

COMETR

Competitiveness Effects of Environmental Tax Reforms

Policy Brief

Instrument: Specific Targeted Research or Innovation Project

Thematic Priority: 8 - Underpinning European integration, sustainable development, competitiveness and trade policies (including improved means to assess economic development and cohesion)

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Project coordinator: Professor Mikael Skou Andersen

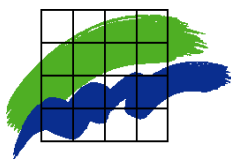
Project coordinator (organisation): National Environmental Research Institute (NERI), University of Aarhus

Revision: 1.0

COMETR provides an ex-post assessment of experiences and competitiveness impacts of using carbon-energy taxes as an instrument to reduce the carbon emissions that cause global warming.

COMETR aims:

- to outline and clarify the competitiveness debate
- to review the experience in environmental tax reforms in seven EU Member States, with particular emphasis on carbon-energy taxation (Germany, UK, Netherlands, Sweden, Finland, Denmark, Slovenia)
- to analyse world market conditions for a set of energy-intensive sectors, as a framework for considering competitiveness effects
- to undertake bottom-up modelling of the effects of environmental tax reforms on sector-specific energy usage and carbon emissions in Member States with carbon-energy taxes introduced on industry
- to undertake a macroeconomic analysis of the competitiveness effects of green tax reforms for individual Member States as well as for the EU as a whole, on the basis of the E3ME-model of Cambridge Econometrics (<http://www.e3me.com/>).
- to provide ex-post figures for environmental decoupling and assess carbon leakage on the basis of a comprehensive analysis, taking changes in import-export ratios into account



COMETR is collaborative research involving the following 6 partner institutions:

National Environmental Research Institute, University of Aarhus (NERI), Denmark (coordinator)

Cambridge Econometrics Ltd (CamEcon), UK

Economic and Social Research Institute, Dublin (ESRI), Ireland

Institute for Economic and Environmental Policy, University of Economics, Prague, (IEEP), Czech Republic

Policy Studies Institute, London (PSI), UK

Vienna Institute for International Economic Studies (wiiw), Austria

COMETR
Work Packages
and
Reports

The policy brief summarises the following reports from the COMETR project

WP1

The environmental tax reforms and considerations in member states (DL1.3)

WP2:

Analysis of world market conditions for energy-intensive sectors as a framework for considering competitiveness effects (DL2.3)

WP3:

An assessment of the impacts of environmental tax reforms on the competitiveness of selected industrial sectors (DL3.5)

The impact of energy taxes on competitiveness, output and exports: a panel regression study of 56 European industry sectors (DL3.4.2)

The Porter hypothesis and changes in energy efficiency (DL3.4.1)

WP4:

The effects of environmental tax reform on international competitiveness in the European Union: modelling with E3ME (DL4.5)

Short description of E3ME-model to non-technical audience (DL4.1)

WP5:

Case studies on energy-intensive sectors (DL5.3)

Leakage analysed within the E3ME framework (DL5.2)

Leakage analysis within a decoupling framework (DL5.1)

WP6:

Mitigation of competitiveness effects: what can we learn from the ETR experience? (DL6.1)

The full draft reports are available to workshop participants on request from Carey Smith (cs@dmu.dk).

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The Environmental Tax Reforms

by

Mikael Skou Andersen, NERI

Six EU member states have implemented tax reforms which shift the tax burden from taxation of labour to taxation of carbon-energy. The member states and the initial year of the tax reform are as follows:

1. Sweden (1990)
2. Denmark (1993)
3. Netherlands (1996)
4. Finland (1997)
5. Germany (1999)
6. UK (2001)

The reforms include tax shifts toward energy and transport taxes, as well as in some cases a restructuring of energy taxes to reflect better their carbon emissions. While the scale of the tax shifts differs between member states, altogether these tax reforms are assessed to have shifted tax revenues for more than 25 billion euros annually in Europe. It is mainly labour which has experienced the lighter tax burden.

While the resulting reductions in carbon emissions are documented in several studies (Clinch et. al., 2006, Speck et. al., 2006; Enevoldsen et. al., 2007), concerns remain as to whether the broader effects for economic growth, competitiveness and employment are also beneficial. The COMETR project has addressed this difficult and sensitive issue by means of a range of methods and research techniques. COMETR has taken its point of departure in official definitions of competitiveness as established by the EU and OECD.¹ The aim of the COMETR project has been to provide an evaluation from an ex-post perspective on the impacts of ETR on competitiveness, in particular that of energy-intensive industries.

The underlying philosophy of environmental tax reform was expressed by former Commission President Jacques Delors in a White Paper on growth and competitiveness, which recommended taxing 'bads' rather than 'goods' (labour) in order to achieve a double dividend. While the first dividend (improved environmental conditions) is long-term in nature, a second and more immediate dividend was expected to arise as a result of a tax shift from labour to pollution. This second dividend, according to the philosophy, would bring increased social welfare; the

¹ The European Commission defines competitiveness as '*a sustained rise in the standards of living of a nation and as low a level of involuntary employment as possible*' (EC, 2004). OECD states that competitiveness denotes '*the degree to which a country can, under free and fair market conditions, produce goods and services which meet the test of international markets, while simultaneously maintaining and expanding the real incomes of its people over the longer term*'.

principal route of effects being an increase in employment as labour costs lower and while costs of fossil fuels increase.

There has been ample criticism of these assertions in economics and taxation literature. Goulder (1995) has suggested that the double dividend cannot be taken for granted but depends on the specific distortionary properties of the tax that is replaced by energy taxation. Bovenberg and de Mooij (1994) warned that energy taxes could cause *inflationary* effects, as wage earners would demand compensation for increased power and heating costs.

The response from the architects of environmental tax reform (ETR) to these critics has been to emphasize the role and design of **revenue recycling**; when energy taxes are used to replace employers' social security contributions, no inflationary push is caused, as a highly distortionary labour market tax is replaced. Indeed this approach has been the red thread in member state ETRs.

A complication arises with energy-intensive companies, because the compensation they receive via the reduction in social security contributions does not fully match the additional energy costs. They may have a small labour stock, while they consume large amounts of energy. Their sensitivity depends on the degree to which they use carbon-intensive fuels. In member states such as Sweden, Finland and Slovenia the energy-intensive industries benefit from the availability of hydropower and nuclear power, and so are less sensitive to carbon-based energy taxes. However, in most member states complicated schemes have been designed to balance, cap or reduce the tax burden of energy-intensive industries. Exemptions present a complex regulatory taxation mesh that distorts not only the desired impacts of energy taxation, but also poses a threat to fair terms of competition. According to EU law such exemptions constitute state aid and must be approved by the European authorities, thus helping to control member state concessions to energy-intensive industries.

ETR changes the relative costs of the products produced by all companies and in particular by energy-intensive companies – and the taxation debate has been followed by speculations concerning the extent to which energy-intensive industries can either reduce their energy consumption or switch the fuel input to less carbon-intensive sources. While many energy-intensive industries maintain that they have already minimised their fossil fuel use to an efficient level, proponents of ETR cite studies and claim that further energy savings can be attained, in particular in response to energy taxation (e.g. DeCanio, 1998; Porter and van der Linde, 1995).

However, the 'Porter hypothesis' (Porter, 1991) boldly states that a pressure to innovate caused by energy taxes in fact will facilitate improved competitiveness, if not of the individual company then of the economy at large. If for specific producers fuels cannot be switched or efficiency not be improved, the changed relative prices will favour other producers, and to the extent that such producers are innovative overall competitiveness of the economy may in fact improve. However, this hypothesis as well as the extent to which the losers of such transitions will respond with carbon leakage rather than with innovation, i.e. relocation to non-ETR countries, remains a controversial issue which connects with broader questions and patterns of globalisation of industrial production, and raises concerns about the need for border-tax adjustments.

The purpose of the COMETR project has been to study the impacts of ETR on competitiveness using a range of approaches and research techniques. As a stepping stone in this aim the COMETR project has built a unique database of sector-specific energy prices and taxes for a range of energy-intensive industries. Basically, four different research approaches have been employed to investigate the competitiveness impacts of ETR;

- indicators of changes in unit energy costs as a result of ETR
- bottom-up analysis of energy cost changes relative to changes in competitiveness
- macro-economic modelling in an ex-post perspective by means of the E3ME-model
- case studies and interviews in energy-intensive industries

The following figures provide an overview of the time-series for **industry tax rates** (current prices) and **unit energy costs** established as part of the COMETR project. The initially rather high Swedish tax rate would translate into a 10-12 US dollar per barrel oil tax.

