Challenges to International Climate Policy – Lessons Learned and Alternatives

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Introduction

When considering an environmental externality problem at the national level governments can in principle take one of two approaches. On the one hand, liberty and the free market can be strengthened by clearly defined property rights and ensuring enforcement. On the other hand, government could interfere using either a policy instrument such as command and control or alternatively a market-based instrument such as imposing taxes or emission permits. These so-called market-based instruments have enjoyed growing popularity over the past two decades; in principal they should allow reaching the centrally imposed goals more efficiently.

The atmosphere is a global public good and hence curbing greenhouse gas emissions in order to mitigate global warming is considerably complicated. Global warming is triggered by the stock of greenhouse gases in the atmosphere, and one ton of CO_2e (carbon dioxide equivalent) contributes equally to this process, independent of source location. There seems to exist increasing consensus that in order to avoid high risks of climate change the concentration of greenhouse gases in the atmosphere should not exceed the 500ppm (particles per million) CO_2e by 2050 (Stern, 2009). The current level of concentration is around 430ppm CO_2e and is increasing at a rate of 2.5ppm per year (Stern, 2009). This implies that in order not to exceed the desired target a strong international effort is necessary.

The fear of global warming has led to international initiatives leading up to the Kyoto Protocol in 1997 under which a number of developed countries (Annex B) have taken on binding emissions caps. Securing the participation of major developing country emitters is one of the major challenges faced in the upcoming negotiations in Copenhagen in December 2009 aimed at formulating a new post-Kyoto agreement.

While reduced emissions undeniably bring environmental benefits, the economic and political stakes involved in the Kyoto Protocol and a potential successor agreement are

huge compared to environmental effects. For a growing number of economists such as Bruce Yandle (Yandle, 1999), Kyoto is just another excuse for regulating the world market and restricting competition in the name of environmental protection. Several aspects of the Kyoto Protocol and of a possible post-Kyoto agreement confirm this suspicion. In fact, its limited environmental effectiveness, the failure to include developing countries, and particular instrument choices all point to Kyoto and its likely successor agreement as only being a disguise for redistributing funds (Yandle, 1999). Independent of the particular shape that a post-Kyoto agreement will take, it seems likely that an emissions trading system will be its centerpiece. In this paper we discuss, based on the experiences with the Kyoto Protocol and the EU-ETS, a number of challenges that arise when designing and implementing a global carbon market. Economic theories, such as the theory of regulation and public choice will be used to show how the blueprint and the implementation of such regulation are influenced by special interests. The paper is structured as follows; section II exposes the public good nature of the atmosphere with respect to greenhouse gas emissions by presenting some of the facts and particularities of carbon dioxide emissions. Section III describes the experiences with international climate policy, while Section IV presents some aspects of rent seeking in permit markets. Section V emphasizes essential features when considering the blueprint for a global carbon market. Finally, section VI presents some policy recommendations and concluding remarks.

Greenhouse gas emissions – some facts and particularities

The atmosphere represents a global commons and containing global warming can be considered an international public good. Greenhouse gases are emitted by a variety of sources in both developed and developing countries and each ton of carbon equivalent contributes equally to global warming irrespective of source location. Furthermore, the residency time of greenhouse gases in the atmosphere ranges from several decades up to 100 years. Global warming is triggered by the stock of greenhouse gases in the atmosphere and emissions in any particular year will only have a minor influence (Nordhaus, 2007).

According to Schelling (1997), Stern (2007, 2009) and, Hepburn and Stern (2008) in the business-as-usual scenario, without any major efforts by the world community, the

effects of global warming will be fully present around 2050. It is hard to predict the effects on local climates with much precision, but today's developing countries will be more affected than their developed counterparts. This is due to the less developed infrastructures and to the fact that agriculture provides a larger share of income in these countries (Schelling, 1997). Furthermore, by 2050 eight out of nine billion of the world's population will live in today's developing countries (Stern, 2009).

