Do environmental taxes reduce sectoral competitiveness?: some theoretical and ex-post case studies*

Ana Cebreiro-Gómez
OECD

Abstract

Many OECD countries are expected to implement new environmental policy initiatives given the legally binding and quantified obligations of the Kyoto Protocol to limit emissions of greenhouse gases. Despite the theoretical efficiency advantages of environmentally related taxes, concerns of reduced international competitiveness are often an obstacle to their implementation.

This paper attempts to assess the competitiveness impact of environmentally related taxes using theoretical and ex-post case studies. Its main result shows that the competitiveness pressures depend on the type and design of a given environmentally related tax, and the characteristics of the markets and firms affected. The case studies indicate modest impacts of environmentally related taxes implemented at the OECD level, especially if the policies raise revenues that can be used to lower some taxes that cause significant economic distortions. In contrast, simulation results show likely stronger negative impacts on international competitiveness when unilateral environmentally policy instruments are implemented.

Additionally, provisions to protect industry typically linked to the implementation of environmentally related taxes make it difficult in practice to find examples of the negative impacts on competitiveness. An important lesson to learn is that relatively modest carefully designed compensation schemes can often suffice to make firms equally well-off as before implementing environmentally related taxes. The relevant challenge for policy makers is to find a reasonable balance between the benefits and the costs of environmental improvements and to choose the policy instruments that best help in achieving a given environmental target at the lowest possible cost to the society as a whole.

Keywords: environmentally related taxes, competitiveness, double dividend

* The views expressed are those of the author and are not necessary the views of the OECD or the governments of its member countries.

1. Introduction

The Kyoto Protocol entered into force on 16 February 2005. Under this Protocol many countries have legally binding and quantified obligations to limit emissions of greenhouse gases. Therefore, many OECD countries are expected to implement new environmental policy initiatives in order to limit CO_2 emissions from various industries. In fact, the EU Member States have already implemented a CO_2 emissions trading scheme from 1 January 2005, with obligations for selected industries to hold emission allowances for the CO_2 emissions they cause.

Environmentally related taxes are one of the possible environmental policy instruments, which have well known theoretical advantages (especially the static and dynamic efficiency). However, a major obstacle to the implementation of these taxes is the fear of reduced international competitiveness in the most affected economic sectors.

But, do environmentally related taxes strongly reduce sectoral competitiveness or are they only accelerating the needed restructuring of some sectors? If environmentally related taxes do reduce sectoral competitiveness, should the affected sectors receive any compensation for this negative impact? If so, how can these sectors be compensated?

This paper uses two theoretical case studies (simulations in the steel and cement industries) and two ex-post case studies (the United Kingdom Climate Change Levy and the Norwegian Aviation Fuel Tax) in an attempt to answer the above questions. [1]

In the long run and with environmentally related taxes implemented at the OECD level, the theoretical studies summarized in this paper indicate modest impact on sector competitiveness, especially if the policies raise revenues that can be used to lower some taxes that cause significant economic distortions. The competitiveness pressures depend on the type and design of a given environmentally related tax, and on the characteristics of the markets and firms affected. The simulations particularly in the steel industry show, however, that given the present imbalances in the sector, environmentally related taxes may speed up an inevitable restructuring process in the industry.

On the other hand, simulation results show likely stronger negative impacts on international competitiveness when environmental policy instruments are implemented in a non-global manner (unilateral policies).

1) For a complete analysis see OECD (Forthcoming, a).

In practice it is difficult to find examples of the negative impact of environmentally related taxes on competitiveness. This fact is mainly explained by the different provisions to protect industry that typically go together with the introduction of such taxes. The ex-post case studies summarized in this paper present some examples of the use of tax exemptions and revenue recycling as compensation measures. It is important to note here that there is a risk that affected firms could be seriously over-compensated. In general, relatively modest compensation schemes can often suffice to make firms equally well-off as before implementing environmentally related taxes. The relevant challenge for policy makers is to find a reasonable balance between the benefits and the costs of environmental improvements and to choose the policy instruments that better help in achieving a given environmental target at the lowest possible cost to the society as a whole.

This paper is structured as follows. A brief description of the case studies is presented in Section 2. Section 3 discusses the three key issues to take into account when assessing competitiveness (the definition of competitiveness, the "baseline" policy against which the impact is being assessed and the environmental policy instrument that is used). Section 4 explains the main compensatory measures that could likely reduce the negative impact of environmentally related taxes on competitiveness. Finally, Section 5 concludes with some political economy lessons that can be drawn from the case studies.

2. Brief introduction of the case studies [2]

This section briefly describes the case studies. The main conclusions on the impacts on sectoral competitiveness and their policy implications are presented as examples in the remaining sections of the paper.

2.1 Theoretical case studies

As underlined in OECD (Forthcoming, a), theoretical case studies are useful mainly for two reasons. Firstly, simulations can help to get a better understanding of the likely impacts of possible cost increases on sectors where these taxes are currently absent. Secondly, theoretical cases can simulate possible and not often used measures to reduce industrial relocations when unilaterally implementing environmentally related taxes, for example border tax adjustments. The theoretical case studies undertaken were in the steel and cement manufacturing sectors. While both are high energy-intensive sectors, they differ in the degree of international competition. Steel manufacture has a strong but differentiated international competition; in contrast, cement manufacture has only some degree of international competition.