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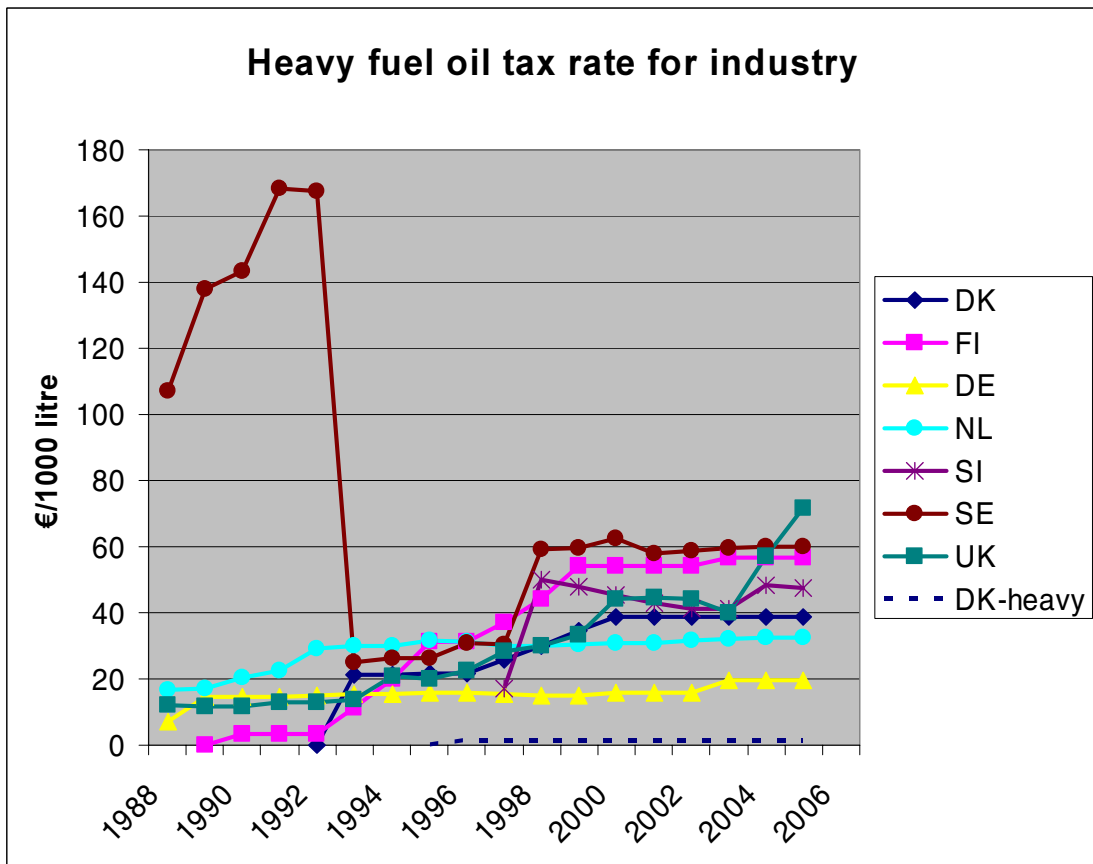
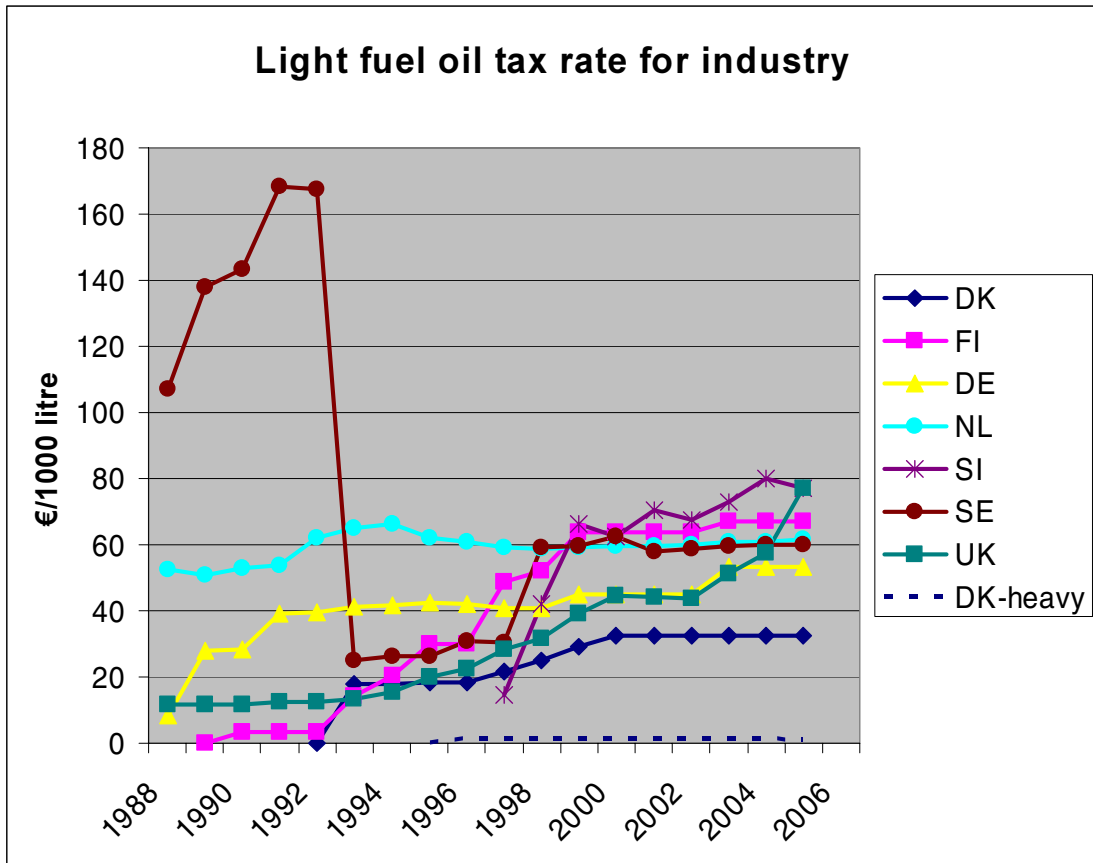
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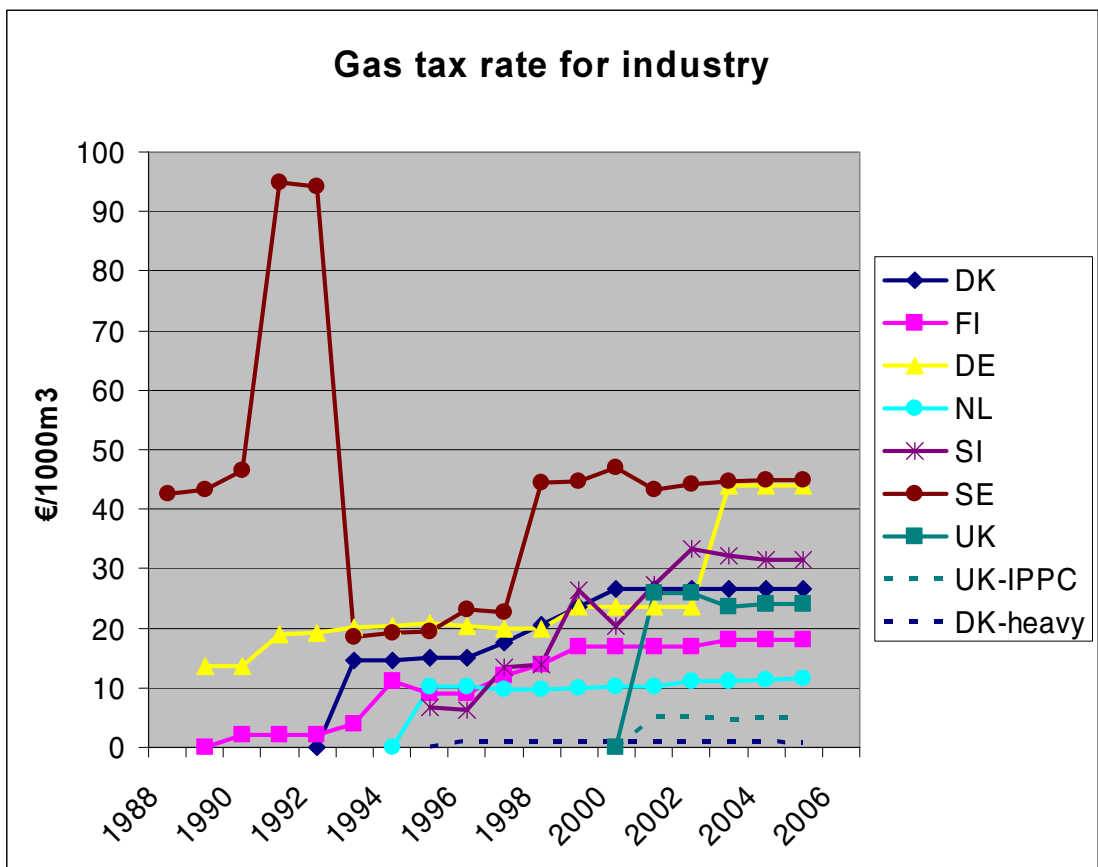
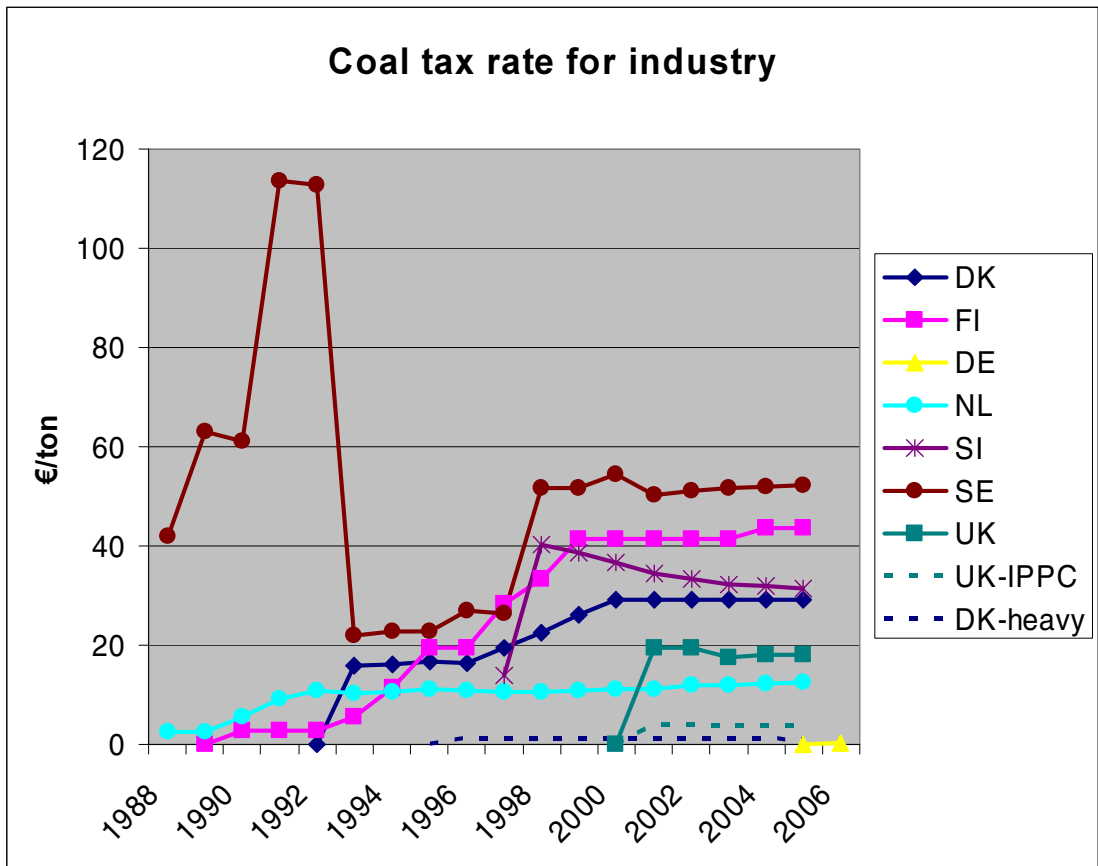
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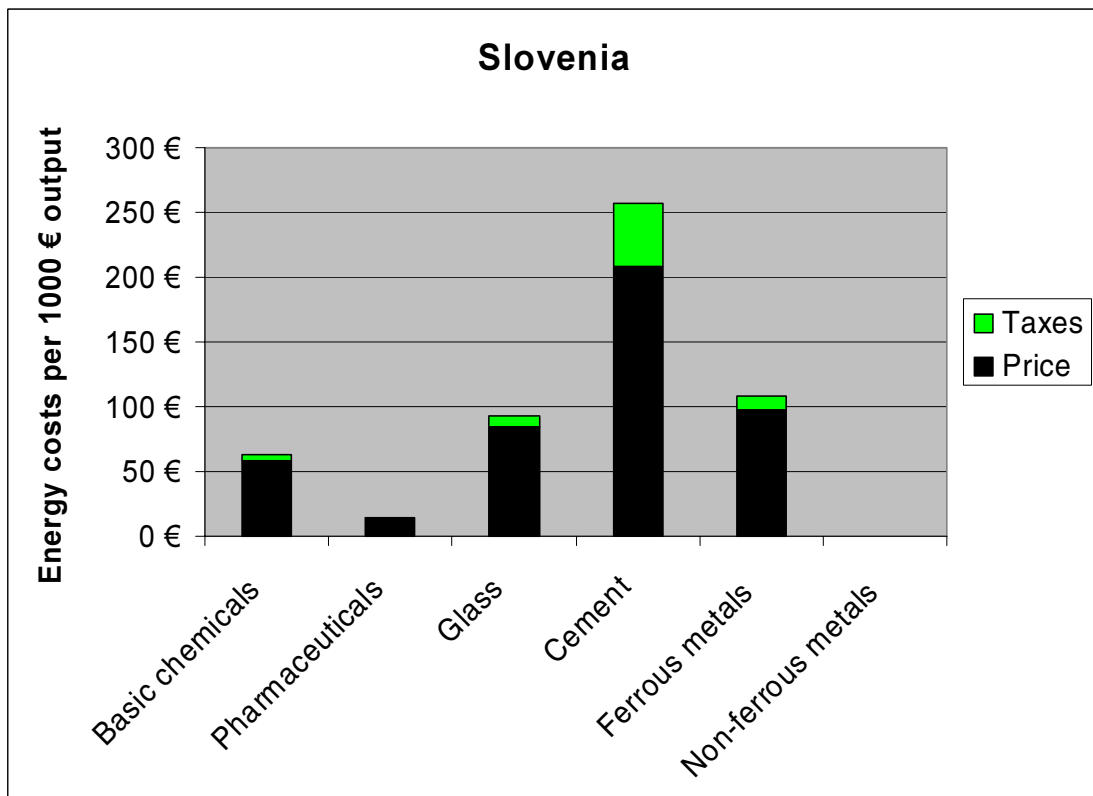
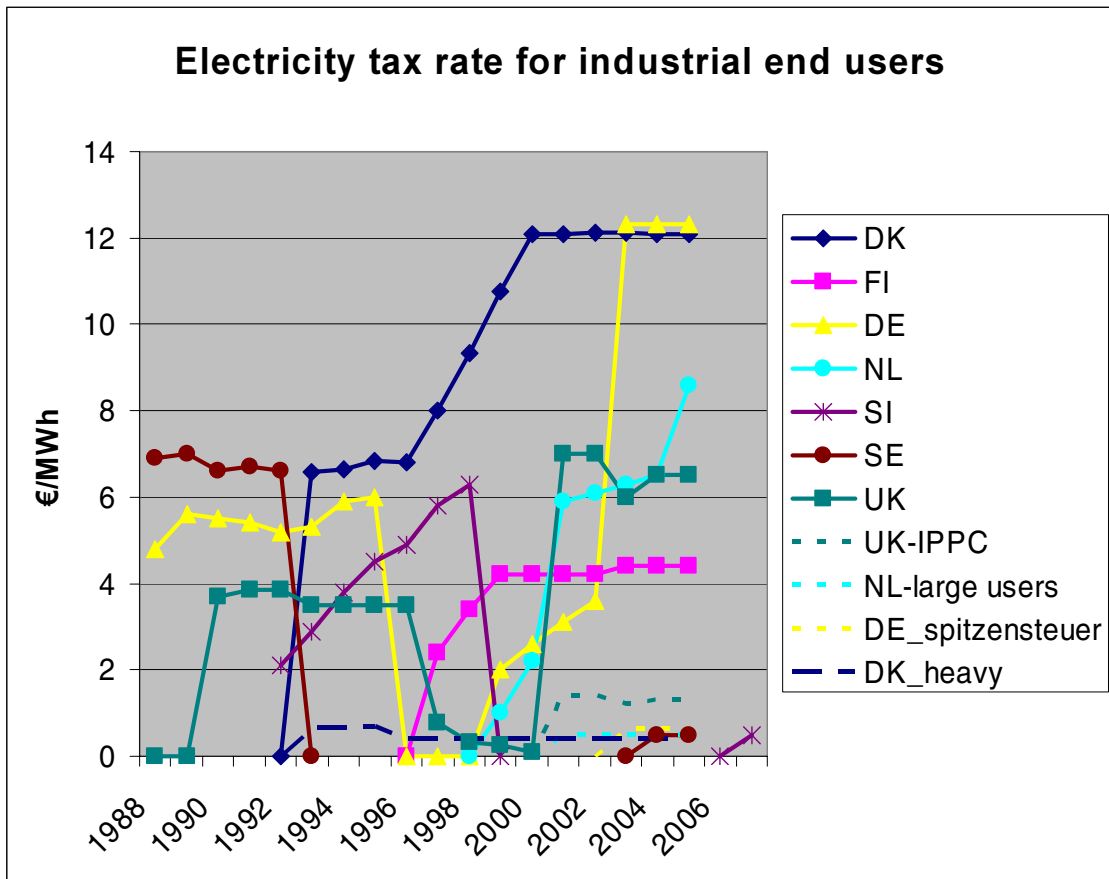