Underlying the difficulty of reaching a comprehensive agreement are two basic issues pertaining to the public good nature of the atmosphere. First, reducing greenhouse gas emissions is costly while benefits are shared universally; this gives nations an incentive to free ride. While for other local pollutants, such as SO_2 for example, one can observe an environmental Kuznets curve this is not the case for CO_2, for which total emissions increase with income (Frankel, 2005; Frankel and Rose, 2005). Frankel (2005) attributes this difference to the local versus global externality nature of the two pollutants. This incentive is exacerbated by thelimited knowledge about the effects of global warming that creates uncertainties with respect to the benefits of any greenhouse gas reduction initiatives. Furthermore, the costs of reducing greenhouse gases are also not known with certainty. The estimate of the costs of reducing GHG emissions sufficiently to prevent global warming from reaching a level where it would cause major disruptions have recently been increased from 1% to 2% of world GDP (Stern, 2007; 2008). The benefits of reducing GHG emissions lie far in the future while the costs are incurred immediately. All these facts increase the incentive for free riding.

Second, there are large differences in past, current and projected future emissions. Developed and developing nations currently enjoy a different level of economic development and this entails differences in past, current and projected future emissions. In 1973 OECD countries were responsible for roughly 66% of world total CO_2 emissions and this percentage shrunk to nearly 45% in 2007 (IEA, 2009).

Table 1 shows the world's top 25 emitters who collectively are responsible for over 84% of total annual 2007 CO_2 emissions resulting from the consumption of energy. The share of energy-related CO_2 emissions from total CO_2 emissions varies by country, but it typically constitutes the vast majority of emissions. The energy sector is worldwide, the major culprit for carbon dioxide emissions. Globally, CO_2 emissions from fossil fuels

account for around 60% of total CO_2 emissions. For developed countries alone this percentage is around 80% (IEAb, 2009). Out of a total of 29 Gt of CO_2 emissions in 2007, 41% come from the electricity sector and 23% from the transport sector (IEAb, 2009). Energy demand in developing countries is growing at a much higher rate than in industrialized countries. This rise in energy demand implies that the energy sector is expanding at a much faster pace in developing countries.

To be environmentally effective a post-Kyoto agreement requires for all major emitters to commit to binding caps and participation should be as large as possible to dissipate fears of leakage and concerns about unfair competition (Frankel, 2005; Stern, 2006). An international agreement, therefore, needs to include at the very least the top 25 emitters. Presently, 11 of the 25 are non-Annex B countries and in addition the United States has not ratified the Protocol, meaning they did not commit to any reductions in emissions.

Figure 1. Carbon Dioxide Emissions from the Consumption of Energy by Country (2007)

Rank	Country	CO_2 (MMT)	CO_2/capita (MT/person)
1	China	6,283.56	4.75
2	United States	6,006.71	19.94
3	Russia	1,672.62	11.83
4	India	1,400.71	1.25
5	Japan	1,262.39	9.91
6	Germany	835.13	10.13
7	Canada	589.90	17.91
8	United Kingdom	564.02	9.28
9	Korea, South	515.98	10.69
10	Iran	490.29	7.50
11	Italy	460.80	7.92
12	Australia	456.36	21.99
13	Mexico	452.96	4.17
14	South Africa	452.28	9.35
15	Saudi Arabia	433.93	15.73
16	France	405.06	6.36
17	Brazil	397.56	2.05
18	Spain	383.21	9.47
19	Ukraine	354.39	7.65
20	Indonesia	318.54	1.36
21	Taiwan	307.89	13.47
22	Poland	301.71	7.83
23	Turkey	277.20	3.71
24	Netherlands	261.46	15.78
25	Thailand	248.15	3.81

Source: Energy Information Administration

Note the remarkablediversity of these countries both in terms of total emissions and in terms of per capita emissions. China is the biggest emitter contributing 21% to world total emissions, followed by the US (20%), Russia (5.6%), India (4.7%), and Japan (4.2%).Per-capita emissions among the top 25 range from around 1.25 ton of CO_2in India to roughly 22 tons of CO_2in Australia. Increased economic growth is associated with an increase in greenhouse gas emissions and consequently the rate of growth of emissions (both in absolute terms and in per capita terms) is much higher in developing countries than in developed countries (Baumert et al., 2005). In other words, developing countries' per-capita emissions' growth rates are very high while per capita emissions for developed countries have pretty much stabilized or increase at a much lower rate.