2) For a complete description of the different case studies see OECD (Forthcoming a).

The *steel case study* uses a partial equilibrium model to assess the impacts resulting from a hypothetical OECD-wide carbon tax (equivalent to a system of tradable emission permits) levied at 25 USD per tonne of CO_2 emissions.[3] CO_2 emissions from steel production differ significantly between processes, with the 'EAF' process involved in recycling scrap releasing less CO_2 per tonne of crude steel than the 'BOF' process of the primary integrated steel plant combustion of coal (BOF) (about 75 per cent of global CO_2 (atmospheric) emissions from steel production are related to the latter).[4] Additionally, the CO_2 emissions associated with iron and steel production also differ across countries and regions, depending on how much energy is used and the CO_2 intensity of that energy.

The *cement case study* simulates a business-as-usual scenario (BaU) from 2000 until 2030 and three climate policy scenarios:

- a CO_2 tax or an Emission Trading Scheme (ETS) with auctioned allowances is implemented in the Kyoto Protocol Annex B countries that have ratified it, hereafter labelled "Annex B",[5] assuming a CO_2 price of 15 euros per tonne;
- the same policy is implemented with Border-Tax Adjustments (BTA), i.e. a rebate on cement exports and a taxation of imported cement, is implemented.
    - o In the "Complete BTA" scenario (BTA scenario), exported production is completely exempted from the climate policy and imports of cement from the rest of the world are taxed in accordance with the CO_2 intensity of the cement production in the exporting country.
    - o In the "WTO BTA" scenario, exports benefit from a rebate corresponding only to the least CO_2 intensive technology available on a large scale, and imports are taxed to the same level. Such a scenario is more likely to be compatible with the current WTO rules than the first one.

2.2. Ex-post case studies

While there are no doubts about the theoretical advantages of environmentally related taxes, in practice it is difficult for policy makers to implement all the desirable features of market based instruments for environmental policy. In the practical design and implementation of such taxes there is a trade-off between economic efficiency and other goals, which are not necessarily consistent with each other. Additionally, governments have to contend with pressure groups and lobbies which, in turn, represent sets of conflicts of interest. The analysis of ex-post case studies allows a better understanding of this gap between the actual and "optimal" policy and the processes influencing it.

3) Note that most recent estimates of an international "carbon price" considered in the implementation of the Kyoto protocol tend to be significantly lower.

4) Primary integrated steel plants transform iron into steel in a Basic Oxygen Furnace (BOF) so called 'mini-mills' recycle scrap into steel in an Electric Arc Furnace (EAF).

5) The USA and Australia are not included in the Annex B area. Additionally, since New Zealand is merged with Australia in the model data set, it has been assumed that it does not implement the climate policy although is has ratified the Kyoto Protocol.

A main finding drawn from these ex-post case studies is that significant 'competitiveness' pressures are indeed a reality in certain cases, depending on the type and design of a given environmentally related tax, and the characteristics of the markets and firms affected. However, in general these negative impacts on competitiveness are reduced by (not always well designed) provisions to protect industry.

The remaining of this section briefly introduces the United Kingdom Climate Levy and the Norwegian Aviation Fuel Tax.

The *United Kingdom Climate Change Levy* (CCL) is a 'downstream' tax, i.e. it is paid by energy users not by extractors or generators, it is levied on industry only (including agriculture and public sector), with households and transport being exempt (also renewable energy since 2002), and it is structured so as to encourage renewable energy but not nuclear power (users of nuclear electricity pay the tax). An 80 per cent discount could be secured if the industry in question negotiated a 'Climate Change Agreement' (CCA) –i.e. an industry package of measures to reduce emissions relative to some baseline.[6]

Additionally, the CCL is designed as a revenue-neutral tax. Most revenues from the CCL are 'recycled' back to CCL-paying industry in the form of reductions in employer's social security contributions in order to encourage employment and, thus, ensure no 'competitiveness' harm. Also, reinforcing the substitution effect arising from the resulting price increases, part of the revenues from the CCL are used to finance carbon technology improvements. However, the revenue effect expected from the use of this part of the tax revenues to encourage longer-run switches to low carbon technologies has been questioned. The very modest sums (around 4 per cent of CCL revenues per annum) spent by the Carbon Trust[7] suggest that the use of such revenues to secure long-run substitution effects is unlikely to be effective.

However, the incompatibility of the climate change policy with the EU ETS constitutes a real problem for the policy.[8] Anyone over-complying with the CCA agreement could, in principle, trade the resulting credits into the UK emissions trading scheme (ETS), along with permits allocated under that scheme and renewable energy certificates under a separate renewable energy constraint on generators. The linkages between the UK CCL/CCA package, the UK ETS and the EU ETS are immensely complex and they are out of the scope of this paper,

---

6) The CCAs came into being because of the very strong political lobby against the effects of the CCL on the competitiveness of energy-intensive industries.

7) The major part of the CCL revenues are recycled directly back as social security refunds and the other revenues partially finance The Carbon Trust, which also receives grants from DEFRA.

8) For an excellent analysis see Sorrell (2002).