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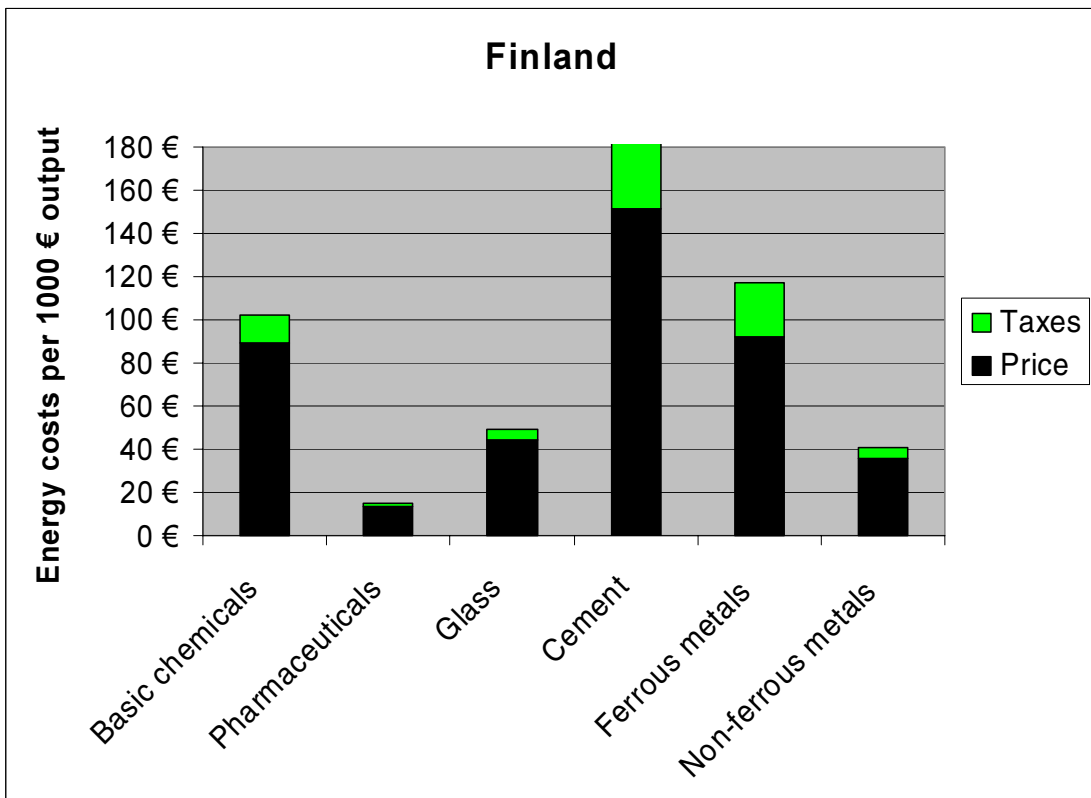
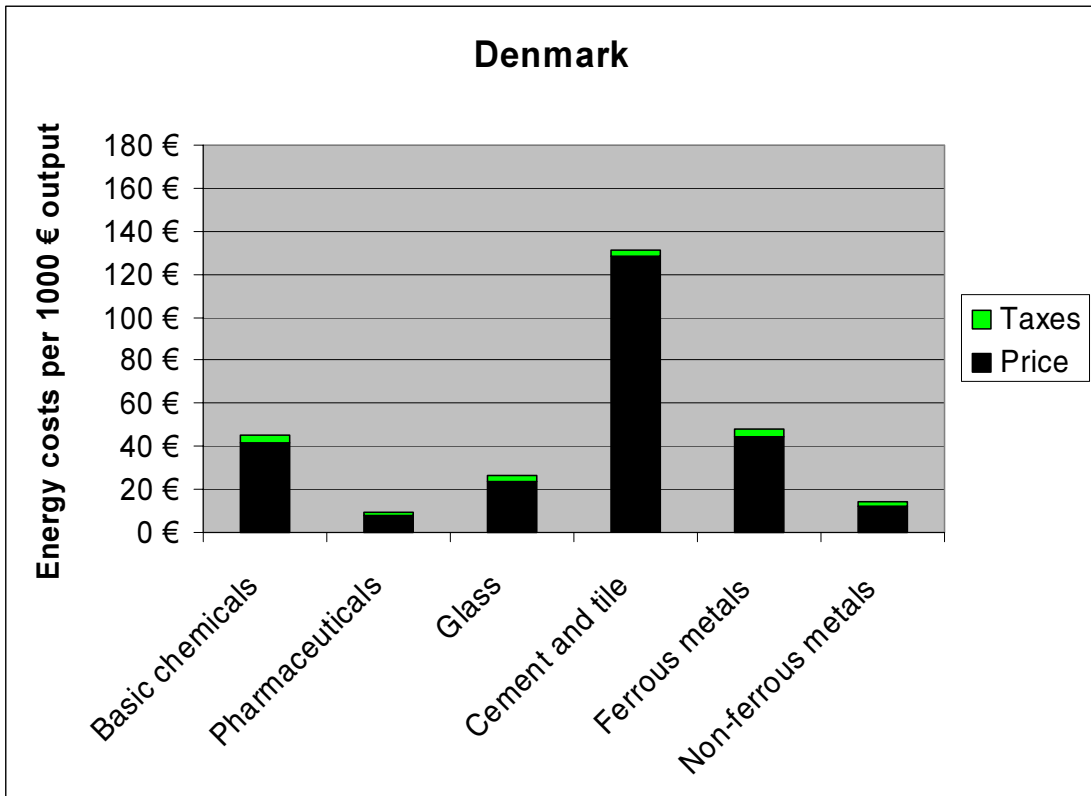
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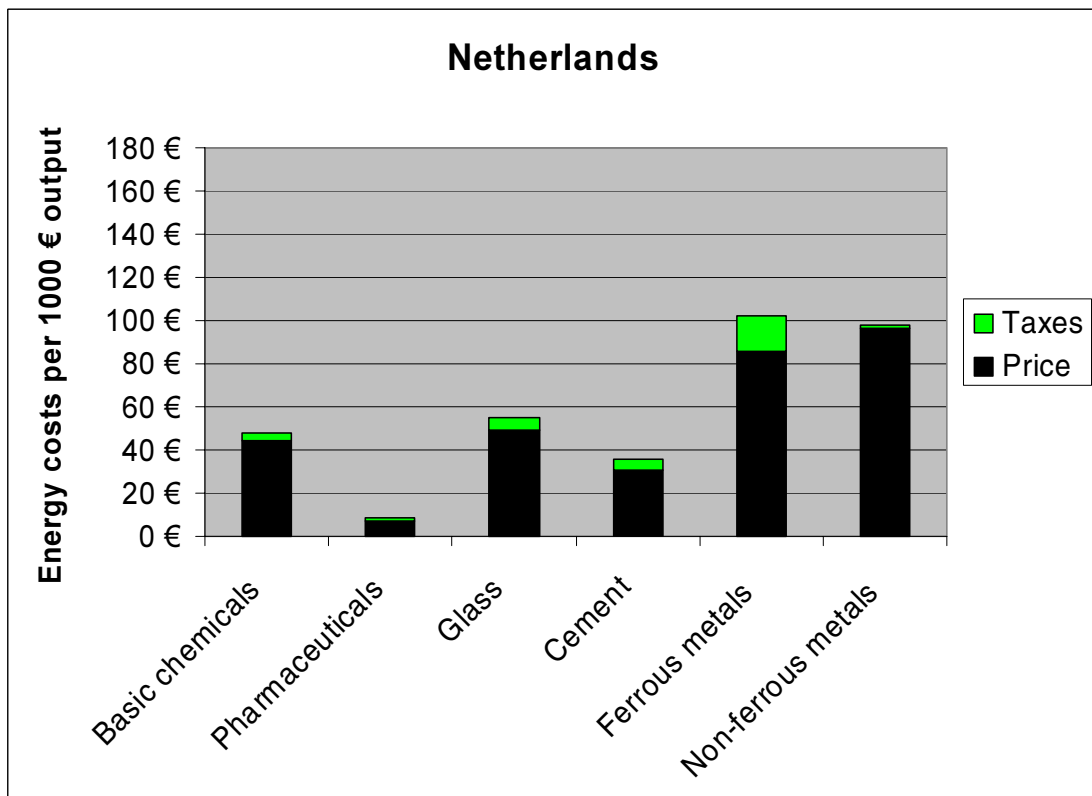
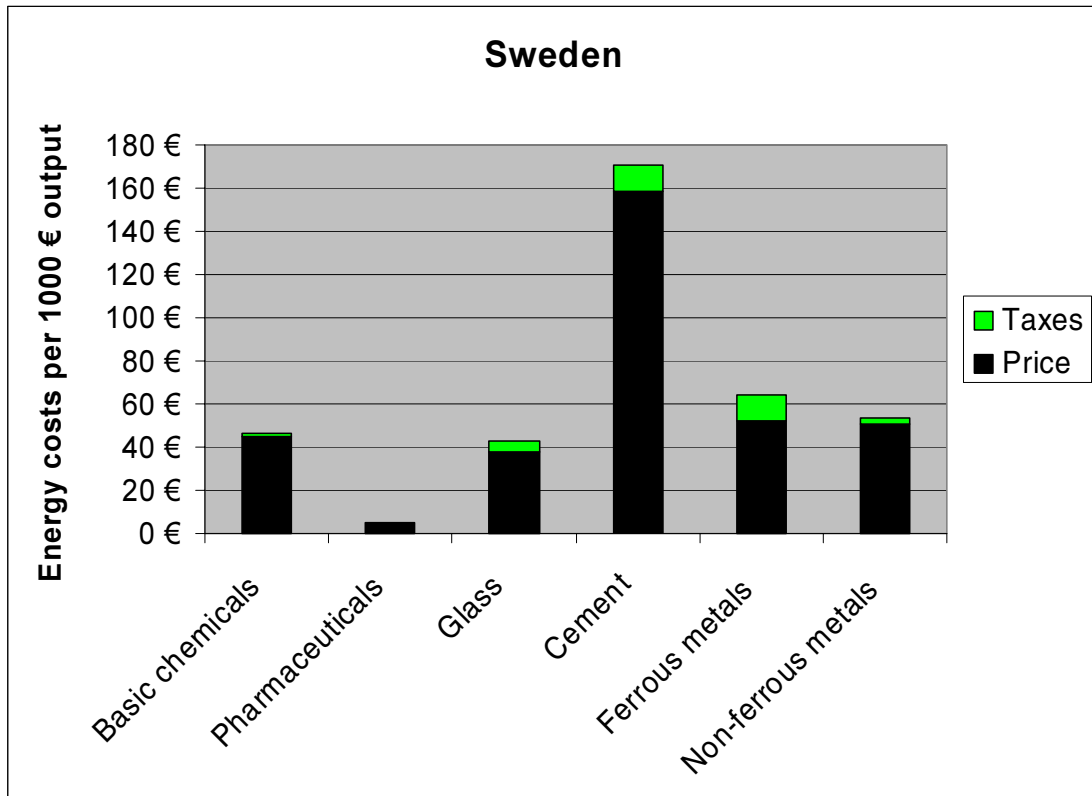
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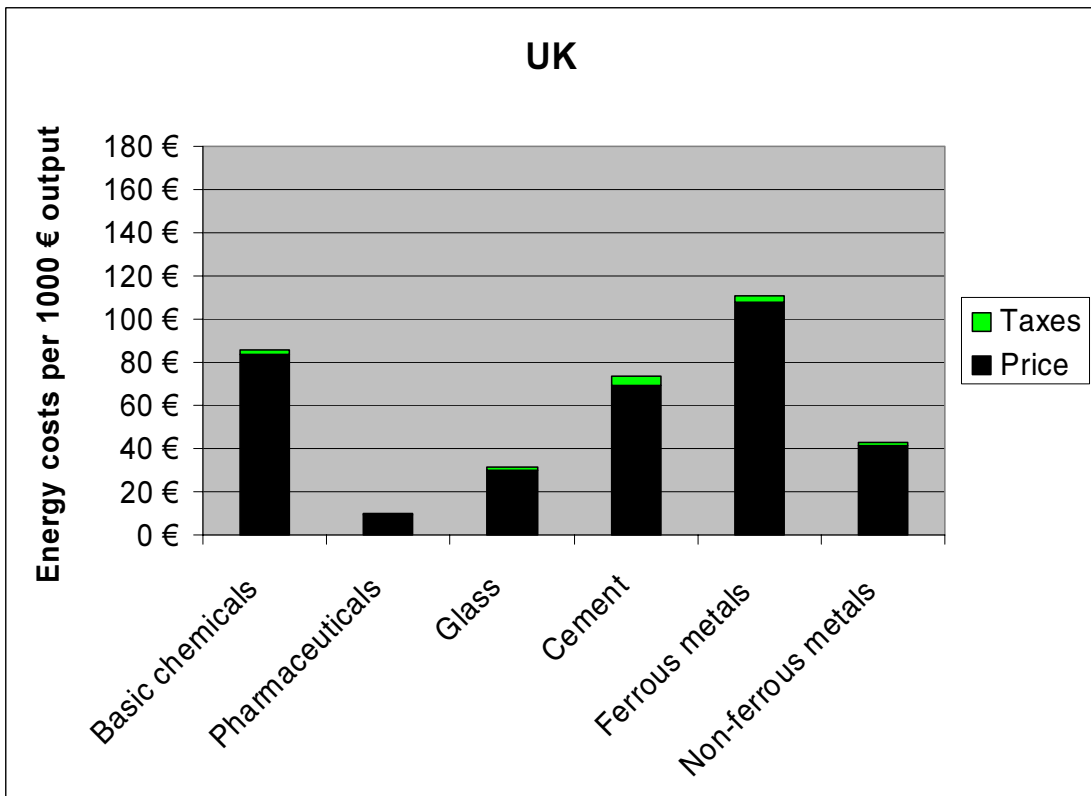
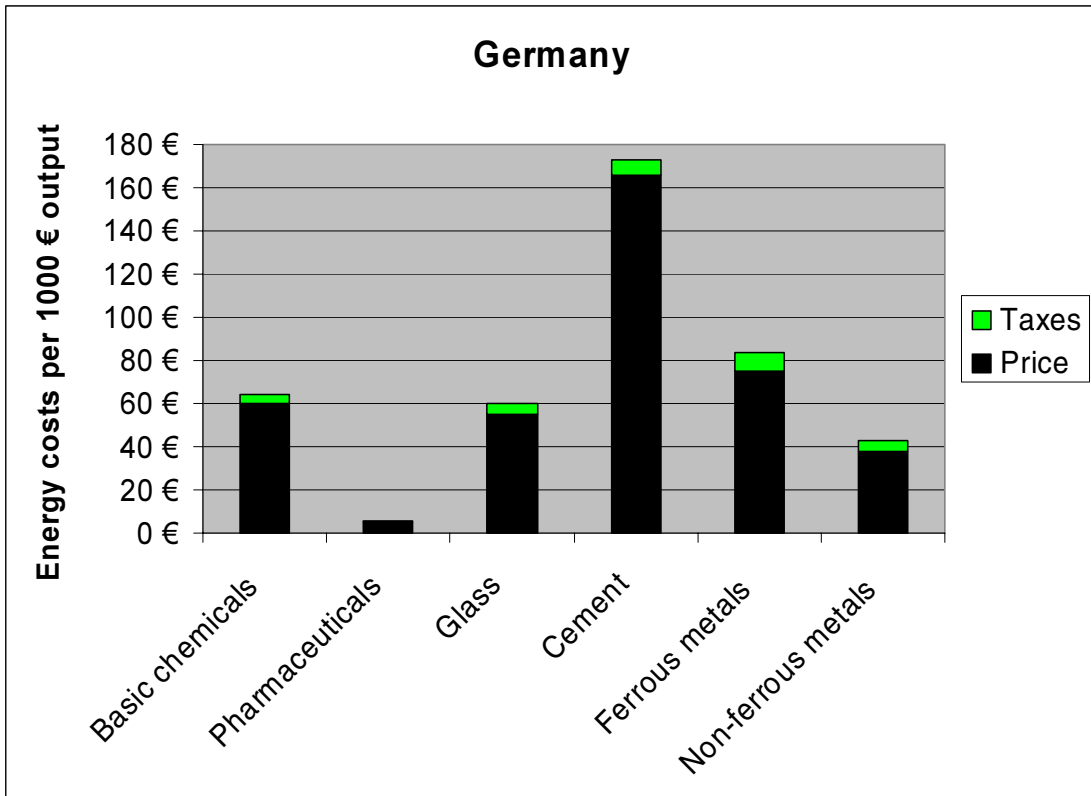