III. International experiences with climate change policy

An overview and critique of the Kyoto Protocol

The Kyoto Protocol of 1997 is the first international agreement under which a group of developed (Annex B) countries have committed to binding emissions caps with the aim of reducing GHG emissions by around 5% from 1990 levels over the five-year period 2008-2012 (Stern, 2007). As of 2004, Annex B countries generated 46% of global GHG emissions,represented a 20% share in world population, and produced 57% of the world's Gross Domestic Product based on Purchasing Power Parity (IPCC, 2007).'Common but differentiated responsibilities' have been established in Rio de Janeiro during the 1992 'Conference on the Environment and Development', and accordingly developing countries are not subject to binding emissions caps under the Kyoto Protocol.

The previous section clearly demonstrates the importance of the inclusion of developing countries in such a global agreement. As Nordhaus (2007) points out, the US, China, India and South Korea are all among the world's top 10 emitters yet they are only included as non-Annex B countries in the Kyoto Protocol and hence the emissions involved only represent a small percentage of global greenhouse gas emissions. Combined with the absence of ratification by some of the Annex B countries this leads to an expected emissions reduction of only 2% from base year emissions (EEA, 2007). But, even if the Kyoto Protocol succeeded at reducing emissions by 5% from 1990 levels as intended, this mitigation effort has barely any effect on global warming. Unfortunately, the rate of growth of CO_2e emissions was much higher between 1995 and 2004 (0.92 $GtCO_2e$ per year) than during the previous period of 1970 to 1994 (0.43 $GtCO_2e$ per year) (IPCC, 2007).

The US opposed participation in the Kyoto Protocol arguing that it includes too small a percentage of global emissions, that it places a disproportional burden on the US, and that major developing country polluters did not agree to binding emissions reductions (Yandle, 1999). But, despite the non-participation of the US in the Kyoto Protocol, it led to a number of regulations in the US. Yandle (1999) describes the differential effects of these regulations on the formation of coalitions within the US. Sectors or firms would

take position in favor of the Kyoto Protocol if legislation would be advantageous, while they would lobby against it in the opposite case.

The Kyoto Protocol's environmental ineffectiveness, its disproportionately high costs relative to benefits (Yandle, 1999) and the choice of emissions trading as a major abatement tool, all point to it being merely a re-distributional tool.

An overview and critique of the EU-ETS

In a situation of perfect information, perfectly competitive markets and no transaction costs (Stern, 2007) a permit market or a flat rate CO_2 tax can achieve the same static result. With a permit market the overall amount of allowances available provide a cap on emissions, while with a tax firms can emit as long as they pay the tax. Policy makers can however achieve a given emissions goal with either instrument since for every cap there exists an equivalent tax.

During the 1990s several attempts to introduce a harmonized carbon tax in the EU have failed; fiscal matters require unanimous consensus among member states of the EU (Djauberg andSvendsen, 2001). While as Wittneben (2009) points out the Europeans are not usually as opposed as Americans to introducing a new tax they were however not willing to give up their national taxing powers.

The EU-15 has committed under the Kyoto Protocol to reduce its greenhouse gas emissions by 8% as compared to 1990 levels by the 2008-2012 phase. Specific emission reduction targets for individual member states were agreed on under the EU-15 burden-sharing agreement (EEA, 2007). The EU opted to achieve part of its Kyoto target through the introduction of an ETS that started on January 1st 2005 and completed its first phase at the end of 2007; during this time 10,559 installations participated (EEA, 2009). It is currently in its second phase, which runs from 2008 to 2012; thereafter five-year phases are planned.

For the realization of the EU-ETS it was crucial to get the major emitters in key industries on board so as to cover a sufficiently large amount of emissions. The original 'Green Paper' outlining the potential blueprint of the EU-ETS was issued in March 2000; the final blueprint of the market was substantially different. Following the Green Paper a Directive Proposal was presented to the European Parliament whose main discussion

partners on the issue were member state governments. The final blueprint was heavily influenced by the rent-seeking activities of industries and their lobbies that intervened both at the national and at the community level (Markussen et al., 2005; Svendsen, 2002).

The development of a politically acceptable blueprint as well as the problems faced during implementation led to a watered down version of a textbook model permit market. The resulting distortions and perverse incentives cause inefficiencies and will continue to hamper the proper functioning of this market (Grubb &Neuhoff, 2006).