The *Norwegian Aviation Fuel Tax* is a CO_2-tax on aviation fuel implemented in Norway in 1999 as a part of a larger proposal of a Green Tax Reform. The level of taxation was determined on a pragmatic basis, with the declared Norwegian political goal of being a frontrunner in climate change policy. Therefore, the adjustments in the tax were considered in relation to the level of CO_2-taxes imposed in other countries. To reduce the increased costs for the most affected sectors and regions, the Government proposed decreasing the existing seat tax on domestic flights accordingly to get a neutral effect on the tax burden of the aviation sector. The impacts of this fuel tax on the airlines' cost are difficult to assess mainly because of many other changes in the various taxes and duties on air traffic. However, the total level of aviation charges seems to have increased substantially since 2001 mainly due to changes related to security measures. The minor importance of the aviation fuel tax could be explained by its small tax revenue compared to the revenue from the other duties. The effects on air ticket prices and thus air travel demand seems to have been negligible due to increased competition in the domestic market and cost reduction programmes imposed by the airlines. Additionally, environmental impacts of the tax have probably been negligible. However, the marginal effects of the tax cannot be isolated from the effects of all other changes in the aviation sector over the years.

Given airlines concerns on competitiveness, the Norwegian government (requested by the Parliament) created a Commission in 1991 to investigate the air traffic competitive conditions both at national and international level. One of the main arguments regarding competitiveness was that airlines with international flights could avoid the tax by tanking abroad. This could have consequences for the competitive position for some airlines as well as for the potential environmental effects of the tax. This Commission concluded that the aviation fuel tax caused competitive distortions between airlines with mainly domestic flights and those with extensive international traffic. In contrast, experiences so far show that the actual possibilities of tanking abroad are limited. There are some costs connected to tanking abroad that can reduce net savings: the weight of the aircraft increases resulting in considerable increase in fuel usage. The relatively low level of the tax can also explain the limited tanking abroad to avoid the fuel tax. The Norwegian government made no changes in the tax as a result of the report.

3. Environmentally related taxes and sectoral competitiveness

A major obstacle when implementing environmentally related taxes is the fear of reduced international competitiveness in the most affected economic sectors.[9] This concern is not only for economic but also for environmental reasons.

9) See OECD (2001).

First, the main economic argument is that when the introduction of environmentally related taxes increases domestic production costs of internationally traded goods, domestic production would be expected to decline - exports become less attractive and imports more - at least in the short run, implying job losses and other adjustments in the national economy.

Second, in terms of environmental improvement unilateral implementation of environmentally related taxes may be inefficient in cases of transborder pollution, such as CO_2 emissions. This is the case when in some sectors, where profits are significantly reduced, producers relocate operations or consumers preferentially buy more goods from regions where the taxes were not implemented and where CO2 emissions are higher (the problem of 'carbon leakage'). Consequently, non-unilateral policy actions should imply, at least, better results in the environment side; for example in the reduction of CO_2 emissions as explained in the following section.

When assessing competitiveness there are three key issues to take into account:

- How competitiveness is defined;
- The ex-ante and ex-post scenarios; i.e., the "baseline" policy against which the impact is being assessed;
- The environmental policy instrument that is used.

The remaining of this section discusses these three issues and the role of double dividend hypothesis in the impact on sector competitiveness. However, the opposition to environmentally related taxes tends to overlook that such taxes are only one of a number of factors determining a firm's overall competitiveness.

3.1. Definition of competitiveness

It is important to distinguish between competitiveness impacts at a *national* and at a *sector* or *firm* level OECD (2003a). A company is competitive if it is able to produce products that are either cheaper or better than those of other firms. Ultimately, business competitiveness is a matter of relative performance. The impact of environmental policies may be complex, and may well vary between firms. Applying the concept of competitiveness to industrial sectors or to whole economies is more controversial. At a national level any negative impact imposed upon one firm or sector will tend to be attenuated by positive impacts on others.

This paper concentrates on sectoral competitiveness for three reasons: a) policy changes that make some firms worse off will *always* make other firms better off; b) at a national level any negative impact imposed upon one firm or sector

will thus tend to be attenuated by positive impacts on others; c) in practice policy makers tend to be more concerned with any potential 'losers' from a policy change than with the impacts on the economy as a whole.

Additionally, considerable attention is given to policies addressing climate change, in part because such policies are likely to trigger more significant behavioural changes throughout the economy than most other environmental policies and in part because of the problem of *'carbon leakage'*. As explained in the previous section, the 'leakage' problem arises when the unilateral imposition of environmentally related taxes in one country results in the relocation of production to other countries. In the case of taxes levied on 'local' pollutants, the loss of competitiveness as evidenced by the relocation may be judged to be worthwhile because of the resulting local environmental improvement. However, when the pollutants concerned contribute to global problems, the loss of competitiveness in the country imposing the tax results in little or no local environmental improvement, as the country continues to suffer from the pollution even though the activities that produce it have moved abroad. Economic competitiveness concern and this problem of "leakage" are the main arguments against non global mitigation policy or at least in favour of compensations.

If a policy instrument fails to create changes in consumption and/or production patterns, it simply cannot deliver any environmental improvements. The more relevant issues are, hence, who should change their behaviour, by how much and within which timeframe. In addition, it is a relevant issue whether or not given environmental targets – or the lack of such targets – represent a reasonable balance between the benefits and costs of environmental improvements.