COMETR WP 2 Policy Brief

The market: structure and sector vulnerability

by

John Fitz Gerald and Sue Scott, ESRI

*Which sectors are potentially vulnerable?
Are they exposed to global competition?*

Competitiveness and vulnerability to competition are defined in several ways. This makes it difficult to assess the implications for the manufacturing sector of the introduction of environmental tax reform (ETR), especially the carbon or energy taxes aspect. The present work package looks at the market and structure in which manufacturing sectors have to compete and investigates the two questions posed above, in two main parts.

The first part uses the traditional measures, such as energy intensity, to measure vulnerability, and a screening process is subsequently undertaken in order to select those manufacturing sectors that are potentially vulnerable. In the second part the selected sectors are subjected to an analysis that helps us to understand the kind of market in which they operate and it throws light on the important and insufficiently addressed issue of market power. The point is that a sector may be highly affected by carbon/energy taxes, but ability to pass on these costs in its selling price gives rise to less concern than if the sector has to meet the world price and has to absorb the tax increase. There are also other options such as relocation, technical adjustment and mitigation policies to help sectors adapt and these are touched on in the discussion.

Screening for sectors that are potentially vulnerable under ETR

Screening of all manufacturing sectors at the NACE 2-digit level was undertaken in order to identify sectors that might be vulnerable. For each sector, calculations were undertaken of energy expenditure shares (of value added, gross output and operating surplus); labour's share of value added; exports as a share of total output; imports as a share of supply on the domestic market, and of the shares of exports going to EU and non-EU destinations. Using each of these various measures the sectors could be ranked and allocated to categories of high, medium and low vulnerability. A key measure is energy intensity as this determines the amount of tax due under ETR.

Representation of sectors with low labour intensity was necessary as these could be vulnerable under ETR where revenues were recycled to reduce labour taxes. They could find themselves "under compensated". After consultation with project partners, seven sectors were selected as potentially vulnerable that would be subjected to detailed analysis in the COMETR study. Geographic relevance was taken into account in the selection, such as the importance of wood and paper in the Scandinavian ETR

countries (the countries that introduced ETR being Denmark, Germany, Finland, Netherlands, Sweden and the UK). Selected sectors are as follows:

Table 2.1 Seven potentially vulnerable sectors selected for further study

	<i>NACE code</i>	<i>Intensity</i>			
		Energy	Labour	Export	Import
Food and beverages	15	high	low	low	low
Pulp, paper and board	21	high	medium	low	low
Wood and wood products	20	medium	low	low	low
Basic chemicals excl. pharmaceuticals	24 less 24.4	high	low	high	high
Pharmaceuticals	24.4	low	low	high	high
Non-metallic mineral products	26	high	medium	low	low
Basic metals	27	high	high	medium	medium

Source: WP 2 Table 2.1, footnotes apply. This table applies to the UK, where the sectors were ranked by intensities and split into three groups, high, medium and low intensity.

Some observations noted in the study are worth mentioning, focusing on the nineties when ETR was in full swing. It appears that there is much variation in unit energy costs between countries within a sector. Take basic metals in 1998, for example, unit energy costs could amount to about a third (of gross value added) in Finland, compared to less than ten per cent in the UK. Unit energy costs in the wood and paper sector were also highly varied across countries.

By contrast there appears to be more consistency within countries. A country that has high unit energy costs in one sector tends to have high unit energy costs in many other sectors as well. Germany and the Netherlands provide good examples. At the other end of the scale, Denmark and then the UK have fairly consistently lower unit energy costs. A ranking according to unit energy cost in the following table shows this.

Table 2.2 Ranking of countries according to unit energy cost (GVA basis) within each sector (1998, 1=most intensive country; 6=least intensive country)

	Wood and Paper	Pharmaceuticals	Basic Chemicals	Non-metal mineral products	Basic Metals	Food, Beverages & Tobacco	Total Gross Manuf. Output
1998							
Denmark	6	6	6	6	5	3	5
Germany	3	2	2	2	1	1	3
Finland	1	4	4	3	2	5	1
Netherlands	4	1	1	4	3	4	2
Sweden	2	3	3	1	4	2	6
UK	5	5	5	5	6	6	4

Source: Cambridge Econometrics E3ME database.

