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Trade, Competitiveness and Carbon Leakage: Challenges and Opportunities

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Summary

Following the Kyoto Protocol, some countries have introduced (or are planning to introduce) a cap-and-trade system to curb carbon dioxide emissions from power generation and large industry. In most of the rest of the world, especially emerging economies, such a broad carbon cost is not imminent, and they therefore benefit from a distortion of competition. This paper explores various policy options that aim to restore a level CO_2 playing field, and outlines the challenges and opportunities associated with their introduction.

Introduction

As countries move towards building a low-carbon global economy, the issue of competitiveness stands as a potential barrier to progress. This is linked to fears of carbon (or emissions) leakage, whereby emission reduction efforts in one country would be offset by emission increases in non- carbon-constrained regions. These concerns are manifested through asymmetric domestic climate policies at the international level. The Kyoto Protocol regime, linked to the UN Climate Change Convention, reflects this asymmetry: so-called Annex 1 country Parties (i.e. developed countries) have quantitative emission objectives while developing countries such as China are so far exempt from emission targets, as the Protocol places a lighter burden on developing nations. Yet countries recognize the principle of 'common but differentiated responsibilities and respective capabilities' (CBDR) (i.e. Article 3.1 of the Convention).

While CBDR is an accepted principle, as governments start driving the wedge of a carbon price into their industrial activities to reduce greenhouse gas (GHG) emissions, they are increasingly aware of possible repercussions on their industrial competitiveness and on the risk of carbon leakage (i.e. a displacement of GHG emissions to the unconstrained regions). The European Commission and Australian proposals, as well as various bills under discussion in the US Congress for the design of future domestic climate policies targeting industry, illustrate the momentum of these issues. Policy-makers are looking for specific policy measures to avoid putting industries exposed to a risk of carbon leakage at a competitive disadvantage *vis-à-vis* the rest of the world. Some countries have a domestic focus in addressing the issues. Others have also suggested introducing measures such as sectoral approaches or border adjustment schemes, which would have effects beyond their frontiers with the aim of levelling the CO_2 playing field.

1. Asymmetric climate policies

Currently, governments around the world are introducing a range of policy tools to mitigate climate change: cap-and-trade (also called emissions trading), voluntary agreements, taxes, standards, subsidies. In economic terms, an implicit or explicit price on CO2 and other GHG is the most effective way to influence future investment and technology choices in sectors that have a strong potential to lock in GHG emissions. Emissions trading policies put an upper limit on emissions by different industrial sectors – thereby effectively putting a price on CO2 (or GHG) emissions. Under emissions trading schemes (ETS), companies or production facilities are issued emission allowances, which represent the right to emit a specific amount. The total amount of allowances cannot exceed the cap, and thus total emissions are limited to that level. In theory, companies will implement GHG mitigation options up to the point where these investments cost as much as the market price of CO2 allowances. At that point, some will have exceeded their emission reduction goals, others will have fallen short and need to acquire allowances from the market.

Emissions trading potentially offers lowest-cost solutions for the economy: companies with higher marginal abatement costs (i.e. the cost of eliminating an additional unit of pollution) can still achieve given emission objectives by acquiring allowances from companies with lower abatement costs. However, the introduction of a cap, visibly pricing CO2 emissions in a subset of the world regions, distorts the playing field, creating a risk of carbon leakage and job losses for sectors exposed to trading internationally.[1]

Emissions trading regimes are already widespread across OECD countries, as Table 1 shows, but the EU has by far the largest trading system, providing 80% of the global trade by value and 70% by volume. Most ETS focus only on a selection of GHG-intensive sectors, typically industry and power sectors. Globally, these sectors represent close to two-thirds of world CO2 energy-

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[1] Loss of competitiveness and carbon leakage concerns also arise under other climate policies targeting industry (e.g. production or product standards), yet cost impacts for industry are less known. As such, while the focus of this paper is on ETS, distortion of global competition could also result from policies that do not introduce a visible price for CO_2 emissions.

related emissions (IEA, 2007). Most schemes also include a participation threshold such as a thermal capacity installation. In the case of the EU-ETS, for example, companies with large combustion installations above a certain threshold (>20MWth rated input) have a cap on their emissions.