As underlined in OECD (Forthcoming, a), the effects on competitiveness when implementing environmentally related tax will be stronger:

1. The lower the ability to pass costs increases to prices. This will depend on the price-responsiveness of demand, the market structure and the geography of the sector market, international competition being the most important factor in reducing this ability.[10]

2. The lower the feasibility of the substitution possibilities; a limited scope for identifying and financing cleaner production technologies and processes implies an inability to substitute away from environmental taxes;

3. The higher the energy intensity of the sector, since the bulk of environmentally related taxes are levied on energy use and transportation.

10) The scope for shifting tax burdens on to demanders or suppliers through price incidences is lower for smaller and more open countries.

For example, energy costs typically account for 15-20% of the costs of steel production (OECD/IEA, 2000). Hence, a carbon tax may significantly increase the production costs, leading to lower profits, either through lower margins or through a reduction in sales, or both. Reduced profits may in turn lead to closure of firms and/or relocation of activity to countries with less stringent climate policies.

The main simulation result of imposing an OECD-wide carbon tax in the steel sector indicates marked improvement in the environment despite the leakage problem and a relatively low competitiveness impact, although the latter differs across producers depending on the process used (BOF: 9 per cent; EAF: 2 per cent). Because steel demand is relatively price inelastic and because steel is a non-homogenous good, a significant share of the gross tax burden would be carried by the steel consumers. The shift of the tax burden to consumers would be facilitated by the increase in marginal production costs in non-OECD countries as steel producers in this region are pushed closer to their capacity limits. Suppliers of inputs to the steel industry also carry part of the tax burden of BOF steel producers, but far less than the consumers. For EAF producers, a carbon tax would increase the input costs due to higher scrap prices.

Carbon taxes would seriously hamper new investments in BOF capacity in the OECD area, whereas new investments in EAF steel making would still be profitable. In the long run, a stronger restructuring of the OECD steel industry towards EAF steel making is envisaged as well as new capacity in non-OECD regions. This would reduce the price/cost margin of OECD steel producers even further. However, due to the industry large sunk costs, there is little reason to believe that the carbon tax in itself would lead to massive closure of firms in the OECD. But given the present imbalances in the steel industry, environmentally related taxes may speed up an inevitable restructuring process in the industry.

On the other hand, simulations show that unilateral policies by single regions or countries may lead to quite dramatic cut-backs in the production of BOF steel. This is because unilateralism leaves smaller opportunities to shift the tax burden over to suppliers or customers, thus the impact on competitiveness turns high for integrated steel plants and modest for 'mini-mills'. For EAF steel producers, the net effect of unilateral policies would not differ much from an OECD-wide approach, because unilateral policies will lead to a smaller increase in scrap prices.[11]

In contrast to the steel case study, the lower impact on competitiveness in the cement sector is mainly explained by the high ability of the sector to increase operating profits by passing more of their marginal cost increases to prices. Simulation results show that a CO_2 tax implemented in the Annex B countries would reduce cement production in these countries by 7.5 per cent; in contrast a carbon tax at the OECD level would reduce the OECD steel production by 9 per cent for the more polluting BOF process plants.

11) See The Carbon Tax (2004).

Theoretical simulations also predict a *leakage problem* in both the steel and cement sectors. While decreasing production in the OECD countries, a hypothetical OECD-wide carbon tax in the steel sector would raise steel production outside the OECD, where the emission intensities are relatively high, by almost 5 percent (implying thus a fall in world steel production of roughly 2 percent). However, global emissions from the sector would decline by over 4.6 per cent (more than twice the percentage reduction in global steel production) due to a substitution towards cleaner input mix and cleaner production processes in the OECD area. On the other hand, this substitution process (mainly from the use of pig iron towards more intensive use of scrap in BOF steel making) will push scrap prices up and, therefore, reduce the competitiveness of scrap-based EAF steel producers.

The implementation of a CO_2 tax in the Annex B countries (those ratifying the Kyoto Protocol except the USA & Australia) in the cement sector would entail a decrease of around 20% in CO_2 emissions in these countries. However, part of these reductions would be compensated by emissions increases in the non Annex B countries, which are less CO_2 efficient than Annex B countries. The corresponding leakage rate is around 25% in 2010 (around 15% after), a result in the upper range of leakage estimates presented in the IPCC third assessment report (5 to 20%, Hourcade and Shukla (2001)). World emissions are predicted to decrease by around 2% in 2010, 2020 and 2030.

3.2. "Baseline" policy and impact on competitiveness

When assessing the impact of environmental taxes on competitiveness it is important to clearly specify the alternative "baseline" policy against which the impact is being assessed. Two dimensions are particularly relevant:

- The impact on the government budget: whether the comparison is made on a revenue-neutral basis or tax revenues are assumed to be higher with the environmental tax than in the baseline case.

  The general case is assuming revenue-neutral basis by, for example, using its tax revenues to replace existing distortionary taxes such as social security contributions. Then, for some firms the tax burden will rise and for others it will fall (redistribution of the tax burden), depending on their energy intensity and labour use. Thus, although the overall effect is assumed to be revenue-neutral, this does not necessarily imply that the impact on the trade balance will be neutral.

- The impact on the environment: whether the comparison is between two equivalent ways of achieving a given standard of environmental protection, or the level of environmental protection varies between the two scenarios (general case). In general the costs of environmental compliance (abatement costs) may be unevenly distributed across firms and sectors. The greater the heterogeneity of firms in terms of marginal abatement costs, the greater this effect will be.

