly highlight the current legal issues arising under the WTO regime for climate-related trade measures. Chapter 5 concludes by discussing the institutional and political aspects of the policy approaches.

2 Without China.

2 Trade and Climate Change

2.1 How Are They Related?

The debate about trade and climate change is part of the discussion on trade and environment which set off in the early 1990s (Esty 1994). At least six aspects have been identified, which characterize the impact that trade and investment have on emissions. First, there are *scale effects*. Trade and investment liberalization have led to considerable economic growth world-wide during the last decades. This development has been leading to increased resource utilization, emissions – not least from surging transport activities – and other environmental damages.[3] Second, the lowering or full abolishment of trade barriers, such as tariffs, quotas and non-tariff barriers, has widened the markets for producers leading to *structural effects*. These are important for a country's resource demands, and changes in production structures are directly related to emissions. Third, liberalization also entails new consumption possibilities, known as *product effects*, which determine emissions of firms and households. Fourth, trade allows the access to new technologies (*technology effect*), which is most important for the diffusion of energy-efficient production methods world-wide. Fifth, there is always a *distribution effect*, which summarizes the impact of changes in production and consumption on incomes and on the environment (Brack and Branczik 2004). And last, but not least, we add the *regulatory effect*. It includes all changes in national policies which precede or follow free trade, e.g. taxing and subsidization, environmental regulation. A well-known negative example is the reduction of environmental standards due to international competition, coined as "environmental dumping".

All these effects could have negative as well as positive consequences for GHG emissions (e.g. Galeotti and Kemfert 2004). As trade is not an end in itself but rather acts as an amplifier of national and international policy measures, it strongly depends on the actual national climate policy whether trade liberalization or trade restrictions work in favor of or against climate change. Currently, given the failure in many countries to stabilize or even to reduce emissions, and other pollution caused by economic expansion, the net effect of liberalisation must be expected to be negative. This expectation motivates a number of restrictive trade policy suggestions. They include countervailing tariffs for products from countries with lax emission standards, border tax adjustments for emission-intensive production methods, and trade bans against non-compliants of the Kyoto Protocol as a political means to make them enter the coalition.

The expectation of a negative net effect, moreover, must not override the potential and actual positive effects from the abolishment of specific barriers to trade. First, subsidies, in particular subsidies for coal extraction, can contribute to GHG emissions by lowering market prices domestically, but also internationally. Subsidies by large countries (e.g. the U.S.) distort world market prices and lead to overexploitation of natural resources (other examples are the fisheries and agricultural sectors). Thus, the abolishment of these subsidies ranks high on the environmental policy agenda. Second, diffusion of technological innovations play an important role in climate control policies and this needs support from trade and investment rules. Moreover, innovative technologies and FDI could create new

3 The debate about growth and emissions is held in the environmental Kuznets curves literature. See e.g. Müller-Fürstenberger et al. (2004).

markets and increase national competitiveness (Brewer and Young 1998, 2002). The transfer of technological innovations to developing countries could boost markets for low emission technologies (Esty and Gentry 1997). Among the factors that stimulate technological innovations are national climate policy measures, including product standards on energy saving or energy efficiency, as well as production standards or tax incentives to use carbon-free and more energy-efficient technologies. The effectiveness of these policy approaches could be supported by free trade and investment flows which enhance their application world-wide.

2.2 Scenario Simulations

2.2.1 The Tool

In this study, we highlight the scale effect as well as the technological effect using the general equilibrium model WIAGEM. WIAGEM is an integrated assessment model merging an economy model, based on a dynamic inter-temporal general equilibrium approach, with an energy market model and climate sub-model. The global economy is aggregated into 11 trading regions. The economy of each region is disaggregated into 14 sectors, including five energy sectors: coal, natural gas, crude oil, petroleum and coal products, and electricity. Fossil fuels are produced from fuel-specific resources. Goods are produced for the domestic and the export market. The output of the non-energy sectors is aggregated into a non-energy macro good. The production function for this macro good incorporates technology through transformation possibilities on the output side and constant elasticity substitution (CES) possibilities on the input side. The CES production structure combines a nested energy composite with a capital-labor-land composite at lower levels. The energy-capital-labor-land composite is combined with material inputs to get the total output.