Region	Participation	Timetable
European Union (2005)	Power generation and energy-intensive industry (iron and steel, cement and lime, paper, food and drink, glass, ceramics, engineering and vehicles)	Phase II: 2008-2012 Phase III under discussion (2012-2020)
Japan (2005)	Industry (food, breweries, pulp, chemicals)	16-month trading periods
New South Wales (Australia) (2003)	Power sector and (voluntarily) consumers >100GW	Set to 2012, with commitment to extend scheme to 2020 – would be replaced by Federal scheme
Norway (2005)	Energy production, refining, iron and steel, cement, lime, glass, ceramics	Phase II: 2008-2012
Alberta (Canada) (2007)	Electricity, energy, chemicals (Emitters >100t CO_2e per year)	Annual targets
New Zealand (2008)	Forestry (incl. deforestation), waste, liquid fossil fuels, stationary energy, industrial processes, agriculture	Sectors phased in, starting with forestry (2008-2010)
Switzerland (2008)	Heating process fuels. Ceramics, glass, paper, chemicals, aluminium, lime, food, printing	2008-2012
Regional Greenhouse Gas Initiative (2009) (US North Eastern States)	Power generation (coal, oil and gas-fired with capacity over 25MW)	3-year periods from 2009 to 2018
S Korea (2008)	Large emitting companies	Late 2008-2011
Canada (2010)	Power generation, iron and steel, cement, lime, chemicals	Output based allocation; starts in 2010
Australia (draft proposal) (2010)	Facilities emitting over a defined threshold per year, plus upstream fuel. Discussion with agriculture and forestry sectors about their inclusion	Absolute cap; starts in 2010

Source: Updated from Reinaud and Philibert, 2007.

Table 1 : Existing and announced emissions trading schemes

2. Competitiveness, carbon leakage, job leakage: potential impacts of uneven climate policies

Theoretical concerns

Competitiveness loss

By introducing a price on GHG emissions, ETS potentially change the competition playing field for carbon constrained sectors *vis-à-vis* unconstrained competitors. Concerns are that uneven carbon constraints (e.g. in Europe) would enhance the competitiveness (i.e. international market share – exports and imports – and profit levels) of non-carbon-constrained producers (e.g. in China). The implied higher carbon cost associated with energy-intensive industries within the constrained region would create incentives for those industries either to source carbon-intensive inputs from the unconstrained region and/or to relocate. Sectors with international exposure where production is relatively easy to relocate are vulnerable to these leakage concerns. This is the case for aluminium, steel and, to a lesser extent, cement. These sectors also have some degree of product and process uniformity; consumers tend therefore to be indifferent to where products were made, provided they are less expensive.

Within trade-exposed sectors, analyses point to large differences between a few industry sectors and sub-sectors, based on their high level of CO_2 emissions per output (i.e. emissions-intensive sectors); their exposure to indirect costs, electricity in particular (i.e. electric-intensive sectors). Emissions-intensive sectors are typically cement or steel produced through blast furnace methods. Electricity-intensive sectors include primary aluminium and steel produced via recycling methods.

Emissions-intensive activities will be vulnerable to the level of direct costs the scheme induces. Direct costs are borne to control emissions levels or to acquire emission allowances if sectors need to cover emissions above their initial quotas. In addition to the direct cost of complying with an emissions cap, there is also an indirect cost attached to the likelihood that other sectors covered by the ETS will increases prices (Reinaud, 2008a). For example, fossil-fuel power generation plants are likely to pass their CO_2 costs on to wholesale markets, resulting in higher electricity prices (Reinaud, 2003). As such, electricity-intensive sectors will be vulnerable to this type of costs.

Nonetheless, cost increases do not necessarily translate into reduced profits for companies. This will depend on the ability of (sub-)sectors to pass through costs to their product prices, without inducing loss of market share.[2] Elements influencing pass-through include market concentration, tight market (i.e. available production for the export market), exposure to international competition and the degree of product differentiation (Reinaud, 2008a).

Studies in the EU, US, and Australia (Reinaud, 2005a and 2005b, Hourcade et al., 2007; Öko Institute, 2008; CE Delft, 2008; CITI Investment Research, 2008; Morgenstern et al., 2007; Aldy and Pizer, forthcoming) list a diverse set of sectors and subsectors that are vulnerable to the carbon constraint. Risks are restricted to cement and clinker kilns, refineries, primary aluminium smelters, integrated steel mills, electric arc furnace ovens, chemicals, etc. Furthermore, their share in some OECD countries' GDP (i.e. the UK and Germany) is small, and costs as a percentage of revenue or value added are modest for commodities whose emissions costs represent more than 4% of the products' value (Hourcade et al., 2007; Öko Institute, 2008).

Adjacent concerns: carbon leakage and job losses

Loss of competitiveness resulting from climate policy is also related to two sensitive policy issues. In addition to a poorer economic outcome (i.e. loss of profits and loss of output), there could be a negative impact on the environmental effectiveness of the ETS, with potential 'carbon leakage' (i.e. displacement of emissions in non-constrained regions). Production (re)location in favour of non-carbon-constrained regions could have detrimental social consequences with job losses. These issues lend weight to the argument of ultimately creating a global cap-and-trade regime that is as inclusive as possible. The more countries – particularly all major economies – participate under the same constraints, the less the scope for carbon leakage and competitiveness concerns.