As for unit labour costs, the UK and Denmark were found to have relatively high unit labour costs across the selected sectors, which can be important for ETR, depending on how the revenues are recycled.

An indication of international competitiveness can also be gained by the export and import intensities of the sectors identified. As expected, WP 2 saw strong, and growing, export intensities in wood and wood products from Finland and Sweden. Export intensities were in the 80 per cent range by 1998 for these two countries, but around 20 per cent or less for the others. Pharmaceuticals are heavily traded, exports

reaching 80 per cent or more in the cases of Sweden and Denmark. Basic metals are exceptionally highly traded in the cases of Sweden and Finland, and growing.

At the lower end of trade intensity, the food and beverages sector is rather low in export intensity, with Denmark and the Netherlands at the higher end of the countries studied. Non-metallic mineral products have relatively low trade intensity, at around 20 per cent, though rising to around 40 per cent in 1998 in the cases of Sweden, Denmark and Finland.

Are they exposed to global competition – do they have market power?

The effects of competition hinge on whether or not the selected sectors can pass on increases in costs, such as the cost increases due to the introduction of carbon or energy taxes. In effect do they have market power, or are they price takers who have to be able to match the world price or else go out of business in this jurisdiction? Sectors that have no market power can be particularly vulnerable to an ETR policy, unless the revenue recycling mitigates the damage, or technical and other options are favourable.

To answer this question, price determination was investigated in each of the selected sectors in each of the ETR countries for which data were available. The influence of domestic costs as against world prices was then tested. Two polar cases of the pricing of domestic manufacturing output can be posited, where prices are either:

- externally determined, and the sector is a price-taker, or
- determined as a mark-up on domestic costs, and the sector is a price-setter.

In the latter case the sector is less exposed to competitive pressures and can be said to have market power. It is less vulnerable in the event of the introduction of the tax element of ETR, such as a carbon or energy tax, as the tax can be passed on. If on the other hand the former case holds and prices for the sector's product are externally determined, then that sector could indeed be vulnerable in the event of the introduction of a carbon/energy tax, in the absence of mitigating or other options. Such options might include revenue recycling or technological adaptations that it can undertake. A mixture of the two polar cases above is also a possibility.

Pursuing this line of reasoning the following model could therefore be estimated:

$$p_i = \alpha_0 + \alpha_1 mc_i + \alpha_2 p_i^f$$

where p_i is the domestic output price, mc_i is the domestic marginal cost, and p_i^f is the foreign or world price. Estimation enables one to test for evidence that prices are either set domestically i.e. according to domestic costs, or otherwise set by the foreign price. In the results from this equation estimated from the data, three separate outcomes are of interest: that only the coefficient α_1 on domestic costs is significant and non-zero, only α_2 is significant so that domestic costs do not drive the prices set

by the sector and only the external price situation matters, or thirdly a mixture of the two.

The equation above is taken to be a long-run price relationship and a lagged response to price change is allowed (by an error-correction representation). A synopsis of the results is given in Table 2.3 for two sectors taken from each extreme of results.

Table 2.3 Modelling the domestic output price - with the US price and then German price representing the foreign price.¹

-Adjustment speed λ -Domestic cost -Foreign price -Fit: Adjusted R ²	BASIC METALS		NON-METALLIC MINERAL PRODUCTS	
	US price	German price	US price	German price
Denmark	-0.062** 0.174 0.643*** 0.323	-0.156*** 0.079* 0.866*** 0.500	0.009 1.377 -0.920 0.540	-0.234*** 0.513*** 0.139 0.211
Germany	-0.149 0.270 1.246 0.598	..	-0.022 0.079 -0.327 0.498	..
Finland	-0.116*** 0.375*** 0.301*** 0.600	-0.136*** 0.194** 0.516*** 0.643	-0.048** 0.278** 0.056 0.410	-0.315*** 0.419*** 0.053** 0.227
Netherlands	-0.083** 0.300*** 0.405*** 0.508	-0.139*** 0.146** 0.665*** 0.605	-0.016 0.124 0.134 0.395	-0.177*** 0.406*** 0.412*** 0.178
Sweden	-0.038* 0.410* 0.711** 0.634	-0.124*** 0.047 0.942*** 0.830	-0.002 -8.456 0.027 0.727	-0.176* 0.716*** 0.018 0.257
UK	-0.055*** 0.329*** 0.267* 0.700	-0.115*** 0.229*** 0.476*** 0.830	-0.035*** 0.352*** 0.260 0.730	-0.167** 0.518*** -0.000 0.216
RESULT (no. of significant price determinants in sector)	4 Domestic 5 US	4 Domestic 5 German	2 Domestic 0 US	4 Domestic 2 German

¹ Using US\$ exchange rates and DM exchange rates, and imposing Purchasing Power Parity.

* Significant at 10%, ** Significant at 5%, *** Significant at 1% level.

The modelling used quarterly data from 1975 to 2004 inclusive, taken from OECD and Eurostat.

Source WP 2 Table 2.5a and 2.5b.

The results are given in a set of four figures for each sector in each country. The first, λ , is the speed of price adjustment; the second indicates the influence of domestic cost (domestic wage rates) in the long run; the third indicates the influence of the 'foreign' output price in the long run, which in the first column is the US price, and in the second column it is the German price, acting in the manner of an 'EU price'. The fourth figure is the measure of fit. As mentioned results are shown here for just two of

the selected sectors, that emerge at opposite extremes of the pricing power spectrum. These are the basic metals sector which judging from the results has least pricing power and non-metallic minerals which has most pricing power.

Basic Metals

In the basic metals sector the US price has a strong and significant influence on output prices except in the case of Germany. An even stronger external price effect is found when using the German price as the external price, but this sector is evidently a price-taker on world markets as results indicate that this sector's pricing is the most responsive to both sets of external prices. The German price is a more important determinant of the output price and far outweighs the influence of domestic costs, which are of lesser significance and in fact insignificant in the case of Sweden under the German price. This indicates that environmental tax reform consistently applied across the EU would limit the effect on competitiveness. The adjustment coefficient suggests a relatively strong and significant stable long-run pattern of response across all the countries studied.

Non-metallic Mineral Products

This sector is not highly traded and the US price, when used to represent the foreign price, is nowhere significant in explaining movements in the sector's output price. In the UK in particular the model shows domestic costs as a determinant. If the sector responds to any foreign price, it is likely to respond to the German or 'European' price. This reflects the low trade shares on the world market owing to the bulky nature of the product and its high weight-to-value ratio.

In the final column, however, where the external price is represented by the German price, the outcome is an inferior fit and the German price is only significant in the Netherlands and to a minor extent in Finland. Domestic costs on the other hand significantly determine a substantial portion of this sector's output price in all countries investigated. To the extent that the external price is at all significant, the fact of it being the German price indicates that a carbon-energy tax applied EU-wide would not create significant competitive disadvantage, given that the rest of the EU would face a similar tax.

Implications for ETR

The main points to note from the analysis of pricing power are:

1. The model performed overall well statistically.
2. It gave plausible results.
3. The mainly better explanatory power of the German as opposed to the US price has important policy implications and suggests that an EU-wide ETR would have advantages.
4. According to the extent that they are price-takers, sectors can be informally ranked according to vulnerability on international markets.

This ranking, based on the relative strengths of the foreign price as opposed to domestic cost in determining the output price is shown here. The ranking, starting with the most vulnerable sector, which we saw above to be basic metals, is as follows:

Table 2.4 Sectors ranked by vulnerability on pricing

Basic metals (most vulnerable)
Paper and paper products
Wood and wood products
Chemicals
Food, beverages and tobacco
Non-metallic mineral products (least vulnerable)

These measurements of price-setting power bring an important dimension to bear in the assessment of a sector's vulnerability under ETR. It also has a bearing on the debate concerning foreign direct investment and carbon leakage, which features strongly in discussions about carbon/energy taxes. From a survey of the literature on the pollution haven hypothesis it emerged that relocation of production is a possible outcome of the introduction of environmental regulations. This is not a surprising finding, though there is considerable debate on the methods used to investigate it, and the effect is usually small in any event. This brings the advantages of ETR over environmental regulations into focus, because revenues in ETR are available that can help to prevent industrial relocation. This is provided that the revenue recycling is designed and targeted carefully.

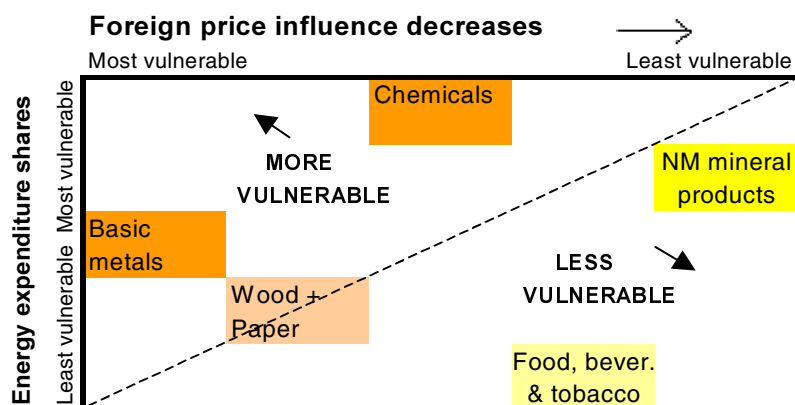
Further insights into vulnerability

We said at the beginning that there are several ways in which vulnerability is measured. We are now in a position to combine them in useful ways.

To give an example, Chart 2.1 below illustrates the situation when unit energy costs and price-power are taken together for the combined ETR countries. The vertical axis shows increasing energy expenditure share of output, and the horizontal axis shows increasing market power, that is, decreasing foreign price influence in price-setting. Vulnerability is highest in the top left-hand corner where the energy share is highest and price-setting ability is lowest. Vulnerability is lowest in the bottom right-hand corner.

The most vulnerable sectors are basic metals and chemicals in the top left-hand of the chart. The chemical sector has the highest energy expenditure share and basic metals is the most exposed to the world price - it is the least able to pass on cost increases.

Chart 2.1: Vulnerability with respect to pricing power, ETR countries



In the bottom right-hand corner of the chart are the less vulnerable sectors, food, beverages and tobacco and then non-metallic minerals products. Ranked in the middle in terms of vulnerability is wood and Paper.

The implications are that the introduction of ETR would require most attention to be paid to its effects on the competitiveness of basic metals and chemicals compared to non-metallic mineral products and food, beverages and tobacco. These rankings of vulnerability apply jointly to the combined six countries that implemented ETR.

Another important qualification of a sector's vulnerability is its scope for introducing economically worthwhile energy efficiency investments. Encouragement to efficient energy-saving improvements is a major objective and a useful feature of carbon/energy taxes. Potential technology adjustments available to energy intensive sectors in the UK had been estimated by Entec as part of the process of Climate Change Agreements, and these can be used for illustrative purposes. Here again the sectors can be ranked, by scope for adjustment measured in percentage energy saving potential at positive NPV, starting with those that have least scope (i.e. the most vulnerable again), as shown in Table 2.5.

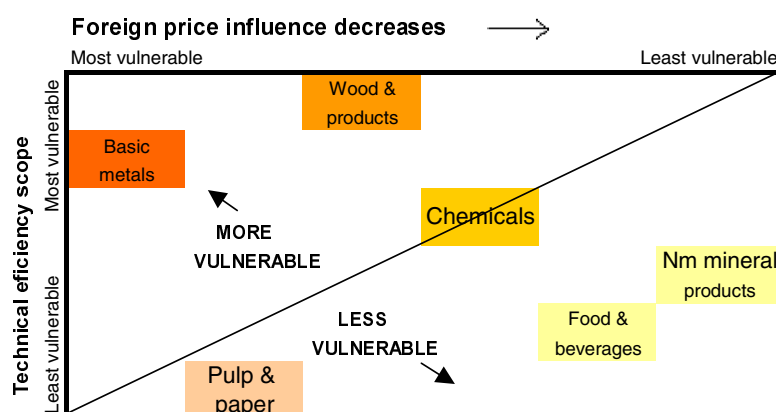
Table 2.5 Ranking of sectors with respect to scope for technological adjustment, UK 1995

Wood and wood products	(least scope, most vulnerable)
Basic metals	
Chemicals	
Non-metallic mineral products	
Food and beverages	
Pulp, paper and paper products	(most scope, least vulnerable)

Source: Entec/Cambridge Econometrics, 2003

The sectors now ranked according to their technological potential for energy efficiency adjustments can be similarly incorporated in a chart. Chart 2.2 relates to the UK and along with ranked vulnerability to price competition, it shows ranked vulnerability with respect to absence of scope for technological adjustment.