A representative household in each region allocates lifetime income across consumption in different time periods to maximize lifetime utility. In each period, households choose between current consumption and future consumption, which can be purchased via savings. The trade-off between current consumption and savings is given by a constant intertemporal elasticity of substitution. Domestic and imported varieties of the non-energy macro good are imperfect substitutes in each region as specified by a CES Armington aggregation function constrained by constant elasticities of substitution.

Producers invest as long as the marginal return on investment equals the marginal cost of capital formation. The rates of return are determined by a uniform and endogenous world interest rate such that the marginal productivity of a unit of investment and a unit of consumption is equalized within and across regions.

Technological change is determined endogenously. Energy productivity in the CES production function is endogenously influenced by changes in R&D expenditures. Increased R&D spending provides a comparative advantage for a region and enables emission reduction targets to be met with less loss of output. Investment in R&D competes with other expenditures (crowding out) and it is endogenously determined by production changes. Technological innovations have spill-over effects through trade and capital flows. Countries that do not cooperate in R&D can benefit from these spill-over effects.

In addition to the macro good, also oil, coal and gas are traded internationally. The global oil market is characterized by imperfect competition to reflect the ability of the OPEC members to use their market power to influence the market price. Coal is traded in a competitive global market and gas is traded in competitive regional markets with prices determined by supply and demand in the relevant global or regional markets.

Energy-related greenhouse gas emissions occur as a result of economic and energy consumption, as well as production activities. The model includes three of the greenhouse gases covered by the Kyoto Protocol: carbon dioxide (CO_2), methane (CH_4) and nitrous dioxide (N_2O). These gases are considered to have the most influence on climate change over the 50 year period covered by the model, so inclusion of the remaining gases is not believed to have a substantial impact on the analyses. In order to identify the major effects of trade and R&D on the economies and on low emission technology, we shortly demonstrate the scale and the technological dimensions. In section 3 we then focus on the linkage and coalition formation.

2.2.2 Simulation of Scale Effects

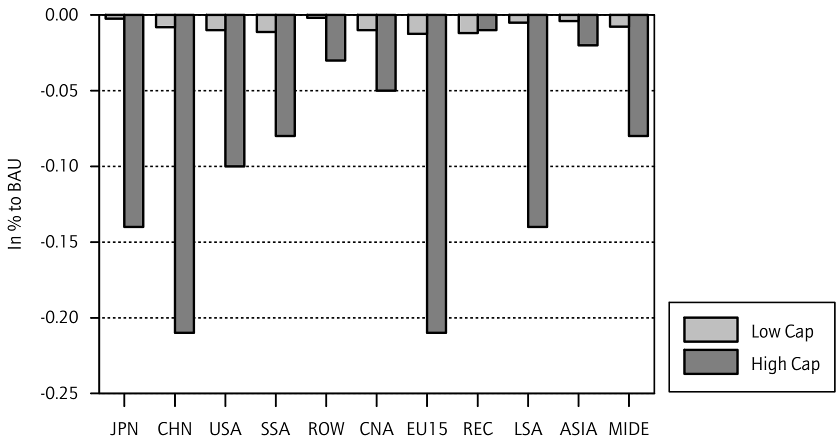
If one would consider to reduce world-wide trade in order to reverse the growth-driven emissions, the various world regions would be negatively affected in economic terms. The economic effects can be measured in a change of the terms of trade (ToT). ToT describe the relationship between a country's exports and its imports using current prices. An increase in the ToT can be caused by higher export or by lower import prices. If, for example, export prices increase at a faster rate than import prices, a country faces an increase in its ToT. A negative development of the ToT indicates a welfare loss, because a country has to export more products in order to pay for its imports.

If trade is reduced by a low (5%) and by a high amount (15%) in the global international trade model, we find the following results (see figure 1): Rapidly growing regions like China and Latin South America (LSA) would face high welfare losses. Their ToT would worsen compared to a business-as-usual (BAU) situation. Regions with a high export share like the EU and Japan would face higher ToT reductions than e.g. the United States. A reduction in trade activities leads to lower emissions in all world regions.