Carbon leakage definition and theoretical estimates

Carbon leakage can take place through several channels, but probably the prevalent fear for policy- makers is competitiveness-driven carbon leakage.[3]

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[2] Note, however, that even within a sub-sector, there may be differences between facilities, as geographical location, among other elements, may play an important role. Cement has a low value per tonne, and is not transported easily on land. Coastal production may be at risk, however, if there is excess capacity in the rest of the world.

[3] 'The three most important carbon leakage channels include: *i)* the short-term competitiveness channel, where carbon-constrained industrial products lose international market shares to the benefit of unconstrained competitors;

This could materialize in two ways. First, differences in CO_2 cost levels could trigger immediate loss of market share (i.e. decreases of exports and increases of imports) for carbon-constrained industrial products, to the benefit of non-carbon-constrained countries, as companies shift to the sourcing of emissions-intensive products from abroad. Second, in the long run, differences in cost levels could trigger changes in investment patterns. Energy-intensive industries would (re)locate in countries with a less stringent climate policy (Reinaud, 2008a). In both cases, carbon leakage would be visible though changes in production levels and trade flow patterns.

Studies on competitiveness-driven carbon leakage reveal that carbon leakage would never wipe out entirely an effort to reduce emissions in an industry with small leakage rates (Reinaud, 2008a). The Intergovernmental Panel on Climate Change (IPCC) defines the carbon leakage ratio as emissions increase from a specific sector outside the country (as a result of a policy affecting that sector in the country) over the emission reductions in the sector (again, as a result of the environmental policy) (Reinaud, 2008a). For example, studies indicate that at a CO_2 price of €20/tonne until 2012, carbon leakage ratios would range between 0.5% and 25% in the iron and steel sector, and between 40% and 70% in the cement sector, depending among other things on how allowances are distributed (Demailly and Quirion, 2007, Ponssard and Walker, 2008). Taking into account specific design of the allocation mode (e.g. free allowances) yields much lower leakage rates than under a CO_2 tax.

Limits to theoretical analysis

Longer-term estimates of carbon leakage (i.e. changes in investment decisions) are less reliable than short-term estimates, as little is known about ongoing structural changes in the manufacturing sector, especially in light of the current economic slow-down. Barriers to industry relocation are also important and play a significant role in companies' decisions on the location of new investments. The degree of mobility of manufacturing activities is hence not straightforward. From a theoretical point of view, environmental policy stringency should matter in determining the location of firms. Yet the empirical literature yields somewhat less clear-cut results.

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ii) the investment channel, where differences in returns on capital associated with unilateral mitigation action provide incentives for firms to relocate capital to countries with less stringent climate policies; and *iii)* the fossil fuel price channel, where reduction in global energy prices due to reduced energy demand in climate-constrained countries triggers higher energy demand and CO_2 emissions elsewhere, all things being equal' (Reinaud, 2008a).

Nevertheless, concerns about loss of competitiveness, carbon leakage and job losses are likely only to grow as mitigation commitments increase, driving CO_2 prices to higher levels. Final products and intermediates (i.e. semi-finished products) are also increasingly produced within global value chains, raising levels of intra-firm trade for global firms (OECD, 2007). The challenge for governments will be to provide tailored solutions to deal effectively with the different forms of leakage (i.e. production and investment leakage channels) as they may not require the same type of action (as discussed in section 3).

Empirical analysis

Experience with the EU ETS

The EU-ETS has provided a large-scale experiment to identify the magnitude of competitiveness and carbon leakage (Reinaud, 2008a) for several trade-exposed emissions-intensive sectors. Empirical evidence of carbon leakage shows that the EU-ETS in place since 2005 has not triggered changes in trade flows or production patterns for cement products, iron and steel, refineries or aluminium.[4] Had the ETS had an impact, the EU would be importing more, cheaper products from unconstrained regions, and exporting less to the rest of the world.

The reality is that in practice the EU ETS was introduced unilaterally with some form of rebate for industrial sectors to accommodate competitiveness concerns and stranded costs. In other words, total costs were modest for emission-intensive sectors as allowances were distributed for free and often over-allocated in the manufacturing sector compared to the cap. For electricity-intensive sectors, the still functioning long-term electricity contracts softened the blow of rising electricity prices (*Economist*, 2008).