Chart 2.2 Vulnerability with respect to scope for technology and price-setting, UK



At the extremes, it can be seen that in the UK basic metals is again clearly in a relatively vulnerable position in the chart, now joined by wood and wood products. food, beverages and tobacco and the non-metallic mineral products sectors are least vulnerable - they have modest potential for adapting technology and have scope for price setting. Chemicals and pulp and paper fall in between.

To sum up on the implications, the most vulnerable among the selected sectors in terms of energy intensity and constraints on pricing and technological scope is likely to be the basic metals sector. By contrast, non-metallic mineral products and food beverages and tobacco are the least vulnerable. The importance of these results is that they indicate where to prioritise mitigation in the event of environmental tax reform.

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COMETR WP3 Policy Brief

An assessment of the impacts of ETR on the competitiveness of selected industrial sectors

by

Paul Ekins, PSI

The Impact of ETR on Energy Costs

As discussed in WP2 six EU countries (Denmark, Finland, Germany, Netherlands, Sweden and the UK) have already implemented modest ETRs, and the purpose of this work package was to assess whether there is evidence that different industrial sectors had experienced damage to their competitiveness as a result, or whether, conversely, there was evidence consistent with ‘the Porter hypothesis’, that government regulation (including the imposition of environmental taxes) could improve firm and sectoral competitiveness by stimulating innovation and the take-up of cost-saving technologies that had before been overlooked. Four countries were selected for the analysis: Denmark and Finland, which implemented ETRs in the early 1990s, and Germany and UK, which did so in the late 1990s/early 2000s.

The sectors chosen for the analysis were as set out in Table 3.1, and comprised sectors of medium to high energy intensity, and of low to high exposure to international trade.

Sector (NACE 3-digit):

- 15.1 Meat industry
- 21.2 Paper and cardboard articles
- 24.1 Basic chemicals industry
- 24.4 Pharmaceuticals industry
- 26.1 Glass industry
- 26.5 Cement, lime and plaster
- 27.1-27.3 Basic ferrous metals
- 27.4 Basic Non-ferrous metals

Table 3.1: Sectors chosen for ex-post analysis of effects of ETR

The work required the construction of a detailed data set for each of the sectors in each of the ETR countries over the 1990s and early 2000s, that included output (Y), energy use (GJ) and energy prices (EP), and expenditures on energy taxes (ET). The change in energy costs in a time period ($C_{2/1}$) due to the implementation of energy taxes is $GJ_2*(ET_2 - ET_1)$. The savings in energy costs in the same period ($S_{2/1}$) due to reductions in energy intensity stimulated by the increased energy taxes is $[(GJ_1/Y_1 - GJ_2/Y_2)*Y_2]*EP_2$.

Then a negative effect on competitiveness could occur if $C_{2/1} > S_{2/1}$, while evidence consistent with the Porter hypothesis would be if $C_{2/1} < S_{2/1}$.

The generation of the required dataset was far from straightforward, given that data at the required sectoral detail is not generally available from a single consistent source, so that it had to be constructed from a range of sources, and some problems with the dataset remain. This should be borne in mind when interpreting the results.

For each of the countries two tables were constructed, showing the development of the energy intensity and the effective energy tax rate (defined as the sectoral energy tax expenditures divided by the sectoral energy use) over the period in question. It should be noted that, because of widespread special tax treatment of the different sectors (which of course also varied between countries), the effective tax rate for the different sectors within and between countries was very different.

In fact the energy intensities of the sectors exhibited a wide variety of trends, although most sectors in most countries exhibited a generally downward trend. Table 3.2 describes these trends and also gives the range of the effective tax rates for the different sectors. It may be seen that these rates differ by one to two orders of magnitude for the different sectors, but the ranges are quite comparable across the different countries, with Denmark exhibiting the lowest, and Sweden the highest, tax rates. As is seen in more detail below, in general the lowest tax rates were applied to the sectors with the highest energy intensity, so that in many cases the tax rate applied to these sectors was very low indeed.

Country	ETR year	Energy intensity (GJ/k€)	Tax rate (€/GJ)
Denmark	1993/1996/1998	Sectors 24.4, 26.1, 26.5 show notable change in trend after ETR	Ranges from -0.004 to 1.75
Finland	1990/1994/1997	Downward trend in almost all sectors (not 15.1, 26.5)	Ranges from 0.02 to 1.6
Germany	1999-2003	Downward trend in most sectors (stable 26.5, 27.1-3)	Ranges from 0.07 to 1.2 (below average 26.5, 27.1-3)
Netherlands	1998/1999	Downward trend in most sectors	Ranges from 0.06 to 1.3 (27.4 particularly low)
Sweden	1991/1992 2001-2010	Mixed trend	Ranges from 0.05 to 3.8 (significant reduction after 1992)
UK	2001	Mixed trend	Ranges from 0.01 to 1.1

Table 3.2: Energy Intensities and Tax Rates in Different ETR Countries

Consistency with the Porter hypothesis would imply that imposition of the tax would reduce the energy intensity of the sectors, and a simple graph of energy intensity over time soon showed whether this was the case. However, this relation is only likely to be strongly evident where both the energy tax rate and the energy intensity were high and therefore the tax would give a significant stimulus to energy saving.

For those sectors where simple inspection of the graph revealed seeming inconsistency with the Porter hypothesis a further table for $C_{2/1}$ and $S_{2/1}$ was constructed to search for a possible explanation. Such an explanation could be that

either the energy intensity or the energy tax rate (or both) for the particular sector was too low for the imposition of the tax to have any stimulating effect.

Table 3.3 gives the summary results of the exercise for the four countries which had data for all the sectors. The descriptors Low, Medium, High refer to the relative positions of the variables (energy intensity/energy tax rate) of the sectors within the same countries. These variables vary dramatically across the countries, especially the tax rates and their evolution. The comparison is only between the listed sectors (i.e. a Low energy intensity is low relative to the eight sectors, not necessarily in respect of other sectors in the country concerned). It may be noted that within each country, in the discussions about energy taxation, sectors will argue, for example, that they have High energy intensity in respect of other sectors in the country, and therefore deserve favourable tax treatment, rather than comparing themselves with the same sector in other countries.

The table shows fairly clear consistency in respect of the energy intensities of the same sectors in different countries. Only in respect of 27.1-3 and 27.4 does the UK have a higher relative energy intensity ranking than other countries, but inspection of the figures reveals that these intensities are not high in absolute terms compared with the other countries. Inspection also reveals, though with exceptions, that sectors with Low energy intensities tend to have High or Medium tax rates, while sectors with High energy intensities have Low or Medium tax rates. Finland (sectors 21.2 and 26.5) is the only country with exceptions to this trend.

The results show that there is some evidence of consistency with the Porter hypothesis, but it is patchy. However, there is only one case where the absence of such consistency cannot be explained on the grounds that either or both of energy intensity or the tax rate were too low to stimulate reduced energy intensity. In Finland, high energy intensities and tax rates in sector 26.5 failed to improve energy intensity as expected.

The same sectors in different countries exhibit different results, with only 26.1 (glass) showing consistency with the Porter hypothesis in all countries, and 24.1 (basic chemicals) in all but one. In all other sectors, two countries show consistency and two do not.

A major difference between the countries was when they implemented their ETRs (see Table 3.2). In Denmark and Finland, implementation was in the early 1990s, and the tax rates were generally maintained or continued to increase throughout the period (the Danish sector 26.5 is an exception, with tax rates falling from 1998). In German and UK implementation was much later. However, there is little evidence that the early signals in the former countries have produced more results consistent with the Porter hypothesis.

	Denmark	Finland	Germany	UK
<i>15.1 Meat</i>				
Consistent with Porter hypothesis?	No	No	Yes	Yes
Energy intensity	Low	Low	Low	Low
Energy tax rate	High	Medium	High	High
<i>21.2 Paper & card</i>				
Consistent with Porter hypothesis?	No	Yes	No	Yes
Energy intensity	Low	Low	Low	Low
Energy tax rate	Medium	Low	High	High
<i>24.1 Basic chemicals</i>				
Consistent with Porter hypothesis?	Yes	Yes	Yes	No
Energy intensity	Medium	Medium	Medium	Medium
Energy tax rate	Medium	Medium	Medium	Low
<i>24.4 Pharmaceuticals</i>				
Consistent with Porter hypothesis?	Yes	No	Yes	No
Energy intensity	Low	Low	Low	Low
Energy tax rate	High	Low	High	Medium
<i>26.1 Glass</i>				
Consistent with Porter hypothesis?	Yes	Yes	Yes	Yes
Energy intensity	Medium	Medium	Medium	Medium
Energy tax rate	Medium	Low	Low	Medium
<i>26.5 Cement, lime & plaster</i>				
Consistent with Porter hypothesis?	No	No	Yes	Yes
Energy intensity	High	High	High	High
Energy tax rate	Low	High	Low	Medium
<i>27.1-27.3 Basic ferrous metals</i>				
Consistent with Porter hypothesis?	Yes	Yes	No	No
Energy intensity	Medium	Medium	Medium	High
Energy tax rate	Medium	High	Low	Low
<i>27.4 Basic non-ferrous metals</i>				
Consistent with Porter hypothesis?	No	Yes	Yes	No
Energy intensity	Low	Low	Low	Medium
Energy tax rate	High	Medium	High	Medium

Table 3.3: Evidence Consistent or Otherwise with the Porter Hypothesis

The patterns of energy taxation of the late implementers of ETR, Germany and the UK, over the 1990s and early 2000s were very different. Despite ETR in Germany which increased tax rates for all sectors over 1998-2000, tax rates fell significantly in all sectors over 1995-1998, and in some cases by 30-50% over 2000/01, before

increasing significantly again in 2002. Although many of the energy intensities were falling over 1995-2003, and all sectors ended the period with lower energy intensities than they had at the beginning of it (which is not true for all four countries being analysed), the signal coming from the tax rate was variable to say the least.

In the UK the tax rate fell significantly in all sectors (sometimes by a factor of 10) between 1990 and 2000, before rising again (but remaining below the level in the 1990s) in the ETR of 2001. Consistent with this, the energy intensity of four of the sectors changed little through the 1990s, but after 2000 energy intensity in three of the sectors jumps inexplicably. These changes may be due to data errors. Such occurrences show the essential fragility of the evidence on which the above analysis is based.

Statistical Estimation of Competitiveness Impacts

Another way of approaching the COMETR sectoral dataset would be to subject it to statistical analysis and estimation. Regressions were carried out for each of four dependent variables: unit energy costs, unit labour costs, output and exports. The regressions had a number of explanatory variables, including in each case energy prices and energy taxes. All variables were logged to make the results interpretable as percentage elasticities. The purpose of the regressions was to shed light on the Porter hypothesis by gaining insights into the sectoral outcome of ETR in respect of three effects acting in different directions:

1. Direct effect: This would cause unit energy costs to rise.
2. Indirect effect: Improved energy efficiency may lead to a *fall* in unit energy costs because less energy is used.
3. Indirect effect: Factor substitution and process and product innovations may also lead to a *fall* in unit energy costs (Porter effect).