2.2.3 Simulation of Technological Effect

Moreover, we are interested in the effects on ToT and emissions if trade and foreign direct investment in environmentally friendly technologies increase. We also assume that technological transfers induce a self-enforcing investment process in the recipient countries. Our calculations yield that the transfer of low emission technologies to China, Asia, Latin America, and Sub-Saharan Africa helps stimulate investment that augments the energy efficiency in these countries. Benefits from such a process could become significant for the ToT, depending on a country's development status and specialization in production. This process also leads to a rise in the share of new and less carbon intensive technologies. Figure 2 shows the share of regionally applied carbon-free technologies in five regions until 2050 if a self enforcing process is assumed.

Figure 1
Terms of Trade Impacts Through Trade Caps



JPN = Japan, CHN = China, SSA = South-Saharan Africa, ROW = Rest of the World, CAN = Canada, REC = Russia & Eastern European Countries, LSA = Latin South America, ASIA = Asia, MIDE = Middle East.

Source: Simulation with the model WIAGEM.

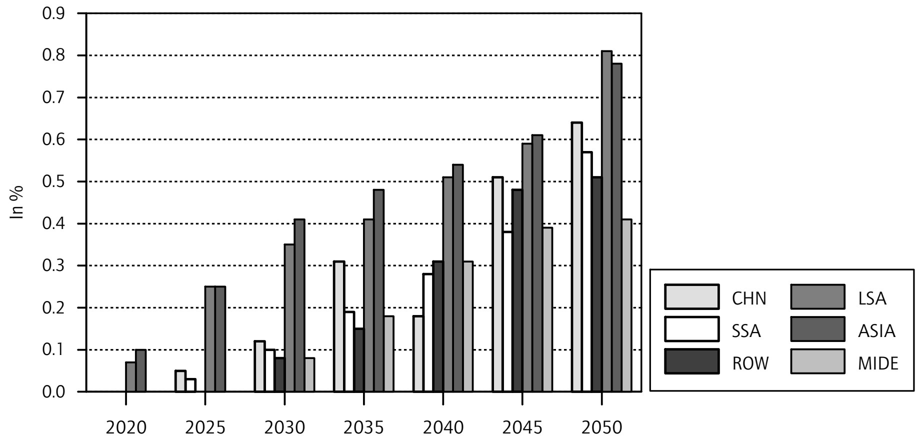
We find that there are substantial technology transfer impacts from developed to developing nations. As developed nations invest in R&D expenditures to improve energy efficiency of technologies, also developing nations as sub Saharan Africa and Asia, benefit from the technology spill-over effects. More importantly we find that the transfer of carbon-free technologies to fast growing developing but also to least developed countries has a considerable impact on future emissions, because it would stimulate the application of cleaner technologies in general. This delivers a strong argument in favor of intensification of trade relations and policies that intend to improve technological knowledge in order to make them environmentally beneficial.

3 **Stabilization of Climate Coalitions**

We turn now to using trade restrictions as a political means to make a free-riding country join a climate coalition. The largest free-rider is the United States who have left the Kyoto process in 2001. The idea to integrate global environmental policy and trade policies has been subject to intensive discussions in the game theoretic literature under the heading of “issue linkage” (e.g. Carraro and Siniscalco 1995, Barrett 2003). Issue linkage describes a setting were incentives to cooperate on one policy issue are increased by introducing another topic. As the international protection of the climate shows the characteristics of a global public good, and as there is no international institution that could actually enforce or implement climate protection, the combination of climate-related measures with policy measures that generate a measurable economic impact is highly relevant.

Figure 2

Share of Regional Applied Carbon-Free Technologies



Source: Simulation with the model WIAGEM.

Following the actual situation in international climate policy, we investigate the impact of climate-related trade restrictions on coalition formation incentives (see e.g. Carraro 1997, Finus 2001). By creating coalitions or cooperation alliances which maximize the benefits from both, trade and environmental policy measures, countries can try to avoid negative welfare effects that could come along with separate actions. The Kyoto negotiation process confirms that individual countries are mainly concerned about potential economic disadvantages from emissions reduction, not about the economic consequences of their inaction. The United States withdrew from the Kyoto Process in 2001, arguing with high national costs and low effectiveness of the Kyoto coalition (Bush 2001). Maximization of national welfare can lead to unilateral operations, or to a formation of small coalitions or to free riding. Whether a stable coalition can be reached depends on the opportunities to reduce conflicts, e.g. by finding a minimum agreement.