Obviously the real world is not static; market conditions differ from the textbook situation and interference in the market is the norm. A flat rate CO_2 tax and a permit market involve the creation of rents at different levels. With a CO_2 tax the regulator has to decide on the tax level, the tax base and agents will lobby for exemptions and rebates and compete for the new revenues.

IV-Rent seeking in permit markets

Lobbying/rent seeking will occur both in the case of a carbon tax and in the case of a permit market. In the EU setting,both a common CO_2 tax and a permit market involve decision making at the member state level as well as at the EU level. The complexities involved in the creation and functioning of a permit market are however much greater than in the case of a flat rate CO_2 tax and consequently we claim that a permit market will entail more social losses than a common tax. We argue that this is especially true when such regulation is introduced at a supranational level.

The appearance of rents in competitive markets is commonly observed in response to changes in demand or supply; as profit-seeking entrepreneurs enter to capture some of these rents, value will be created. The situation is slightly different when rents are created ‘artificially’ by government (Buchanan, 1980), as in the case of a permit market. In this case such rents will become potentially available at the various stages; from blueprint to implementation. Buchanan (1980) distinguishes between profit seeking and rent seeking. While both induce the same behavior, due to the different institutional setting the first creates value, whereas the second one destroys social wealth. The constraints that interest groups and firms face in the marketplace are different from those encountered in politics (Buchanan, 1980; Tollison, 1982).

In his seminal work,Gordon Tullock (1967) criticizes the standard approach to measuring welfare losses from tariffs, taxes or monopoly creation using the Harberger triangle. According to Tullock (1967), the large amounts of resources that are invested by interest groups in order to receive or avoid transfers are wasted from the viewpoint of society as a whole. Thus, Tullock (1967) considers rent seeking for a tariff, monopoly or tax as a pure waste. The Harberger triangle ignores the costs involved in rent seeking and hence largely underestimates the cost of transfers assumed to produce no welfare losses.Krueger (1974) compares an exogenous tariff without rent seeking with a quota that gives rise to rent seeking in order to capture the premium from import licenses. She concludes that in this latter setting rent seeking gives rise to a loss of welfare over and above that of the usual triangle.

V- The blueprint for a global carbon market – essential features

The view of regulation has profoundly changed over the past half century; originally it was viewed as a welfare-improving necessity to remedy situations of market failure (McChesney, 1997). Stigler's (1971) positive model of regulation challenged the perception of firms as victims of regulation. 'Economists instead came to recognize that, as a strictly positive matter, government regulation had the power to create benefits that were unavailable other than through politics, or were more cheaply availablethrough politics' (McChesney, 1997 p.9-10).

Most observed regulation is not of the form described by Stigler's model or the extended Stigler-Peltzman model since the latter is still based on the idea of exchange and therefore does not completely capture the relation between regulators and regulated parties (McChesney, 1997). The Stigler-Peltzman model does however consider the creation of infra-marginal (Ricardian) rents, and this 'raising rivals' cost model can explain some of the features of the EU-ETS and a possible global agreement based on a carbon market.

To give just one example, the cost predation model can explain why large electricity producers (irrespective of the share of fossil fuels in their supply mix) lobbied in favor of the EU-ETS that would increase the costs for the entire industry. The costs of this regulation would however increase less for large utilities than for their smaller

competitors. As emphasized by Markussen et al., (2002, 2005) grandfathering as well as the allocation of permits at the member state level were clear advantages for large electricity producers that have low abatement costs and turned out to be net sellers of permits (Wittneben, 2009).

The EU-ETS still represents the World's largest emissions trading system and this experience gives us some valuable insights for a global emissions trading system. The aggregate emissions of the sectors included in the EU-ETS roughly amounted to 43% of total EU emissions in 2007 (EEA, 2009).

Sector coverage

In principle, the more sources, sectors and countries participate in a global carbon market the more efficient such a market will be, yet the very diverse mobile and stationary sources emitting CO_2 make the use of permits more challenging than alternative instruments such as a CO_2 tax for example.

Compliance, Monitoring and Reporting

In order to set the caps for any emissions trading system it is necessary to have both reliable emissions data and a reliable monitoring and reporting system (ZylaandBushinsky, 2008). Only reliable data will guarantee that the caps are set neither too tight nor too lax and avoid the associated problems of permit prices that are too high or too low. For a global carbon market one has to take account of the particular administrative and technical difficulties involved in monitoring, reporting, and enforcement. It is not clear that developing countries can satisfy the necessary requirements.