For example, while the Climate Change Levy in the United Kingdom was designed a part of a revenue-neutral reform (most revenues from the CCL are 'recycled' back to CCL-paying industry in the form of reductions in employer's social security contributions), this does not mean that each and every industry would find itself in a tax-neutral position. ECOTEC (1999) estimated the effects of the early 1999 CCL proposed levy, not of the eventual levy. The study suggested that the net effects of the CCL and the social security rebate would be very modest – either beneficial or a very small cost – for most industries. Even then, the net tax is very small relatively to sectoral turnover. Moreover, those industries facing a net tax are most energy-intensive and they could take advantage of the provision for a CCA.

An example of the benefits from recycling tax revenues in terms of competitiveness is found in the steel case study. If the tax revenues were recycled back to the steel industry as an output subsidy, the decline in OECD steel production would be quite small (<1%, in contrast to 9% when revenues are not recycled). If the tax refund were uniform across processes, there would, however, be a significant restructuring in the OECD towards the relatively clean process (EAF steel making). This reinforces the fact that different firms within a given sector will be affected in different ways by any use of economic instruments. However, revenue recycling would reduce global emission reductions in the sector from 4.6% to around 3%. In other words, protecting the competitiveness of energy intensive sectors in the OECD area through the recycling of tax revenues to the given sectors is likely to lower the environmental effectiveness of the policy as a whole.

3.3. Double Dividend Hypothesis and sectoral competitiveness

In addition to competitiveness concerns because of cost increases due to the additional tax payments, there is the issue of the competitiveness consequences of the revenues raised. This issue is closely related to the double dividend literature. As stated in OECD (2001), the term 'double dividend' refers to the possibility that a revenue neutral environmentally related tax shift could generate two possible benefits or dividends: more effective environmental protection (gains from the static and dynamic efficiency of environmentally related taxes), and benefits arising from the reduction in other distortionary taxes. Then, how far (if at all) does this second benefit offset the impact on competitiveness of these environmentally related taxes?

The literature distinguishes between "weak" and "strong" double dividend.[12] They differ in terms of the comparison that is being made. The "weak" double dividend, widely accepted among economists, is defined as the claim that using revenues from environmentally related taxes to reduce other tax rates reduces excess burdens, thus lowering the efficiency cost of the green tax reform. Thus, this "weak" claim involves a comparison of two cases with equivalent environmental impact but a different use of revenues.

12) See Goulder (1995)

In contrast, the "strong" definition of double dividend is more controversial. It claims that switching the structure of taxation towards a greater revenue contribution from environmentally related taxes would reduce excess burdens. Thus, a green tax reform does not only improve the environment but also increases non-environmental welfare. The question as to whether this strong form holds, heavily depends on the structure of the economy.[13]

Although the strong double dividend argument does not create a compelling case for environmentally related taxation, there are a number of significant policy implications which follow from recognition of the weak double dividend argument:

1. If revenues from environmentally related taxes are used to make compensating lump-sum reductions in tax burdens (e.g. for distributional reasons, or to avoid disturbance to sectoral competitiveness), this foregoes possible efficiency gains, compared with reductions in marginal tax rates. This generally implies a preference for revenue-raising instruments, compared with those that forego revenues.[14] In choosing between "grandfathered" and "auctioned" tradable permits it will be noted that grandfathering is equivalent to a lump-sum return of revenues, and therefore foregoes potential efficiency gains from using the revenues to cut distortionary taxes.

2. The optimal level of pollution abatement is not independent of the environmental policy instrument used (Lee and Misiolek, 1986). Assuming the rate of the environmentally related tax is below the Laffer maximum-revenue tax rate, the efficient level of pollution abatement will be higher under a revenue-raising instrument than under a non-revenue-raising instrument.

3.4. Environmental policy instruments and competitiveness

Those strongly opposed to introducing environmentally related taxes on competitiveness grounds sometimes tend to forget that alternative policy instruments used to reduce pollution, such as regulations and permits, also affect firms' costs and impact on the competitive position of individual sectors and the country as a whole. By enhancing the economic efficiency by which a given target is reached, properly designed taxes will help to minimise adverse effects on competitiveness nation-wide, compared to e.g. direct regulation or "voluntary approaches".[15] This section briefly compares the competitiveness effects of regulations, taxes and permits.

---

13) The literature suggests that the strong double dividend is unlikely to exist if the starting point has an efficient pattern of revenue-raising taxes, see for example Bovenberg and van der Ploeg (1994).

14) If the environmental externality is not addressed by the tax, it has to be addressed by some other form of regulation which is likely to have similar counterintuitive effects (Sterner, 2003).

15) All policy instruments can have an impact in competitiveness, but environmental taxes are more "visible" than, for example, regulations.

A hypothetical efficient command and control policy would be one in which the pattern of pollution abatement required across sources minimises the aggregate cost of abatement. The core of the argument for market mechanisms in environmental policy is, of course, that command and control regulation is unlikely to be able to achieve this efficient outcome, because it requires the regulator to be able to obtain full information about firms' abatement costs. Therefore, the "real regulatory policies" cannot take the differences on abatement costs across firms on board and involve higher aggregate costs of abatement, and hence aggregate inefficiency, and a loss of competitiveness for the economy as a whole. Thus, the differences in abatement costs will imply differential competitiveness effects (in the sense of gainers and losers) among regulated firms.