We compare two scenarios, the TRADE RESTRICTION and the R&D scenario, with a BASE CASE, in which countries follow the Kyoto Protocol (Annex B regions Europe EU, Japan JPN, Russia REC, Canada CAN). In the TRADE RESTRICTIONS scenario the climate coalition decides to install import tariffs against the non-cooperating United States.[4] In the BASE CASE, emission reduction countries act according to the Kyoto Protocol, i.e. Annex B parties' emission limitation of 3,112 Mt C in the first commitment period are carried forward until 2050, while the U.S. is assumed to follow its 10 years intensity target[5] of 18% up to 2050. The use of sinks is allowed following the Marrakesh Accords.[6] Emission permits are traded among countries and Russia is assumed to follow a strategic restriction in emission allowances of 50% of their surplus in the commitment period. The base case leads to a net cost for the Kyoto Protocol Parties and to a net benefit for the U.S.

4 We model import tariffs as percentage restriction (30%) on all imports from the USA.

The developing countries who have no emission limitation, nevertheless suffer from economic consequences that arise in the Annex B countries, especially from a reduction in trade, and from general trade effects stemming from a lower economic activity in the Annex B countries.

In the TRADE RESTRICTION scenario, the climate control coalition imposes border tax adjustments on imports from the United States. We model BTA as a percentage restriction on all imports. This policy option is also discussed by Biermann and Brohm (2005) in this volume as an option for the European Union's climate policy. Border tax adjustments can be deemed as necessary, because the WTO members follow the *destination* principle which stipulates that goods should be taxed in the country where they are consumed (Biermann and Brohm 2005, Dröge et al. 2004: 176).[7] If now a country follows a climate protection policy, for instance by imposing national CO_2-taxes, it can impose this tax also to imports. We are interested in whether or not these trade restrictions work as a penalty (or "stick") to bring the U.S. back to the climate coalition. In this scenario, there are also "other measures" (production and product standards, eco-labels) which promote GHG-reduction, and which also yield potential trade effects (including trade diversion and trade reduction). These "other measures" are reflected in a 10% decline in emission intensity of products in 2010 as well as in the Armington elasticities, which are adjusted in order to reflect a higher preference for domestic products as well as for products from other Kyoto Protocol parties. No adjustments are made for the following periods.

Next we compare the trade restriction option with the effects generated by R&D measures. We assume that the members of the climate control coalition plus the non-coalition member United States cooperate on R&D (R&D USA). This helps to assess whether R&D could lead to a stricter emission target in the U.S. and accordingly this could function as a carrot to make the U.S. cooperate in global climate policy. Technological cooperation is not stipulated in the Kyoto Protocol. Nevertheless we consider this option, because it is contributing to reducing the costs of emission reduction.

Figure 3 shows for 12 regions and countries how the import tariff and the R&D transfer would affect the ToT. This is expressed in percentage change compared to the BASE CASE. The TRADE RESTRICTIONS would lead to inferior ToT in a majority of countries, but to a small degree, while for Russia the ToT would decrease the most. This is because Russia highly depends on the trade relations in the area of fossil fuel, for example gas exports. The U.S. will increase imports, especially from Russia. If these trade flows are restricted, substantial negative economic impacts arise. An increase can only be stated for the rest of the world (ROW). The most important result of this scenario is that trade restrictions motivated by a "stick" policy do not induce the U.S. to return to any climate policy game. Rather, this approach harms considerably all world regions. Moreover, trade re-