A harmonized system for measuring and verifying emissions across all participating countries is important; in the EU-ETS the large freedom in the interpretation of the guidelines relating to monitoring and verification has led to pronounceddifferences in application (Kruger et al., 2007). Furthermore, the different legal systems led to differences in enforcement. Companies are subject to national laws, yet enforcement needs to be harmonized. One can only imagine how such distortions would be exacerbated at the global level.

Under the Kyoto Protocol, countries have their own national registries and transactions are registered with the International Transaction Log (ITL). Since January

2008 the EU's CITL (Community International Transaction Log) is linked to the ITL. In theory, this system could be expanded to include all member countries of a post-Kyoto agreement.

Permit Allocation Rules – A Clear Case for Auctioning

At the heart of the design of any emissions trading scheme is the choice of the allocation method, whichis probably the most contentious issue. There exist two major methodologies for the initial allocation of permits. Allowances could either be sold to firms at a fixed price or auctioned off; or alternatively the permits could be handed out for free (for example based on historical emissions also known as grandfathering).

While the Green Paper of the EC (March 2000) proposed auctioning, in the Final Directive grandfathering was the chosen allocation rule and auctioning was reduced to a mere 5% of permits for the first phase (2005-2007) and to 10% for the second period (Hepburn et al., 2006). With grandfathering, a regulatory agency has to decide on how to distribute the new assets and this creates strong lobbying activities (Grubb andNeuhoff, 2006). In the EU-ETS grandfathering is based on historical emissions, and for a number of sectors benchmarking against the best available technology was used to determine the quantity of emissions permits to be allocated.

Grandfathering has distributional effects and affects firms' profits leading to a number of economic distortions (Grubb andNeuhoff, 2006) that mainly influence inter-EU competition. Because of the high price inelasticity of electricity demand, electric utilities in the EU have been able to pass on the opportunity cost of permits to their customers in the form of higher energy prices while they received enough free allowances; they could thus secure so-called windfall profits (see Wittneben, 2009).

Grandfathering can also lead to perverse environmental effects; if based on historical emissions, heavy polluters will be favored compared to cleaner firms and this will encourage them to continue operating longer than they otherwise would. If however, grandfathering is based on energy efficiency, environmentally-friendly firms would be favored.

While it is usually believed that the way in which permits are distributed at the onset of an ETS will not affect the market's efficiency, this does not hold true in a dynamic framework such as the one of the EU-ETS where permit allocation is based on

recent emissions because companies will adjust their behavior and disrupt the efficiency of this market (Neuhoff, 2008).

Auctioning allows avoiding the various distortions noted above, but firms usually resist it because of the higher financial burden it imposes on them (Hepburn et al., 2006). Because of the perverse effects of grandfathering the EC has justifiably decided on a total phasing out over the next decade (Point Carbon, 2008).

New Entrant and Closure Rules

Again, as seen from the experience with the EU-ETS, a harmonized set of rules is crucial for the proper functioning of an international ETS. If the rules for new entrants and for closure of operations are not harmonized across countries a number of distortions will appear. For example, if new entrants receive allowances for free as is the case in the EU-ETS this represents an investment subsidy and member states might end up competing for new investments thereby undermining the environmental objective of the ETS (Schleich et al., 2007).

Following the discussion above it is preferable to auction off permits to new entrants in a global permit market as this will put in place incentives in alignment with the environmental goal of the permit market. Auctioning eliminates several distortions that arise when new firms enter the market, existing ones expand their operations, or when firms exit the market.

Banking

The banking of allowances is beneficial as it gives firms more flexibility in timing their abatement efforts and thereby also increases the cost efficiency of an ETS. Starting at the beginning of the Kyoto Period in 2008 emitters can bank allowances (Neuhoff, 2008).

National Allocations Plans (NAPs)

The NAPs in the EU-ETS require member states to make decisions at three different levels. First, member states have to decide on how much of their Kyoto target will be allocated to sectors included in the EU-ETS, the remainder of the emission reductions will be achieved by other means and/or other sectors of the economy. Next, it has to be decided on the percentage covered by each of the sectors included in the EU-

ETS. Finally, sectoral targets have to be assigned to individual installations (Ellerman and Buchner, 2007).