With an efficiently-functioning permit market, a system of auctioned emissions permits and an emissions tax achieving the same effect on emissions have equivalent fiscal implications. The equilibrium permit price for one unit of emissions would equal the emissions tax per unit, and the payments by firms and the revenues derived would be the same.

Finally, as compared with auctioned permits, grandfathered tradable permits do not derive net revenue, and therefore the weak double dividend efficiency gains do not arise. Therefore, the competitiveness effects at the firm level will depend on the relationship between the permit allocation and the number of permits the firm requires in equilibrium. Firms receiving excess permits will benefit to the value of the surplus permits; firms which are net purchasers of permits incur additional costs of permit purchase.

It is important to note that grandfathered tradable permits analytically equal emissions taxation where revenues are recycled to taxpayers on the same basis as used for permit grandfathering. Except for the dynamic efficiency incentives the case of grandfathered tradable permits is also similar to the case of efficient command and control. In terms of static efficiency, fiscal burden, etc, this is equivalent to grandfathered permits in the case where the permit allocation exactly corresponds to the efficient pattern of residual pollution (so that no post-allocation permit trades take place). However, under command-and-control firms face no incentive for further innovation in abatement technology, since changes in residual pollution have no financial implications.

4. Compensation measures to reduce negative impacts on competitiveness

It is often said that it is difficult to find examples of environmentally related taxes having a serious negative impact on the competitiveness of any sector. It must be remembered, and as the ex-post case studies show, that this situation results directly from provisions to protect industry that typically accompany the introduction of such taxes. This section summarises compensations measures likely to reduce the negative impact on competitiveness.

As also demonstrated by the case studies, the use of *exemptions and/or rate reductions* is the common practice to protect (loss of competitiveness) firms that could be strongly affected by the introduction of new environment economic instruments; e.g. when Norway introduced the CO_2-tax on aviation fuel, the existing seat tax on domestic flights was reduced accordingly and as a result the domestic aviation sector was not supposed to face an increased tax burden. The "Climate change levy" in the United Kingdom offers 80 per cent discount for energy-intensive firms that have signed up to binding negotiated agreements on energy efficiency.[16]

As stated in OECD (2001), other options for mitigating the competitiveness impact include the introduction of compensation schemes, the recycling (at least part) of revenues from environmentally related taxation, the use of 'border tax adjustments', and the co-ordination of countries interested in similar (market-based) approaches.

Exemptions and rebates tend to create inefficiencies in pollution abatement and to undermine application of the polluter pays principle. Indeed, blanket exemptions for polluting products along with rebates for heavy polluting industries can significantly reduce the effectiveness of environmentally related taxes in curbing pollution and similarly reduce incentives for developing and introducing new technologies. A way to get round this problem was sought in the case of the Climate Change Levy in the United Kingdom: an 80% tax rate reduction was offered to sectors that undertook detailed emission reduction targets through the so-called Climate Change Agreements (CCA). As indicated in OECD (2004), there is, however, considerable uncertainty regarding the 'additionality' of the CCAs. There are some claims that the targets set in the agreements represented little more than Business-as-Usual and that the tax rate reductions offered to industry in the Climate Change Levy do indeed reduce the environmental effectiveness of the tax.[17]

16) Some of these exemtions are reviewed in OECD (2001).

17) For further discussion on environmental effectiveness and economic efficiency, see OECD (2003c) and Braathen (2005).

Relatively modest compensation mechanisms can often suffice when introducing a tax or a trading scheme (even based on auctioning), in order to make the owners of the firms equally well-off as before; but the size of the 'necessary' compensation depends on how insulated the domestic market is from international competition. If some degree of compensation is "the price one has to pay" to implement a new environmental policy, this can often be done at a fairly modest cost to society as a whole. However, there is a risk that the affected firms could be seriously over-compensated – in part because policy makers tend to forget that any environmental policy measure that seeks to limit emissions (and indirectly production) automatically will create a "scarcity rent". In the case of emissions trading, grandfathering of all permits means giving away for free all of this 'scarcity rent'. If an 'unnecessarily' large share of the rent is given to the firms, the economic efficiency costs will increase because less money would be available, for example, to reduce distortionary taxes (double dividend hypothesis).

Recycling (part of) any tax revenues back to the firms or sectors in question can be done in ways that maintain firms' incentives to abate emissions at the margin, e.g. if full tax rates are paid on emissions or on inputs, as relevant, while a refund is given based on the historic production levels of the firm. Likewise, even if (some of) the emission allowances in a trading scheme are grandfathered, the firms in question will get a full incentive to abate emissions from the alternative value (or 'opportunity cost') that each allowance represents.

In fact, when considering introducing compensation schemes, it should be kept in mind that such measures exclude the possibility to use the same revenue for other purposes. Three options are often referred to in the context of environmentally related taxes:

1. Reductions in social security contributions, in order to promote economic efficiency and employment;
2. Measures to compensate low-income households for any tax increases; and
3. Increases in public spending to protect the environment.

Option 1 is the 'double dividend' discussed in the previous section. The combining of e.g. energy tax increases and reductions of social security contributions have been used in several OECD countries, including Denmark, Germany, Sweden, and the UK, in part to 'sell' the increase in the energy tax and to reduce the tax-wedge on labour.