A *genuine Porter effect* is assumed to be found if the adverse impacts of the increase in energy prices on economic performance (1. above) are offset by some combination of improved energy efficiency (2. above) and the Porter effect (3. above). If energy taxes only have a minor negative impact on energy competitiveness and output, perhaps because of the Porter effect, and if this negative effect is less than expected by the mainstream economic literature, it demonstrates the existence of a *mitigating Porter effect*. Finally, if economic performance is severely harmed by rising energy prices and taxes as assumed by mainstream theory, it indicates the *absence of Porter effects* in this area.

The main results for each of the four dependent variables were as follows:

- For *unit energy costs* estimates of the energy price effects indicate a significant Porter mitigating effect: energy price elasticities found are in the range of 0.2-0.3 per cent compared to 0.5-0.8 per cent found in the literature.
- There is no significant impact of energy prices or energy taxes on *unit labour costs*.
- A one percent increase in unit energy costs leads to a 0.17 percent decline in *output*, but energy taxes have a positive and very significant impact on output: output increases by 0.2 per cent when energy taxes increase by 10 per cent. This

result is interpreted as evidence of a Porter effect. Another possible reason is that energy taxes are often accompanied by tax revenue recycling in the form of energy investment subsidies, which will have the effect of further stimulating energy-efficiency improvements.

- Energy taxes are positively correlated with *exports*, but this is significant only at 10% level.

On the face of it the most surprising result is the positive impact of energy taxes on output, but it should be remembered that in the case of ETR energy tax revenues are often recycled back into the economy through reductions in labour taxes (i.e. tax revenues overall are unchanged), and it is possible that this change in relative factor prices would stimulate greater employment (especially in a situation of involuntary unemployment), which would lead to increased output. Overall, the conclusion of this analysis is that energy taxes, in the levels experienced so far, are not a problem for competitiveness and economic performance. On the contrary, a moderately positive impact of energy taxes on economic performance is consistent with the existence of a mitigating Porter effect by which energy tax pressure stimulates not only energy savings but also innovative product and process developments that improve competitiveness and stimulate demand for the new products.

Assessment of Competitiveness Impacts through Indicators

Although, as noted above, competitiveness is a complex concept that is open to a range of interpretations, at the most basic level it may be considered that a firm (or economic sector) loses competitiveness if its cost of production rises faster, or falls more slowly, than that of its competitors. In theory therefore, changes in sectoral competitiveness can be measured directly by comparing the changes in production costs of firms in all competing countries. Unfortunately, for many sectors there may be no meaningful unit of measurement for aggregate output (even at the firm level), making the definition of unit production cost problematic. Even for sectors where there is a meaningful unit of measurement for output, the necessary data may not be available. For this reason, alternative indicators of competitiveness need to be found.

Intuitively possible alternative indicators are the share of global production, import intensity and export intensity (if a sector's competitiveness improves one might expect its share of global production and export intensity to increase, and its import penetration to fall, with the opposite being the case if it deteriorates). The validity of these indicators (for export intensity contingent on certain conditions) was confirmed by a formal theoretical model. Data on these indicators was generated and inspected for each of the eight sectors and for each of the seven countries (Denmark, Finland, Germany, Netherlands, Slovenia, Sweden and UK) under investigation. Table 3.4 lists the results for the 56 combinations of 8 sectors and 7 countries.

Each country/ sector case is grouped according to the percentage change in unit cost and the changes in competitiveness observed in the data. Overall the data quality and the high degree of volatility in the data make it difficult to speak of clear trends. Losses in competitiveness occur only in countries/sectors where the impact of the ETRs on unit costs has been smaller than (or equal to) one percent. There is no case of a decrease (or increase) in competitiveness where the impact of the ETRs was above

1%. In Slovenia (26.5) and Finland (26.5) where the impact of the ETR was above 5% no change in competitiveness was registered in the data.

% Change in unit costs	Change in competitiveness			Total
	Gain	No change	Loss	
<= 1	1	37	9	47
1-5	0	7	0	7
> 5	0	2	0	2
Total	1	46	9	56

Table 3.4: Sectoral Competitiveness Analysis in ETR Countries

Out of 56 cases the data show no support for a change in competitiveness in 46 cases. Only in nine cases do indicator movements point to a loss in competitiveness. These occur in the UK (sectors 15.1, 21.1, 27.1-3, 27.4), Germany (21.2, 24.4, 26.1), Finland (24.4) and the Netherlands (27.4). An increase in competitiveness is found in the Danish pharmaceuticals industry.

In summary, the ETRs have not been significant in terms of their impact on unit production costs (below 1% in 47 cases). While there is some evidence for a decline in competitiveness in selected countries/sectors, there is no consistent pattern and it is not possible to conclude that the reform was a significant contributing factor.

COMETR WP4 Policy Brief

The effects of ETR on competitiveness: modelling with E3ME

by

Paul Ekins, PSI

The economic impacts of ETR

The economic effects of ETR are felt in a number of ways at a number of different levels. Most obviously the increases in energy or environmental taxes will increase the prices of the affected fuels or activities. Producers will be able to pass on a greater or lesser proportion of those price increases depending on whether they are in less or more competitive markets.

The revenue recycling mechanism will also affect prices, perhaps directly by reducing the cost of other inputs into production, when this might reduce the prices of goods and services, therefore wholly or partly offsetting the inflationary effect of the tax increase. Another possibility, where the revenue recycling is through a reduction in employers' social security contributions, is that this will increase the demand for labour. In a situation of full or near full employment, this may act to increase wages, which would then add to the inflationary effect of the tax increase, with further knock-on effects throughout the economy.

Another possible economic impact of the tax increase is that firms will seek to reduce their energy use by purchasing energy efficient intermediate or investment goods from appropriate companies. This could have multiple economic effects. First, it will reduce the energy use of the company making the investment, and this will serve to offset wholly or partly the increased tax expenditures (so that company energy expenditure may actually be *lower* than before the tax increase). Second, it will add to the output of the energy efficiency companies, serving to offset wholly or partly any reduction in output from the increased taxes on energy. Thirdly, the investment will stimulate technical change more generally, especially over the longer term. More energy-efficient equipment is often more productive in other ways as well.

All these effects act in different ways on different companies (depending on how their managements respond to the tax increase), different sectors (depending, among other things, on their energy intensities and openness to international trade) and different countries (depending on their overall economic structure). Moreover, there is continuous interaction and feedback at all levels between these effects and all the other influences on economic activity. The effects of ETR on international competitiveness are, therefore, multi-faceted and complex. The only way that insights can be generated into such effects in a complex system like a national economy is through economic modelling.

Previous Modelling Results of the Economic Impacts of ETR

Effects on the competitiveness of one country, or on economic sectors within a country, due to measures such as ETR, and subsequent impacts on environmental emissions, are sometimes called ‘spillover effects’. Where the measures are intended to reduce carbon emissions, then any rise in carbon emissions in other countries due to their increased relative competitiveness is called ‘carbon leakage’. In the literature, there has been a particular emphasis on the spillover effects of carbon mitigation policies taken by Annex I countries on the rest of the world. The effects may be divided into price effects (on international competitiveness and overall CO₂ emissions – carbon leakage) and non-price effects, sometimes called technological spillovers.

While much of the literature recognises the existence of spillovers, different models produce different conclusions with varying level of uncertainties, with an added complication that the effects may be displaced over time. The measurement of the effects is made more difficult because they are often indirect and secondary, although they can also accumulate to make local or regional mitigation action either ineffective or the source of global transformation. It is important to emphasize the uncertainties in estimating spillover effects. In the modelling of spillovers through international trade, researchers rely on approaches (eg bottom-up or top-down), assumptions of perfectly homogeneous versus differentiated products, and estimates (eg of substitution parameters) whose signs and magnitudes are disputed. Many of these models focus on substitution effects in estimating costs and do not consider the induced development and diffusion of technologies, as well as information, policy and political changes brought about by the originating mitigation actions. For example, Grubb et al. (2002) argue that spillovers from Annex I action, via induced technological change, could have substantial effects on sustainable development, with emissions intensities of developing countries at a fraction of what they would be otherwise. ‘However, no global models yet exist that could credibly quantify directly the process of global diffusion of induced technological change.’ (Grubb et al. 2002, p. 302).

There is general agreement in the literature that the international competitiveness of economies and sectors may be affected by mitigation actions (see surveys by Boltho (1996), Adams (1997) and Barker and Köhler (1998)), such as ETR. In the long run, exchange rates change to compensate for persistent loss of national competitiveness, but this is a general effect and particular sectors can lose or gain competitiveness. In the short run, higher costs of fossil fuels may lead to a loss in sectoral price competitiveness especially in energy-intensive industries. This may lead to the re-location of industry, in relation to which Sijm et al. (2004) conclude that ‘existing studies cannot provide a clear picture about the effect of environmental policy on the relocation of energy intensive industries; but they do indicate that - if a relation between environmental policy and relocation should exist - it is statistically weak.’ (p. 165). This is in line with the conclusions of the IPCC’s *Third Assessment Report* (TAR, IPCC 2001), namely that ‘reported effects on international competitiveness are very small and that at the firm and sector level, given well-designed policies, there will not be a significant loss of competitiveness from tax-based policies to achieve targets similar to those of the Kyoto Protocol.’ (p. 589). The TAR also found that international permit trading substantially reduces leakage.

Recent years have seen a number of new empirical studies of carbon leakage, some at least of which suggest that carbon leakage is potentially a serious threat to the effectiveness of mitigation policies. However, such results are not found in the empirical studies of carbon leakage as a general response to mitigation under the Kyoto Protocol. Sijm *et al.*, (2004) summarise these modelling results. ‘Models provide a useful, but abstract tool for climate policy analysis; they are faced by several problems and limitations with regard to practical policy decision- making, including problems such as model pre-selection, parameter specification, statistical testing or empirical validation.’ (p. 14). Moreover, the potential beneficial effect of technology transfer to developing countries arising from technological development brought about by Annex I action is substantial for energy-intensive industries, but has so far not been quantified in a reliable manner. ‘Even in a world of pricing CO₂ emissions, there is a good chance that net spillover effects are positive given the unexploited no-regret potentials and the technology and know-how transfer by foreign trade and educational impulses from Annex I countries to Non-Annex I countries.’ (Sijm *et al.* 2004, p.179). In any case, they conclude that, in practice, carbon leakage is unlikely to be substantial because transport costs, local market conditions, product variety and incomplete information all favour local production, and the cost effects of environmental regulation are found to be small.

Modelling ETR with E3ME: Methodology and Approach

Economic models are constructed using both theoretical insights about the relationships between different economic variables (for example, it is normally assumed that the quantity of a good demanded is reduced if its price is increased, and vice versa), and through statistical estimation of the parameters of these relationships. There are different kinds of economic models which make different theoretical assumptions and therefore have different structures. That is one reason why different models can give different outcomes in their modelling of economic interventions such as ETR. This is not the place to go into a detailed comparison of different models. For the COMETR project the model used was a macro-econometric European model (including the 25 countries which were members of the EU in 2006, plus Norway and Switzerland) called E3ME, which is described in some detail in the relevant COMETR working paper (CE 2006).

As discussed earlier, the notion of ‘environmental tax reform’ (ETR) typically involves the modification of the national tax system to move the burden of taxes from conventional taxes, for example those imposed on labour and capital, to environmentally-related activities, such as taxes levied on resource use, especially energy use, or environmental pollution. To counterbalance the possible adverse effects of an increase in green taxes, other taxes are reduced using the revenues generated by the ETR implementation (called ‘revenue-recycling’). The implementation of a revenue-neutrality policy is designed to ensure that the tax burden falls more on ‘bads’ than on ‘goods’ by ensuring that price signals, as a result of the introduction of ETR, give an incentive to households and industries to alter behaviour.

The ‘revenue recycling’ may take effect through reductions in:

- Direct taxes (income tax, corporation tax);
- Social security contributions
 - paid by employers;

- paid by employees;
- Other measures
 - Support schemes for investment expenditure (and depreciation); and
 - Benefits or other compensatory measures.