Limits of empirical analysis

Results from the analysis of this relatively recent climate policy are nonetheless to be treated with care. Higher prices for traded products (e.g. aluminium, steel and refinery products) as well as the relatively short time span of EU ETS policies did not allow for full observation of carbon leakage potential (Reinaud, 2008a). Yet even with empirical evidence covering many years of data it may be very difficult to identify the isolated effect of carbon prices on investment and production decisions in Europe. Further, past observation of carbon leakage does not mean that there will not be any effects over the longer term. The future form of the EU-ETS may change

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[4] A methodology is emerging that tracks carbon leakage by monitoring changes in trade flows and investment decisions and assesses whether there has been a measurable impact of the CO_2 cost (see Reinaud, 2008a, and Ellerman et al., forthcoming).

these findings for some heavy industries as Europe has planned more ambitious emission reduction targets post-2012.

Challenges

These results are in stark contrast to theoretical analyses that project the effect of a unilateral constraint on emissions from these industries. One challenge, therefore, is to devise measures to mitigate carbon leakage without over-compensating. Policy-makers analysing changes in European industry sectors' competitiveness following the introduction of the EU-ETS will need to identify and simulate what is attributable to climate policy from other factors (e.g. slowdown in demand, changes in exchange rates, etc.). Otherwise they risk using climate policy as a tool for industrial policy and undermining the effectiveness of climate policy.

3. Measures to address competitiveness and leakage concerns

While the ultimate objective of domestic policies such as ETS is to gradually reduce the carbon intensity of the sectors covered, in their design, policy-makers are also looking for specific policy measures to avoid putting industries exposed to a risk of carbon leakage at a competitive disadvantage *vis-à-vis* the rest of the world.

Some countries with ETS have a domestic focus in addressing the issues. Domestic measures encompass the pursuit or introduction of free allowance allocation or direct grants (e.g. state aid) to energy-intensive manufacturing sectors exposed to trade. Direct financial subsidies could notably take the form of revenue recycling of the auction allowances, but only the allocation of gratis allowances is entrenched in existing legislation.

Other countries have also suggested introducing measures that would have effects beyond their frontiers with the aim of restoring the CO_2 playing field. Proposals are twofold: a 'stick'-like approach with the implementation of a border adjustment (BA) measure for imports of CO_2-intensive industrial products; and a 'carrot'-like approach through the engagement of specific sectors in emission reduction efforts in non-carbon constrained countries, known as sectoral approaches (SA). These include various forms of support to developing countries. Some of these measures are examined below.

Free allocation

How does it work?

Critical in the elaboration of ETS is the allocation mode of emission rights. The environmental effectiveness of auctioning is clear – prices of products increase proportionally to the CO_2 allowance price, the products' emissions and electricity intensity, and auction revenues could be used to offset other taxes. However governments fear that the policy will distort the playing field as other countries do not apply similar costs to competing industries. Free allocation minimizes financial costs for companies while still providing an incentive to reduce emissions up to the carbon price.

Designing such measures require at least a two-step approach. The first step involves the identification of free allocation eligibility (i.e. who is entitled to receive gratis allowances). The second is the distribution formula of allowances (i.e. the allocation mode and the amount of free allocation). In most cases, the second step is dealt with by governments. But in some cases, states or regions can also adjust the total allowances distributed to companies to a certain extent. In the EU ETS phases 1 and 2, individual European governments designed their national allocation plans (NAPs); the European Commission is now proposing a more homogeneous allocation process that would be centralized at the European Commission level. In the US, the proposed Lieberman-Warner amended (S. 3036) or Bingaman Specter (S. 1766) bills would provide for some industrial activities to receive additional free allowances from individual states, even though the federal government would distribute most allowances.

The vast majority of allowances under existing ETS are currently distributed free to trade-exposed sectors. EU countries, as well as some US bills (e.g. Lieberman-Warner amended S. 3036), distribute allowances based on historical levels of emissions (i.e. grandfathering). But emissions can also be distributed following an agreed benchmark (e.g. X tonnes CO_2 per tonne of final product). This is the preferred option for Australia's forthcoming ETS. Further, the cap on facilities for GHG emissions can be fixed prior to the trading period (i.e. an absolute cap) or adjusted *ex-post* based on output levels (i.e. output-based allocation or relative cap).

Challenges

Free allocation acts as a subsidy to existing facilities and hence tackles part of the competitiveness-driven leakage route. Nonetheless, free allocation is not without costs for capped activities if the cap is sufficiently stringent. While emissions below the cap are gratis, at the margin (i.e. for emissions beyond the cap), the costs are the same whether emission allowances are provided free or auctioning is used (Reinaud, 2008a). Yet if governments distribute all allowances gratis, companies could also benefit from increased windfall profits if they are able to pass climate-policy-related costs on to their final price, as has occurred in Europe in the power generation sector.