Option 2 concerns distributive issues and it is out of the scope of this paper; however some approaches that may provide relief from an environmentally related tax are summarised below:[18]

18) For a detail discussion on distribution issues see OECD (Forthcoming, a).

- An increase in the basic personal allowance (or introduction of an environmentally related tax allowance),
- The introduction of a 'wastable tax credit'; and
- The introduction of a 'non-wastable tax credit'

Option 3 is also somewhat controversial. While increasing the spending on some environmental purpose simultaneously with e.g. an increase in an energy tax can help increase the public acceptance of the latter, there is a significant danger that the "earmarking' of revenues from certain taxes can create rigidities in the budget process and lead to economic inefficiencies.

Additionally, *regionally or internationally co-ordinated environmentally related taxation* would reduce arguments for exemptions and rebates based on international competitiveness. However, co-ordinated action does not mean that there will not be any winners or any losers. For example, a global tax on CO_2 emissions would be particularly costly for energy- and carbon-intensive economies (OECD, 2001).

Finally, the theoretical case studies show that *border tax adjustments* can be used as an efficient instrument to limit sectoral competitiveness impacts and prevent carbon leakage. Their effect would depend crucially on the scope and the design of the adopted scheme. For example, with both import taxes and export subsidies differentiated across steel types, and border tax rates linked to emission levels in non-OECD countries, the decline in OECD steel production might be as small as 1% (in contrast to 7.5% without BTA). At the same time, the reduction in global emissions would be larger than without BTA. This is because in contrast to the policy without BTA, emissions from the rest of the world would also decrease due to a decrease in their production (around -0.1%). However, non-Annex B could claim that this system distorts competition in favour of Annex B countries since their price-competitiveness would decrease a little and they would loose some market shares. Although the policy treats domestic and foreign producers in a similar way (they pay the same cost per ton of CO_2), it gives a competitive advantage to Annex B producers, who use cleaner production techniques (more energy efficient technologies and less carbon intensive fuels).

This criticism from the non-Annex B producers could be solved under the WTO BTA scenario since total production would actually rise a little in non-Annex B countries. Emissions from non-Annex B would increase a little compared to BaU, therefore the slight spillover observed in the BTA scenario would be replaced by a slight leakage, around 4% in 2010. Thus under the WTO BTA scenario, leakage would still be prevented efficiently, although the reduction in world emissions would be a little lower than under the BTA scenario. The main drawback is that the WTO BTA scenario would lead, as does the previous one, to a higher increase in cement price and thus would hurt consumers in Annex B countries.

5. Some lessons from the case studies regarding the competitiveness concern[19]

5.1. Lesson from the theoretical case studies

A first lesson to draw from the theoretical case studies is that economic instruments will not affect different firms within a given sector in the same way. This is explained mainly by the different input combinations and the resulting differences in emission profiles. An example can be found in the steel case study: when tax revenues were recycled back to the steel industry as an output subsidy, the decline in OECD steel production was estimated to be quite small (<1%). If the tax refund were uniform across processes, there would, however, be a significant restructuring in the OECD towards the relatively clean process, i.e. EAF steel making.

However, an important point to note here is that revenue recycling would reduce global emission reductions in the steel sector (from 4.6% to around 3%). In other words, a second lesson is that protecting the competitiveness of energy intensive sectors in the OECD area through the recycling of tax revenues to the given sectors is likely to lower the environmental effectiveness of the policy as a whole.

A third lesson is the importance of taking into account possible adjustments in related markets when considering the impacts of a given policy on a particular sector. A part of any initial burden placed on a sector is likely to be shifted backwards to input suppliers and forward to the customers. In the steel case, this is *e.g.* illustrated by the (somewhat crudely) estimated impacts on scrap metal prices, and the increase in steel prices. Because steel demand is relatively price inelastic and because steel is a non-homogenous good, a significant share of the gross tax burden would be carried by the steel consumers. The shift of the tax burden over to consumers would be facilitated by the increase in marginal production costs in non-OECD countries as steel producers in this region are pushed closer to their capacity limits. Suppliers of inputs to the steel industry also carry part of the burden of BOF steel producers, but far less than the consumers. For EAF producers, a carbon tax could increase the input costs due to higher scrap prices.

A fourth lesson is that, in spite of some element of 'carbon leakage' even when policies to combat climate change are put in place on a relatively broad front, significant global reductions in carbon emissions – compared to a reference scenario – can be achieved. Thus, an OECD-wide tax would reduce OECD emissions of CO_2 from the steel industry by 19%. Despite relatively high emission intensities in non-OECD countries, global emissions from the sector would decline by 4.6%, *i.e.* more than twice the reduction in global steel production. This is due to substitution towards

19) See OECD (Forthcoming, a) for a wider analysis of political economy lessons.

a cleaner input mix and cleaner processes in the OECD area. A similar finding is made in the cement sector case study. In a scenario with emission trading in Annex B except USA, even if cement production outside this area increases in response to the policies put in place in most of the OECD-related regions, global carbon emissions in clinker manufacturing are estimated to decrease.

A fifth lesson is that – while the importance varies between different industries – the larger the group of countries that put similar policies in place the more limited the impacts on sectoral competitiveness. The steel case study shows a low impact on the competitiveness of the sector when an OECD-wide carbon tax is implemented because of the ability to pass the tax to the consumers. In contrast, unilateral actions reduce these opportunities to shift the tax burden over to suppliers and customers and, therefore, the impact on competitiveness turns high for integrated steel plants and modest for 'mini-mills'.