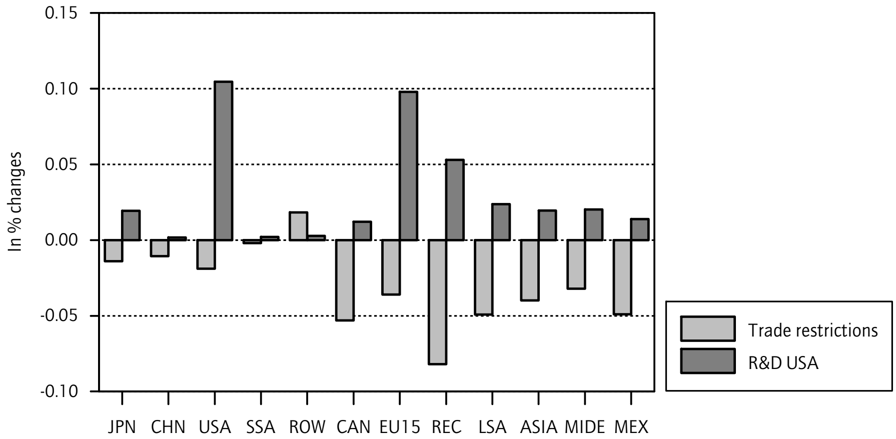
5 The US intensity target denotes a reduction in greenhouse gas intensity of the U.S. economy by 18% by 2012. GHG intensity measures the ratio of (GHG) emissions to economic output, i.e. focusing on reducing the growth of GHG emissions. In efficiency terms, the 183 tons of emissions per million dollars GDP that the US emitted in 2002 is supposed to be lowered to 151 tons per million dollars GDP in 2012 (see *www.whitehouse.gov*).

6 The Marrakesh Accords (2001) foresee full use of sinks in Annex B parties plus 1% of the Annex B base year emissions for afforestation and reforestation in developing countries.

7 Border tax adjustments would be redundant if the origin principle would be applied by all trading partners which stipulates that goods must be taxed in the country where they were produced.

Figure 3

Terms of Trade Changes in Comparison to the Base Case



Source: Simulation with the model WIAGEM.

strictions do not only harm the non-cooperating, but also the cooperating nations. Thus, the total effect is negative.

The R&D cooperation among Annex B parties reduces the compliance costs and raises the benefits to Central and Eastern European countries compared to the BASE CASE. Central and Eastern Europe saves not only compliance costs but has also higher revenues from permit sales. Especially the U.S. benefit form an R&D cooperation policy as there are high positive terms of trade effects. If however, some Annex B countries prefer to cooperate on R&D with the U.S. instead of sanctioning this cooperation, the R&D strategy will not be successful.

We have also calculated the permit prices for the trade restriction and R&D scenarios. Figure 4 shows the results with respect to a time scale for the ten year periods 2010 up to 2050.

The effects on emissions (in Mill t C) in 2010 are shown in figure 5. The TRADE RESTRICTIONS scenario would yield lower emissions than the BASE CASE. This is caused by lower production and by welfare losses. However, the largest effect on emission reduction can be expected from the transfer in energy efficient technology, the R&D scenario. This can be explained by the fact that countries invest in R&D which improve energy efficiency and thus take advantage of less cost-intensive options to reduce GHG emissions. In other words, R&D spending substantially reduces abatement costs so that a climate target can be reached at lower cost. Accordingly, terms of trade reductions are lower and reduction in total GHG emissions are higher than in the trade restriction scenario.

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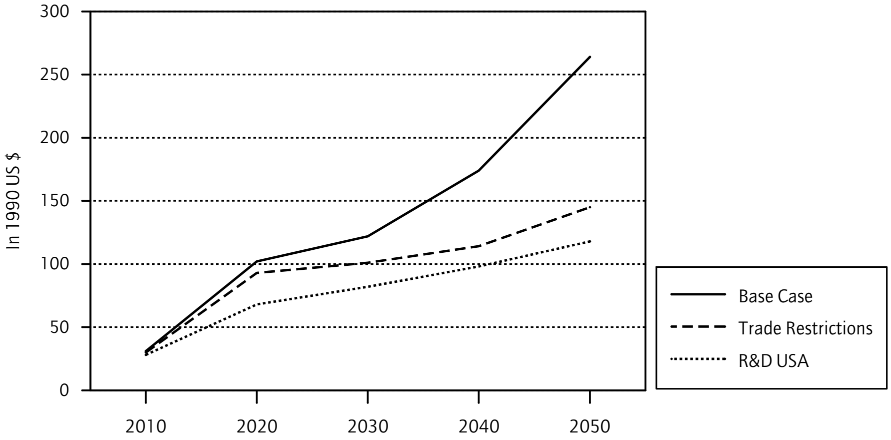
Figure 4

Emissions Permit Prices in Different Scenarios



Source: Simulation with the model WIAGEM.