To be effective in restoring the competitiveness playing field prior to its previous level, before climate policy, free allocation would need to cover both direct and indirect cost increases. Otherwise this instrument would only be effective in shielding emissions-intensive facilities, not electricity-intensive activities, from leakage.

But beyond existing installations, the mode of allocation may also influence investment decisions (i.e. decisions to open or close production facilities). New facilities (i.e. so-called new entrants) and incumbents can be subject to similar treatment. This is the case in most trading schemes. This set-aside allocated gratis to new entrants would be more favourable to investments, as new entrants would otherwise incur direct additional costs to enter the market and thereby represent a market barrier (Reinaud, 2005b). Free allocation to new entrants could reduce the incentive to locate new facilities in regions without carbon pricing. It could also influence the type of investment made (e.g. in Australia, new entrants in manufacturing sectors could be allocated gratis allowances based on emission levels from 'best available technologies' in the sector).

Closure provisions (i.e. if the allocation is contingent on continued production) could influence facilities' decisions to shut down as free allowances would be withdrawn.[5] This would turn the allocation into a subsidy to production, because the firm earns the allocation if and only if it continues to operate the installation (Åhman et al., 2005).[6] In most countries, allocation is based on continuity of operation of the covered facilities (Reinaud, 2008a). Nonetheless, free allocation may not prevent carbon leakage through the investment channel in its entirety as it may always be more economic to

[5] Yet closure rules will need to be closely defined to avoid inducing leakage without surrendering some level of gratis allowances distributed prior to the trading period. Indeed, if a facility reduces its production by 90% compared with previous production levels, would this be considered closure? If not, would it be able to keep its allowances for the rest of the trading period?
[6] Some (e.g. Betz et al., 2004) argue nonetheless that the retrieval of allowances will deter decisions on the closure of inefficient plants and reduce the environmental effectiveness of the instrument (Reinaud, 2008a).

(re)locate production activities in non-carbon constrained zones, whatever the climate policy in the country of operation.

Another challenge is whether free allocation can be distributed without altering the environmental effectiveness of the ETS as a tool to internalize climate change costs. This will depend on whether the total number of allowances a company receives is dependent on output levels (i.e. relative cap) or whether it receives allowances whatever the output level (i.e. absolute cap). While environmental effectiveness may decrease if the total amount of allowances is output-based, it is less true if the emission cap for producers is fixed prior to the trading period. Output-based allocation would limit the CO_2 price signal in product prices and hence would limit product substitution towards lower-CO_2-intensive products.[7]

Opportunities

Whether or not free allocation encourages investments in R&D or in low-emitting carbon technologies will depend on the cap and the benchmark that governments set. Indeed, a stringent cap and benchmark could be set for both incumbents and new entrants, forcing them to reduce their emission levels beyond a 'business as usual' scenario. The benchmark could also be dynamic and become more stringent as technologies develop, influencing the total cap on a sector in the next trading period. For example, a Japanese policy (Top Runner Programme) focuses on benchmarking the leading performing technologies, ensuring that innovative technologies are rewarded for their performance.

To conclude, the effectiveness of free allocation to limit carbon leakage is rather uncertain and will depend on the cap and the mode of allocation. It must be conditional on investment and closure decisions of firms (Neuhoff, Matthes et al., 2008). Addressing loss of competitiveness and carbon leakage domestically in an effective manner will require the implementation of a comprehensive policy portfolio, not only to ensure that the wide range of leakage concerns is effectively addressed (production versus investment leakage), but also to provide a tailored solution that is suited to different

[7] In theory, under an absolute cap of emissions decided *ex-ante*, whether allowances are provided for free or auctioned, the value of carbon emission allowances should be reflected in the prices of products whose producers' emissions are capped since every unused carbon allowance has a market value (the so-called opportunity cost) (Reinaud, 2003). The concept of opportunity cost does not apply to an output-based allocation mode: companies do not lose the opportunity to sell allowances on the market. By reducing production, the amount of received allowances decreases.

sectors, which have different fundamental characteristics (e.g. electricity-intensive versus emissions-intensive sectors).

Border adjustments

How do they work?

Countries could also decide to introduce adjustments on imports and exports of products from sectors vulnerable to carbon leakage. Beyond adjustments based on performance standards, there are currently two distinct options for adjustment measures related to the embedded carbon from production, to and from non-carbon constrained countries without comparable mitigation efforts. Either a levy is applied on imported goods (i.e. a carbon tax), or importers have to purchase emission allowances. In other words, this would affect export revenues of non-participating countries.