A sixth lesson is that, from an environmental point of view there could, in some cases, be advantages related to the use of border tax adjustments, as simulation results show in both case studies. However, the effect of any border tax adjustments depends crucially on the scope and the design of the adopted scheme and both practical and legal issues related to their implementation need to be solved.

5.1. Lessons for the ex-post case studies

The first lesson from the ex-post case studies is that policy-makers should take steps to ensure that competitiveness pressures are adequately assessed and addressed. In doing so, it is important to consider a short-list of mitigating options alongside legal obligations and possibly other constraints to ensure that they would not be found to provide a prohibited subsidy (e.g. energy consumption tax by industry in France).

A second lesson is that when loss of competitiveness is an issue, different mitigating measures can be considered and they will have different effects on both environment and competitiveness. Firstly, one alternative when levying taxes that raise revenue, is compensation by reducing other taxes (for instance as in the case of the Norwegian aviation fuel tax) or other kinds of budgetary compensation. In this case it is important to ensure that the compensational measures do not reduce abatement incentives. Secondly, policy makers could consider sectoral exemptions or reduced rates (as for instance was the case in the UK Climate Change Levy). Finally, sometimes international co-ordination at different levels can be an option to consider. Another, perhaps more theoretical, alternative could be border tax adjustments.

However, there often seems to be a trade-off between the size of the administrative costs and measures to create a 'fair' or 'politically acceptable' scheme. Often mechanisms introduced for non-environmental reasons, to address competitiveness or income distribution concerns are responsible for the increase of the administrative costs; e.g. the CCL in the UK.

Additionally, relatively modest compensation mechanisms can often suffice when introducing a tax or a trading scheme (even based on auctioning), in order to make the owners of the firms equally well-off as before – but the size of the 'necessary' compensation depends on how insulated the domestic market is from international competition. However, there is a risk that the affected firms could be seriously over-compensated. If so, the economic efficiency costs will increase because, for example, less money would be available to reduce distortionary taxes.

References

Bovenberg, A.L. and F. van der Ploeg (1994), "Environmental policy, public finance and the labour market in a second-best world", *Journal of Public Economics*, 55, 349-390.

Braathen, Nils Axel (2005), "Environmental agreements used in policy mixes". In Eduardo CROCI (ed.), *The Handbook of Environmental Voluntary Agreements*, Springer, Dordrecht.

Carbon Trust (2004), *The European Emissions Trading Scheme: Implications for Industrial Competitiveness*. The Carbon Trust, London. Available at www.thecarbontrust.co.uk/carbontrust/about/publications/European%20Emissions%20Trading%20Scheme_Implications%20for%20industrial%20competitiveness.pdf

ECOTEC (1999), "Who Gains from the Climate Change Levy?", Report to WWF UK. Birmingham: ECOTEC

Goulder, L. H. (1995), "Environmental Taxation and the 'Double Dividend': A Reader's Guide", *International Tax and Public Finance* 2, 157-184.

Hourcade, J.-C., and Shukla P. (2001), "Global, Regional, and National Costs and Ancillary Benefits of Mitigation", Chap. 8 in *Climate Change 2001*, IPCC Third Assessment Report, Cambridge UP.

Lee, D. R., and W. S. Misiolek (1986), "Substituting Pollution Taxation for General Taxation: Some Implications for Efficiency in Pollution Taxation", *Journal of Environmental Economics and Management*, 13, 338–47.

OECD/IEA (2000), *Emission baselines: estimating the unknown*. Paris.

OECD (2001), *Environmentally related Taxes in OECD Countries: Issues and Strategies*, OECD, Paris.

OECD (2003a), *Environmental Taxes and Competitiveness: An Overview of Issues, Policy Options, and Research Needs*. OECD, Paris. Available at www.olis.oecd.org/olis/2001doc.nsf/LinkTo/com-env-epoc-daffe-cfa(2001)90-final.

OECD (2003b), *Environmental policy in the steel industry: Using economic instruments*. OECD, Paris. Available at www.olis.oecd.org/olis/2002doc.nsf/LinkTo/com-env-epoc-daffe-cfa(2002)68-final.

OECD (2003c), *Voluntary Approaches for Environmental Policy: Effectiveness, Efficiency and Usage in Policy Mixes*. OECD, Paris.

OECD (2005), *The United Kingdom Climate Change Levy: A Study in Political Economy*, OECD, Paris. Available at www.oecd.org/env/taxes.

OECD (Forthcoming, a), *The political Economy of environmentally related taxes.*

OECD (Forthcoming, b), *The competitiveness impact of CO_2 emissions reduction in the cement sector*. OECD, Paris.

OECD (Forthcoming, c), *The political economy of the Norwegian Aviation Fuel Tax*, OECD, Paris.

Sorrel, S. (2002), *The Climate Confusion: Implications of the EU Emissions Trading Directive for the UK Climate Change Levy and Climate Change Agreements*. Brighton: Science Policy Research Unit – University of Sussex.

Sterner, T. (2003), *Policy Instruments for Environmental and Natural Resource Management*. Washington DC: Resources for the Future, The World Bank and Swedish International Development Agency.