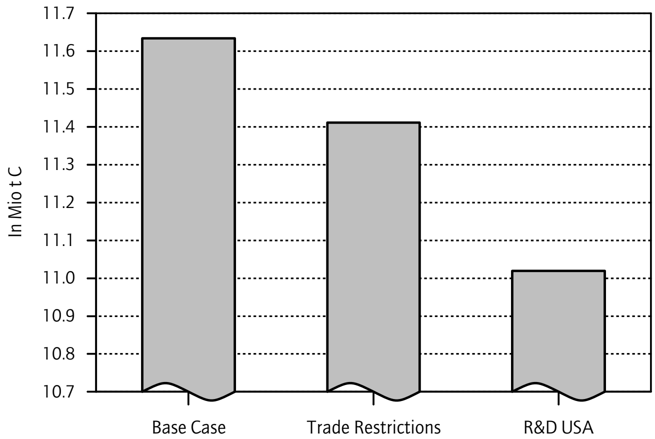
4 WTO Rules and Climate Change Policy

The idea of imposing climate-related trade restriction is tempting and – if we consider the calculations shown above – could yield desirable results from the international climate policy point of view. However, it is not only the investigation of economic costs and alternative approaches – like R&D transfer – that could establish a counter-argument to the idea of restrictive climate-related trade measures. These measures must also be discussed and evaluated in the light of international policy and law. The legal framework of the WTO that stipulates, amongst others, rules for trade in goods (GATT) and services (GATS), does not embody any particular rules on how to treat climate control measures that affect trade relations. Instead, the GATT and other side agreements foresee general clauses which allow for exceptions from the free trade rules. E.g. Article XX (b) GATT allows for measures which are deemed necessary to protect human, animal or plant life and health, and Article XX (g) allows for measures relating to the conservation of exhaustible natural resources, both subject to a number of conditions.

Currently under discussion, and part of the Doha Mandate, is the relationship between multilateral environmental agreements (MEAs) and WTO rules. The WTO Ministerial declaration, adopted on 14 November 2001 at Doha (Doha Declaration), stipulates with respect to trade and environment that certain aspects of the WTO-MEA relationship should be subject to ongoing negotiations. Especially, members agreed to clarify the relationship between the specific trade obligations contained in MEAs and WTO rules. This excludes conflicts with Non-MEA-parties, because WTO members did not want the negotiations to alter their WTO rights and obligations with respect to MEAs to which they are not a party of.

Figure 5

Total Emissions of Different Scenarios



Source: Simulation with the model WIAGEM.

Some multilateral environmental agreements (MEAs) including the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES 1973), the Montreal Protocol (1987) and the Basel Convention (1989), define trade measures, usually against non-coalition countries. The Montreal Protocol also allows for trade restrictions between parties on goods made with, but not containing, ozone-depleting substances. So far, no trade measure taken pursuant to an MEA has been challenged in the WTO by a non-party. The Kyoto Protocol does not include explicit trade measures, but the national climate policy instruments certainly have trade implications, and, moreover, trade measures could be attractive to enforce climate policy. Currently, 70% of the WTO members are also a member to the Kyoto Protocol (Althammer and Dröge 2003). There is, however, a chill factor of WTO rules for climate-related trade measures, because the U.S. have not ratified the Kyoto Protocol but are a WTO member. Representing a large trading nation, the U.S. can use WTO law to fend off attempts by the climate coalition members to enforce the Kyoto policy goals via direct trade restrictions or trade-restrictive national tools.

National climate-related trade measures which could become subject to application of WTO rules include carbon taxes and related border tax adjustment (BTA), product standards, labeling schemes, subsidies (e.g. for carbon reduction), and green government procurement. Usually, the investigation of their legality has two dimensions. First, some measures are part of the WTO-rules, i.e. they are allowed if the user follows the WTO rules. This holds, e.g. for BTA. Second, if a trade measure is not allowed, the WTO exceptions could be applicable. Several authors conducted a thorough analysis of climate-related trade measures and their relationship to current WTO law (Brack et al. 2000, Buck and Verheyen 2001, Dröge et al. 2004, Biermann and Brohm 2005). They conclude that trade measures which discriminate against goods or services from non-coalition nations are very likely to be incompatible with WTO law. There are, accordingly, two contrary forces.