Border adjustment provisions have been suggested in the United States and France, and by the European Commission. They aim to ensure that domestically constrained manufacturers of GHG emissions-intensive goods are not placed at a competitive disadvantage *vis-à-vis* imports produced under less strenuous emissions requirements and that drive carbon leakage (i.e. those that do not have a 'comparable level of action'). Yet in all proposals, countries recognize the notion of 'common but differentiated responsibilities' (Article 3.1 of the Convention).

Challenges

Based on the current legislative proposals, the effectiveness of such as system is questioned. To effectively address competitiveness-driven carbon leakage, the detailed implementation of the BA scheme is critical. Ideally, to prevent carbon leakage and competitiveness loss, the scheme would need to level the playing field by covering all products vulnerable to carbon leakage and introducing the same marginal climate policy costs for all (i.e. covering both direct and indirect costs). In addition to imposing BA on imports, the country would also need to rebate the cost of emission allowances for exports. Indeed the international competitiveness of a domestic sector depends on both import and export levels. Carbon-based export rebates would allow an exporter that is part of an ETS (or carbon tax scheme) to receive a rebate on the costs of the climate policy when and if it exports its products.

While BA appears to be a simple concept, a number of technical, legal, and not least political details have to be carefully considered (Dröge, 2008).[8] These include the following:

- To prevent carbon leakage, BA would need to adjust at the border all costs incurred by the ETS, including CO_2-driven electricity cost increases (i.e. indirect costs). Only under this condition would electricity-intensive goods see their competitiveness restored. This provision is currently included in the US congressional bills. It is not clear, however, whether the European carbon equalization system would adjust prices of products based on these types of costs. Nonetheless, not every industrial company or facility pays the same electricity price in liberalized electricity markets (Reinaud, 2007). Having a clear idea of the role CO_2 prices play in electricity contracts will prove critical for setting the adjustment at an appropriate level. If not, policy-makers risk compensating companies inappropriately.

- To restore a level playing field on the international market and hence address competitiveness-driven leakage, the carbon cost of exported products would also need to be rebated. None of the proposed BA systems address the second issue, however.

- Cases where only semi-finished products, and not all carbon-intensive products, are covered could induce gaming strategies from firms seeking to bypass the adjustment scheme by further transforming their goods to reach a product category that is exempt from the list of 'covered goods' (Reinaud, 2008a). This 'comfort pill' could also worsen the competitiveness situation for the downstream industry where the greatest value added of the sector lies, as well as most jobs (at least in Europe). Considering that more than 60% of primary aluminium ingots are imported into Europe, for example, applying adjustments to all imported ingots would significantly increase the costs of final aluminium products (e.g. cars, windows, etc.) produced in Europe.

- There is also the risk of prompting trade retaliation measures if the appropriate level of adjustment is not properly set. Reinaud (2008a) mentions the difficulty in assessing how much of the ETS cost has effectively been passed through to the price of a final product, which is the basis for the adjustment on exports or that needs to be levied on imports. Among other reasons, costs of the climate policy will be different for each company as they will vary according to the day on which allowances (if needed) are purchased

[8] The WTO compatibility of a BA system is beyond the scope of this paper.

on the market and the electricity contracts are signed (or electricity is purchased on the wholesale market). A careful analysis of emission levels (both direct and indirect) in imports from countries with non-comparable action would also be necessary to obtain an order of magnitude for the effect of the BA on imports.

- If several countries implement BA and non-homogeneous BAs are applied among trade partners, products could be taxed either twice or not at all, depending on the principles on which countries have based their BA. In other words, significant international coordination would be necessary for BA systems to effectively reduce the potential competitiveness effects of ETS and maintain the environmental goal (Baron and ECON-Energy,1997).

- If the tax were levied only on products destined for carbon constrained countries, such schemes may have little leverage on developing countries' industrial activities. Indeed, in some countries, for example China, only a small percentage of total domestic production is exported to the US or the EU (Houser et al., 2008; Reinaud, 2008a). The answer to this challenge may also be international cooperation on border adjustment, which would expand the use of BA to all countries that have signed up to an international agreement (Climate Strategies, 2008).

The administrative requirements, costs and technical practicality of BA may be the greatest barrier to their implementation. Challenges will include measuring, monitoring and verifying imported products emissions of others or setting an appropriate baseline of emissions and establishing 'fair' GHG pricing. Another significantly political consideration is determining 'comparability of efforts' from developing countries, which may or may not implement non-pricing climate policies to mitigate emissions, or which implement policies that only indirectly reduce CO_2 emissions (e.g. energy efficiency policies). Indeed, under current proposals, BA would not be applied to developed countries with comparable emission-reduction commitments or to developing countries that do not contribute adequately to mitigation efforts. For those countries exempt from BA, such a system would not address leakage concerns that might result from different climate policy strategies (i.e. other than CO_2 prices).