In the EU-ETS member states are thus directly involved in the assignment of allowances to individual sources. Government officials have to decide on the actual number of allocations to be received by the participating firms. It is clear that in such a situation special attention will be given to the voices of lobbies and special interest groups. In the process, as government officials 'shield' local industries from competition they will create winners and losers within countries and sectors.

Furthermore, the future price of permits cannot be estimated with sufficient accuracy because the overall supply of permits in the system is determined jointly by the allocations in all member states[1] (Kruger et al., 2007). This has led to an over-allocation of permits of around 3% in the first trading period and high volatility in allowances prices. So far allowance prices have been ranging between 1 and 30 Euros with less volatility in the second trading period (EEA, 2009).

For phase II the EC had developed its own set of criteria to evaluate the NAPs submitted by the member states and requested changes/reductions in emissions for almost all NAPs. Overall, the expected emission reductions for phase II are small, and could be achieved through the use of flexible mechanisms without any reductions undertaken inside the EU (EEA, 2009).

The EU-ETS includes both centralized and decentralized features; the European Commission decides on the sectors included in the scheme (demand-side) but member states decide on the supply of permits (Kruger et al., 2007). In this system regulators have to create the scarcity that is required for a (stable) price of carbon to emerge (Grubb andNeuhoff, 2006); this scarcity is necessary to give firms the right incentives for investment in low carbon technologies. Yet, it is regulators who fail to create this scarcity in fear of harming local/national industries. A drawback of this feature is that organized industrial lobbies can lobby twice for favorable treatment;once at the member state level and once at the EU level (Woerdman, 2000;Svendsen, 2002).

Time frame

[1] This uncertainty could be reduced (possibly at the expense of efficiency) if the central authority would decide on the percentage of emissions reductions to be achieved by both the trading and the non-trading sectors (Kruger et al., 2007).

There is general agreement that combating global warming calls for a long-term strategy (Schelling, 2002; Frankel, 2006; Stern, 2007, 2009), and based on the IPCC scientific findings agreed on in Bali 2007, long-term emission reduction targets should be set for the next 50 to 100 years. This is necessary so that private and public actors around the world can make proper investment decisions.Long-term planning is required especially in the energy sector,which is the major culprit for CO_2 emissions. Essentially, long-term targets need to be distributed across time and countries.

In the case of a permit market the short-term phases, it is claimed, would give enough flexibility to adapt to changes in emissions due to changes in the particular economic situation or due to technological change. Setting caps for five years at a time, yet guaranteeing the continuity of the regulation in the long-run takes away some of the uncertainty that the EU-ETS is suffering from. Yet, even if we would succeed at 'coercing' developing countries into participating in an international carbon market, the necessary frequent re-assessment of the caps will lead, (in addition to the other difficulties mentioned above), countries, industries, firms and interest groups to continuously engage in costly lobbying activities as we currentlyobserve in the EU-ETS and this will intensifythe waste of resources.

Linking existingETSs

A further difficulty of realizing a global carbon market pertains to the linking of emissions trading systems that are currently emerging around the world and show significant differences in their design features. Great variations exist in terms of emissions covered (around 22% for the RGGI, 40% for the EU-ETS, up to around 85% for the Lieberman-Warner Climate Security Act), sectors included, allowance allocation method (full auctioning in the RGGI versus grandfathering in the EU-ETS) and administrative structure. These differenceswill therefore lead to the emergence of different prices per ton of carbon equivalent. To realize cost efficiency in abatement the emergence of a single price is necessary. Thus, for an international emissions trading system the different design features would have to be harmonized.

One common feature of the EU-ETS in its first and second phase and the RGGI that started in January 2009 is that they both have very soft caps on emissions even if they include only developed countries. This reflects the public good nature of the

problem at hand and points once again to the limited effectiveness of a permit market in the particular case at hand.

VI. Discussion and Concluding Remarks

One has to remember that successful international agreements are those where all parties perceive themselves as winners (Nordhaus, 2007). Such agreements will not only give politicians the necessary public support to sign the agreement, but it will also help prevent later defection (Stern, 2007). Currently, in the case of global warming it does not seem that a consensus is close at hand; the emission reductions required to prevent global warming from becoming dangerous and the associated costs involved are both substantial.