On the one hand, the U.S. represents a large trading partner. They can exert a climate-policy chill by announcing a claim under WTO dispute settlement, in case climate-related trade measures would be applied by the climate coalition, whose legality is ambiguous. On the other hand, the economic effects of measures which are allowed under WTO law can exert pressure on countries falling behind on climate change. For instance, as discussed by Biermann and Brohm in this volume, the U.S. itself used border tax adjustments, which are allowed under WTO law for certain environmental taxes or charges on products, in order to accompany the Montreal Protocol on Substances that Deplete the Ozone Layer (Montreal Protocol, 1987). BTA was applied to the Ozone-depleting Chemical Tax (ODC tax). This tax addressed physically incorporated inputs of a product as well as substances applied in the production process that were not physically incorporated in the final product (Brack et al. 2000). The ODC tax has not been claimed violating the GATT or WTO rules by any WTO member country to date.

The findings about the national instruments for climate protection can be summarized as follows (Buck and Verheyen 2001, Biermann and Brohm 2003, Dröge et al. 2004). It is fully compatible with WTO law to apply

- product standards (e.g. energy efficiency) in a non-discriminatory way on imported and domestic "like" products,
- procurement programs developed and implemented in the context of an MEA, even if they include technical specifications based on processes and production methods (PPMs).

Compatibility is given but limited due to a number of criteria and exemptions in case of

- border tax adjustments for certain environmental taxes or charges on products, and
- financial incentives like subsidies.

Qualifications in compatibility, however, apply to

- eco-labeling schemes which consider non-product-related environmental impacts of products, and
- other climate-related trade restrictions based on PPMs (e.g. trade bans or sanctions).

In order to apply the latter types of measures, one needs to draw on the exception clauses to justify them under the provisions of the GATT. One important criterion for an exception could be that measures have been agreed to and negotiated on a multilateral basis. This issue is part of the negotiations under the Doha Mandate as described above and should be treated as highly relevant given the surging need to protect the global climate.

5 Conclusions

Trade and climate change policies could be designed and managed to become mutually beneficial. The Kyoto Protocol has come into force without participation of the United States, who are one of the largest trading economies and the largest contributor to the GHG problem. In our study we have investigated two major issues by calculating a trade restriction and an R&D transfer scenario using the WIAGEM general equilibrium model.

First, we have evaluated the effects that trade restrictions, namely import tariffs, for goods from the United States could have on the world-wide terms of trade and on emissions. Second, we have also considered the transfer of R&D and the relevant spill-over effects. Both scenarios were evaluated with respect to the incentives they yield for a cooperative behaviour by the U.S. We found that in our model trade restrictions cannot be used as a "stick" to force the U.S. to join the climate coalition. Our calculations show that the economic effects are not desirable, as terms of trade decrease in nearly all major countries and regions. Thus, trade restrictions suffer from a credibility problem. This effect is partly excluded in case where R&D exchange is fostered as a “carrot” instead. The credibility problem would prevail though, if some countries prefer to cooperate with the U.S. on R&D instead of cooperating with the climate coalition. Moreover, R&D transfer outperforms trade restrictions in emission reduction.

We also find, that the legal problems under WTO law are currently a major problem to enforce climate policy using restrictive trade measures. Attempts to impose trade restrictions as modelled in the trade restriction scenario can be challenged by the U.S. before the WTO dispute settlement bodies. However, one also needs to consider that a large number of national climate change policy tools are fully compatible with WTO law. National climate policy measures implemented by the Kyoto coalition will also have impacts on international trade relations. A major step in order to make trade and climate change policies mutually reinforcing is to clarify the relationship of climate-related multilateral trade measures and those exemptions that WTO law allows for environmental purposes. This is hampered, because non-parties to MEAs do not want the Doha negotiations to alter their WTO rights and obligations. This means that as long as the U.S. stays outside the Kyoto coalition the application of WTO rules by the U.S. could exert a chill on national climate-related measures which affect trade flows. Thus, cooperation with the U.S. should be further strived for, because only this will guarantee a successful global climate control policy.