Opportunities

If border adjustments were accompanied by full auctioning, this could both induce changes in consumption patterns in favour of lower-emitting products and also encourage innovative R&D for low-carbon emitting technologies.

Further, if companies in developing countries were able to prove the carbon content of their exported goods, this might encourage exporters to improve their emissions intensity as they would be rewarded by lower adjustments at the importer's border. Again this would involve a significant administrative burden in terms of monitoring, reporting and verifying emission levels of both production facilities and the electricity sector (in cases where BA also adjusts for indirect costs). Yet under most US proposals, the carbon content of imported goods would be assessed using a nation-wide average for the country of origin (Houser et al., 2008).

To conclude, the BA approaches on the table today might not be suitable to fully address leakage concerns of vulnerable sectors. While they are effective in addressing leakage concerns for importing emissions-intensive sectors, they are not apposite to both exporting emission- and electricity-intensive sectors. As such, complementary and more cooperative measures that engage specific sectors in developing countries may help address the leakage and competitiveness concerns.

Sectoral approaches

How could they work?

As envisioned in current climate policy debates, sectoral approaches aim to broaden participation in the post-2012 climate regime (i.e. following the first commitment period of the Kyoto Protocol) and encourage more climate-friendly practices in developing countries.[9] The scope of sectoral approaches is broad and the precise design of sectoral actions is unclear at this stage. Among others, SA possibilities include 1) domestic-oriented approaches, often focused on developing countries, with or without GHG emissions crediting and/or trading; and 2) various approaches to technology cooperation. Discussions at the international level range from non-legally binding sector mitigation targets to no-lose targets and legally binding mitigation objectives. They are also more or less linked to possible international carbon market mechanisms.

Challenges

If a sectoral agreement takes the form of national sectoral binding targets in major economies, this could potentially address leakage. Nonetheless

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[9] Approaching developing countries' engagement through sectoral approaches is nonetheless only one option (although a prominent one). For further discussions on options, see Philibert, 2005.

developed countries have repeatedly spoken against legally binding quantified targets for their economy or even sectorally based (see the submissions from China, India, the G77 and China, Indonesia and South Korea to the UN Framework Convention on Climate Change [UNFCCC] in the Accra workshop on sectoral approaches). They do not consider they have the same historical responsibility with regard to climate change. They also fear that caps will restrict their development.

As an incentive for participation in developing countries, mechanisms for support could be brought to bear in the elaboration of SA. The design of domestic sectoral actions points to several options in terms of the type of support they would require and the extent to which they would be used. Some sectoral approaches consider widening the reach of the carbon market, beyond the project-by-project approach adopted with the Clean Development Mechanism (CDM), in the form of a sectoral CDM. Yet developing countries would need, at a minimum, national and sector-based emission inventories if support were distributed in exchange for action. Capacity-building in data gathering and the administration and governance of sectoral agreements will prove critical if developing countries agree on such approaches in the future international GHG mitigation regime. They would also require substantial administrative capacity to monitor, verify and enforce policy, technology or emission objectives (Baron et al., 2007).

Further, mechanisms for support in developing countries may accentuate the loss of competitiveness for activities in developed countries if revenues accrue to competitors in heavily traded manufacturing sectors. Loss of competitiveness could occur if CDM-like projects conceded a competitive advantage to a facility by lowering its production costs. There is also the danger that such mechanisms could reward laggards by effectively subsidizing their GHG improvements while others would have taken such measures without financial incentives (Baron et al., 2007).

Opportunities

Sectoral approaches allow countries to be specific in their efforts to reduce emissions and allow formal recognition of their action. SA are intended to promote the transfer of low-carbon emitting technologies and practices (which could in fact be developed first in carbon constrained regions), and to pursue low-carbon research, investments and policies. SA could potentially reduce leakage from countries under ETS by reducing emission increases (including through energy efficiency improvements) in corresponding sectors in developing countries.

To conclude, whether these types of cooperative SA could play a role in reducing carbon leakage through both competitiveness-driven channels (i.e. trade flows and investments) is unclear. It will depend on the type and amount of support that is provided to developing countries (e.g. the possibility that crediting be expanded from the current project-based CDM) and whether support is extended to companies that relocate from a carbon constrained region. It will also depend on how sectors under ETS are treated (i.e. the mode of allocation of GHG allowances) if an international agreement includes sectoral approaches.