Frankel (2005), analyzes the links between the WTO and the KP and favors a carrot and stick strategy. He suggests the use of WTO membership as a reward for participating in an international environmental agreement like the Kyoto Protocol and trade sanctions as punishment to prevent free riding. Such a strategy has been applied in a few other cases[2]. Krugman (2009) also favors coercion but countries like China for example, see such treatment as unfair, and are also opposed to a carbon tax paid by consumers. Developing countries point to the historic responsibilities of industrial countries for the stock of greenhouse gases in the atmosphere and are in favor of equal per-capita emissions to determine abatement responsibilities; this would however, for reasons of economic growth and population growth not allow the world community to limit the stock of global emissions to 500ppm by 2050.

So far, major developing country polluters such as China or India are still opposed to any binding emission caps fearing that such caps could compromise their economic growth. Indeed, developing countries are asking for immediate assistance for the purpose of mitigation and adaptation, but developed countries, are to date, not willing to agree to the large transfers necessary to motivate them to come on board. The EU, who aims at being the frontrunner when it comes to mitigating global warming, is for example, deeply

[2] For a detailed discussion see Frankel (2005): Nations not currently members of the WTO could be rewarded with WTO membership in return for participating in an international agreement to curb GHG emissions. This strategy was followed in the case of the Montreal Protocol on Substances that Deplete the Ozone Layer. Also, Russia was granted WTO membership in return for Kyoto Protocol participation.

divided over transfers to developing countries,whichwould have to be in the order of 100 billion Euros a year between now and 2020 (Der Spiegel, 2009).

The intensifying substantive efforts to stabilize climate change reflect the willingness and readiness of a growing number of countries to be part of the solution. At the same time however, as exposed above, an international carbon market, or, as a matter of fact, any agreement that would force developing countries to commit to the required emission caps is not about to be realized.

Furthermore, even if we succeeded to coerce developing countries into participating in a global carbon market, we have shown in this paper, by exposing the numerous obstacles involved in such a market, whether they are of practical or theoretical nature, that such a market would merely be a tool for re-distributing funds without achieving the desired cost efficiencyand environmental effectiveness.Furthermore, economic interdependencies in the current world economy are such that one cannot imagine any fruitful coercion.

As mentioned above, the transition to a low carbon economy is required if the world community wants to avoid the dangerous consequences of global warming.Cowen (2009) contends that with forceful intervention special interests will lobby to influence legislation. Companies might lobby in favor of further protectionist measures in the name of CO_2 mitigation. Tariffs and other protectionist tools might then randomly be applied to traded goods, independent of CO_2 emissions involved but rather depending on the political clout and lobbying ability of the groups involved.Such coercion might lead to retaliatory protectionist measures.

Raising public awareness about the dangers of global warming and the necessity of action by all nations will open new doors, however (Cowen, 2009). Populations in developing countries can exert sufficient pressure on firms, industries, and politicians to motivate them to act. In fact, the idea of motivating public opinion might be promising; many globally operating firms are advertising themselves as being environmentally friendly and consumers are more and more aware of a company's environmental position.

Developed countries have been consistently increasing their shares of renewable energy and many have clear percentage targets such as the 12.5% by 2010 and 20% by 2020 for Germany (Varghese and Thomas, 2009). Developing countries have also started

to recognize the potential benefits of developing and expanding their renewable energy sector and many have already jumped on the bandwagon. In terms of installed wind capacity in 2007, Germany ranked first, followed by the US, Spain, India, and China (Stern, 2009).

Currently, investment in clean power is still negligible (around 15%) of the aggregate investments in the energy sector (Stern, 2009). Those developed countries that do not yet have a sizable amount of installed renewable energy capacity as well as developing countries could follow the example of Germany that has substantially increased its share of renewable energy with proper public policy incentives. Varghese and Thomas (2009) examine the different renewable energy policy tools around the world and discuss their effectiveness. The costs of renewable energy are declining rapidly and there is large room in terms of public policy incentives favoring the installation of renewable energy.

Looking at the different positions taken by both developed and developing countries on the issue of mitigation, and given the various challenges of a global permit market we favor decentralized measures. Individual nations should have the power to decide on which means they use for tackling mitigation. Competition in the growing markets for renewable energy can play a crucial and beneficial role in this process.

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