References

Althammer, W. and S. Dröge (2003): Trade and Environment: The Real Conflicts. In: L. Marsiliani, M. Rauscher and C. Withagen (eds.): *Environmental Policy in an International Perspective*. Dordrecht, Kluwer, 151–172.

Barrett, Scott (2003): *Environment and Statecraft*. Oxford, Oxford University Press.

Biermann, F. and R. Brohm (2005): Border Adjustments on Energy Taxes: A Possible Tool for European Policymakers in Implementing the Kyoto Protocol? In this journal, pp. 249–258.

Biermann, F. and R. Brohm (2003): *Implementing the Kyoto Protocol without the United States. The Strategic Role of Energy Tax Adjustments at the Border*. Global Governance Working Paper No. 5. Potsdam, Berlin, Oldenburg. Download under: *www.glogov.org*

Brack, Duncan (1997): *Trade and Environment: Conflict or Compatibility*? Proceedings of the Royal Institute of International Affairs conference, Chatham House. London, Earthscan.

Brack, D. and T. Branczik. (2004): *Trade and Environment in the WTO: After Cancún*. The Royal Institute of International Affairs, Briefing Paper No. 9. London.

Brack, Duncan, Michael Grubb and Craig Windram (2000): *International Trade and Climate Change Policies*. London, Earthscan.

Brewer, T. and S. Young (1998): Investment Issues at the WTO: The Architecture of Rules and the Settlement of Disputes. *Journal of International Economic Law*, 1 (3), 457–470.

Brewer, T. and S. Young. (2002): Location Determinants of multinational Firms: The Effects on Firms' Strategic Choices of the WTO Trade-Investment Regime. In: J.H. Dunning and J.-L. Mucchielli (eds.): *Multinational Firms: The Global-Local Dilemma*. London, Routledge, 18–32.

Buck, M. and R. Verheyen (2001): *International Trade Law and Climate Change – A Positive Way Forward*. FES-Analyse, July 2001, Friedrich-Ebert-Stiftung, Bonn.

Bush (2001): *www.whitehouse.gov/news/releases/2001/03/20010314.html*

Bush (2002): *www.whitehouse.gov/news/releases/2002/02/20020214-5.html*

Carraro, C. (1997): *International Environmental Agreements: Strategic Policy Issues*. Cheltenham, Edward Elgar.

Carraro, C. and G. Siniscalco (1995): Policy Coordination for Sustainability: Commitments, Transfers, and Linked Negotiation. In: I. Goldin, I. and L.A. Winters (eds.): *The Economics of Sustainable Development*. Cambridge, Cambridge University Press, 264–282.

Dröge, S., F. Biermann, F. Böhm, R. Brohm and H. Trabold (2004): National Climate Change Policies and WTO Law: A Case Study of Germany's New Policies. *World Trade Review*, 3 (2), 161–187.

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

Esty, D.C. and B.S. Gentry (1997): Foreign Investment, Globalisation, and Environment. In: OECD (ed.): *Globalisation and Environment: Preliminary Perspectives*. Paris, OECD proceedings, 141–172.

Finus, M. (2001): *Game Theory and International Environmental Cooperation*. Cheltenham, Edward Elgar.

Galeotti, M. and C. Kemfert (2004): Interactions between Climate and Trade Policies: A Survey. *Journal of World Trade*, 38 (4), 701–724.

Kemfert, C. (2002a): An Integrated Assessment Model of Economy-Energy-Climate – The Model WIAGEM. *Integrated Assessment*, 3 (4), 281–299.

Kemfert, C. (2002b): Global Economic Implications of Alternative Climate Policy Strategies. *Environmental Science and Policy*, 5 (5), 367–384.

Kemfert, C. (2004): Climate Coalitions and International Trade: Assessment of Cooperation Incentives by Issue Linkage. *Energy Policy*, 32, 455–465.

Müller-Fürstenberger, G., M. Wagner and B. Müller (2004): *Exploring the Carbon Kuznets Hypothesis*. Oxford Institute for Energy Studies, OIES Working Paper EV34. Oxford.