4. Conclusion

At present, the international architecture under the UNFCCC works under a two-tiered approach that should continue for some time. The Bali Action Plan (BAP), signed in December 2007, sets out the roadmap for the post-Kyoto international agreement. On the emissions mitigation front, it lays down the main elements in the current and on-going negotiations: a shared vision, including a long-term goal for emission reductions, 'quantified emissions limitation and reduction objectives, by all developed country Parties' and 'national appropriate mitigation actions (…) in the context of sustainable development' for developing countries, and financing technology cooperation using sectoral approaches as a means to provide cooperative technology transfer. The BAP thus re-acknowledges a differentiation of efforts between developing and developed countries. This suggests that the agreement in Copenhagen in December 2009 on the post-2012 regime may resemble the Kyoto Protocol.

There is hope that the new climate change regime may alleviate some of the concerns of competitiveness loss and carbon leakage if developing countries introduce mitigation actions in industry sectors. Yet even if all countries adopt mitigation goals, some may still decide to provide preferential treatment for certain sectors exposed to international competition, introduce policies that do not have a visible CO_2 price, or exempt them for emission reduction efforts (Reinaud, 2008a). As such, not all production facilities within a global sector would necessarily be subject to the same level of mitigation costs. Carbon leakage could surface as it is triggered by differences in marginal GHG emission mitigation costs, rather than a differentiated burden under the UNFCCC.

Challenges

Exemptions or additional measures generally add to the administrative complexity of the ETS, with provisions based on ratios of carbon costs to value added, revenue or trade exposure. Further, to minimize the distortion of the CO_2 price signal from ETS, the introduction of provisions to limit leakage under domestic ETS should be differentiated, and tailored towards addressing direct and indirect costs as well as short-term and long-term leakage channels. Yet given how many different concerns there are for industries with different profiles, no individual measure is suitable to effectively address all forms of leakage. Further, the question remains whether BA are able or even intended to provide incentives for developing countries' participation; SA certainly aim at the twin objectives of encouraging participation among emerging economies on a lower emission path and restoring a level CO_2 playing field.

For any compensatory measure, the challenge will be whether potential competitiveness effects can be alleviated by measures without altering the environmental goal (Baron and ECON-Energy,1997). Competitiveness and carbon leakage concerns should not be an excuse for ineffective action (or inaction). Further, 'the sensitive aspects of some of the measures discussed to counter leakage highlight the importance of a careful assessment of the reality of this issue. Policy-makers need to seriously consider today's trends in industrial development to understand how large or small an impact carbon policy may have on it. Without such analysis, policy-makers will not be in a position to balance the cost of leakage-mitigating measures against the benefits (i.e. avoiding competitive loss and higher emissions elsewhere)' (Reinaud, 2008a).

Opportunities

Analysis of climate-policy-induced competitiveness loss can only arrive at limited findings as it deals only with the price element of competitiveness, whereas a number of non-price elements influence companies' decisions on production levels and investment: carbon policy is only one part of the broader industry picture (Reinaud, 2008a). Looking at production and investment decisions only through the lens of climate policy certainly maintains the negative image of asymmetric action and could oversimplify the picture on industry's location choices.

Studies on competitiveness under asymmetric carbon constraints do not consider the possible positive effects of ETS on companies' competitiveness if they are the first to develop low-carbon technologies (i.e. the first-mover advantage). Delivering ambitious targets will require actions across a range of playing fields: rapidly piloting and implementing new approaches to creating large-scale investment flows towards low-carbon developmental paths and removing barriers to trade and investment to encourage and facilitate large-scale diffusion of climate-friendly goods, services and technologies are just two. Winning political support for these kinds of actions may be politically challenging, even impossible, without an expansive vision of the potential benefits rather than costs of the low-carbon transition (Chatham House, 2008).

Investments in energy-efficient technologies will help improve the productivity of companies and strengthen their competitive position and are expected to become more important as the global price of energy increases. Another aspect of competitiveness and leakage that is not studied enough in the literature is the possibility for non-participating countries to benefit from technological developments taking place in those countries with ETS. In the longer run, these so-called spillover effects may help non-participating countries reduce their energy-related CO_2 emissions – not to mention making their industries more efficient and competitive (Baron and ECON-Energy,1997).

Finally, it is important to remember that there is a discrepancy between how policy-makers look at competitiveness and how companies themselves see it. Growth in investment in China may enhance the competitiveness of a European firm that establishes plants in the country, even though from a European perspective it is perceived as a loss of competitiveness. Further, plant closures sometimes result from a decision to focus activity on higher value added parts of the production chain – a good proposition in terms of profitability, even if the result is increased imports of energy-intensive goods, sometimes akin to carbon leakage.

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