An ETR can, in principle, provide complete tax exemptions for economic sectors or reduced tax rates for different energy fuels and economic sectors in combination with some form of negotiated agreements with targets to improve energy efficiency or carbon emissions. Tax ceilings may also be established to limit the total tax burden faced by individual companies. However, such special measures may reduce the economic efficiency of the ETR overall.

In order to model the effects of ETR, a number of scenarios were generated by E3ME over the period 1994 to 2012 (the projection period therefore includes Phase 2 of the EU ETS), the main two of which are reported here:

- the Reference Case (R) which is a counterfactual projection without the ETR, but including current and expected developments in the EU economy, e.g. the EU ETS
- the Baseline Case (B) which is an endogenous solution of E3ME over the period 1994-2012. This scenario includes the ETR in each Member State covered by the project, exemptions or special treatment for the industries most affected and the compensating reduction in another tax. This scenario is calibrated closely to the observed outcome through using historical data which include the effects of ETR implementation.

Modelling ETR with E3ME: Results

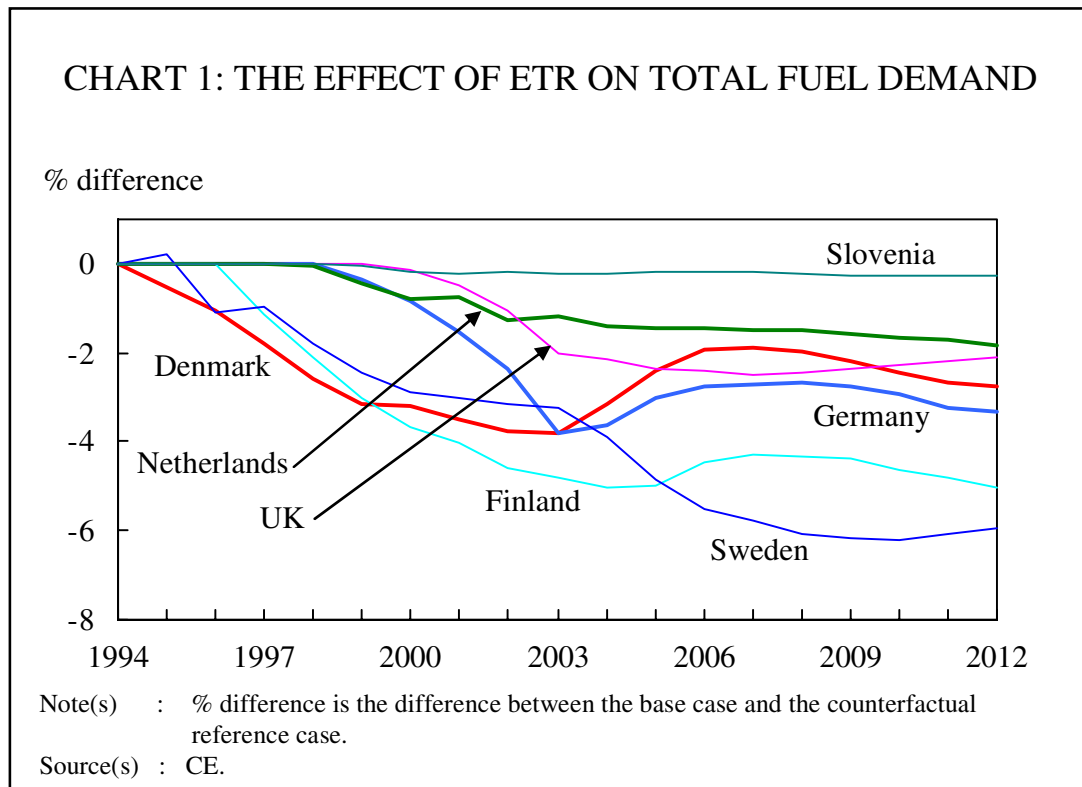
This section discusses the simulation results from the COMETR scenarios, by looking at the Baseline solution, and taking an overview of the results from the countries that pursued ETR in the 1990s, and then discussing the competitiveness effects on individual energy intensive sectors.

The Baseline solution for COMETR is an endogenous model solution of E3ME that fully covers the period 1994-2012 annually. The Baseline solution is calibrated to be consistent with a combination of historical data and forecast. This section compares the results for the Baseline case against the Reference case. In summary, this illustrates the difference between what did happen and what would have happened had there been no ETR (with both cases projected to 2012). The exception to this is that revenue neutrality is assumed in each case through the revenue recycling mechanisms. Exemptions, non-payments and negotiated agreements are included as accurately as possible as they happened, subject to the total revenues matching the published figures in each case.

As the taxes included in the analysis increased fuel prices, we would expect the primary effect to be a reduction in the demand for energy. The scale of the reduction will depend on the tax rates, on how they are applied to the various fuels and fuel user groups, on how easy it is for fuel users to substitute between the different fuel types and non-fuel inputs, and on the scale of the secondary effects from resulting changes in economic activity.

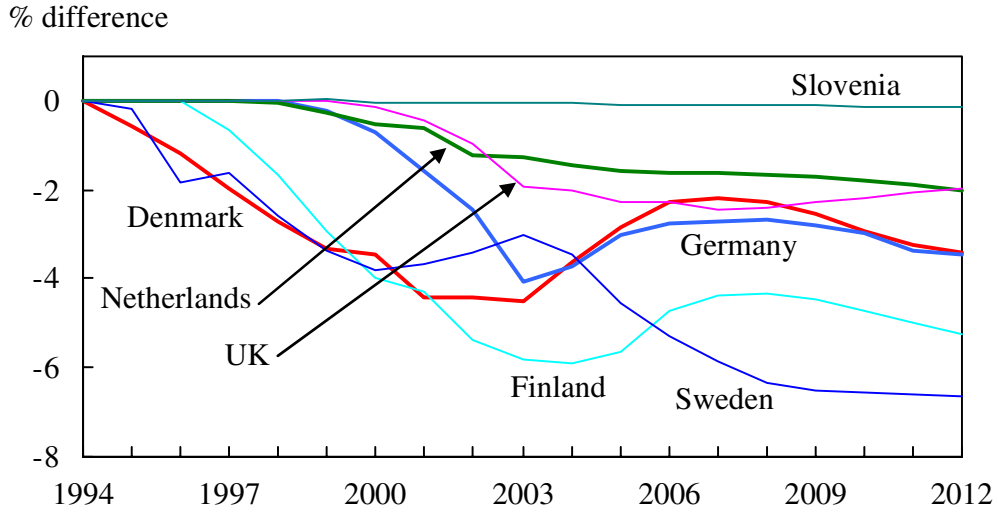
All the six European countries that have implemented an ETR show a reduction in fuel demand from the ETR (see Chart 1; For Slovenia, the CO₂ tax, although not strictly part of an ETR, has been included in the Baseline scenario to give an example of environmental taxation in the New Member States.). In most cases the reduction in fuel demand was in the region of 4%, although it was slightly larger in Finland than the other regions.

A key feature of the results is the recovery in fuel demand in several of the examined countries over 2004-05 in the Baseline case relative to the Reference case, due to higher world energy prices, included in both the Baseline and Reference cases. In most of the ETRs, the environmental taxes were not raised in line with fuel prices (and in some cases may have been reduced), implying a reduction in the relative change in fuel prices. In most of the ETRs the environmental taxes were not increased in line with fuel prices (and may have been reduced in some cases), so the relative change in fuel prices becomes less in 2004-05.



We would expect to see a reduction in atmospheric emissions from lower consumption, but total emissions will also depend on the relative consumption levels of each fuel type. For example, a tax system that encourages the use of coal is likely to produce higher emissions than one which encourages the use of natural gas or bio-fuels. E3ME includes explicit equations for fuel shares of hard coal, heavy oil, natural gas and electricity. Assumptions are made about the other fuel types linking them to the closest modelled alternative (eg other coal is linked to hard coal, crude oil to heavy oil). For middle distillates (petrol, diesel, etc) demand is linked to total fuel demand by that sector. The reason for this is that demand for these fuels is dominated by the transport sectors. These sectors do not generally use any other fuels, so fuel share equations are not required.

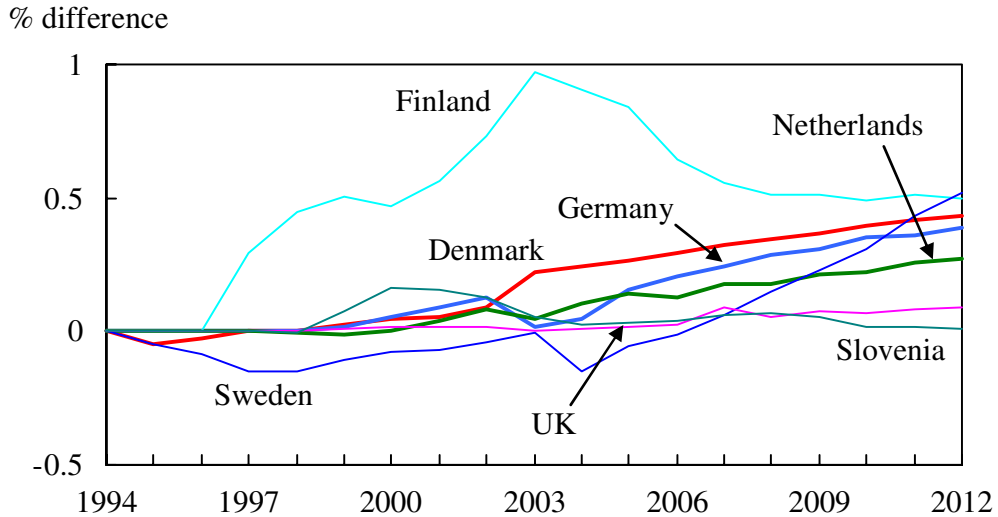
CHART 2: THE EFFECT OF ETR ON GHG EMISSIONS



Note(s) : % difference is the difference between the base case and the counterfactual reference case.

Source(s) : CE.

CHART 3: THE EFFECT OF ETR ON GDP



Note(s) : % difference is the difference between the base case and the counterfactual reference case.

Source(s) : CE.

The scenario results show that there are reductions in GHGs all six ETR regions from the ETR (see Chart 2). The effects closely follow the results for total fuel consumption, with the largest reductions occurring in regions with the highest tax

rates. The largest reduction in emissions occurs in Finland and Sweden. It should be noted that in most cases the fall in emissions is relatively larger than the fall in fuel demand, indicating that the tax policies are efficient at reducing emissions.

As a general rule, the effects of the ETR will be positive on economic activity, depending on how the revenues from the environmental taxes are recycled. However, it is likely that there will be transition costs, so the gains may not be immediate. All six of the ETR countries have an increase in GDP as a result of the ETR (see Chart 3). In Sweden, the effects take slightly longer to come through, as the very large increase in household electricity taxes depresses real incomes in the short run. Finland has a short-term boost to GDP from the effects of the taxes on fuel demand, because a reduction in the demand for imported fuel improves the country's trade balance.

As the ETRs result in higher fuel prices it is considered likely that there will be an increase in the overall price level. The degree of this is likely to be dependent on the scale of the increase in fuel costs, how easy it is for industry and consumers to switch between fuels to cheaper alternatives (and non-energy inputs) and how much of the cost is passed on by industry to consumers (this is dependent on the level of competition in the industry, which is estimated econometrically for each region and sector). It should also be noted that the revenue recycling may have a deflationary effect when the revenues are recycled through reductions in employers' social security contributions (ie labour costs). This is demonstrated for Germany (where just under half the revenues were used for reducing employers' contributions) in Chart 4 below. In Denmark and the UK, there were no significant increases in the overall price index. In the UK this is because the tax is relatively small and was compensated with slightly cheaper labour costs. In Denmark the tax was larger, but was again compensated with lower labour costs (see Chart 5).

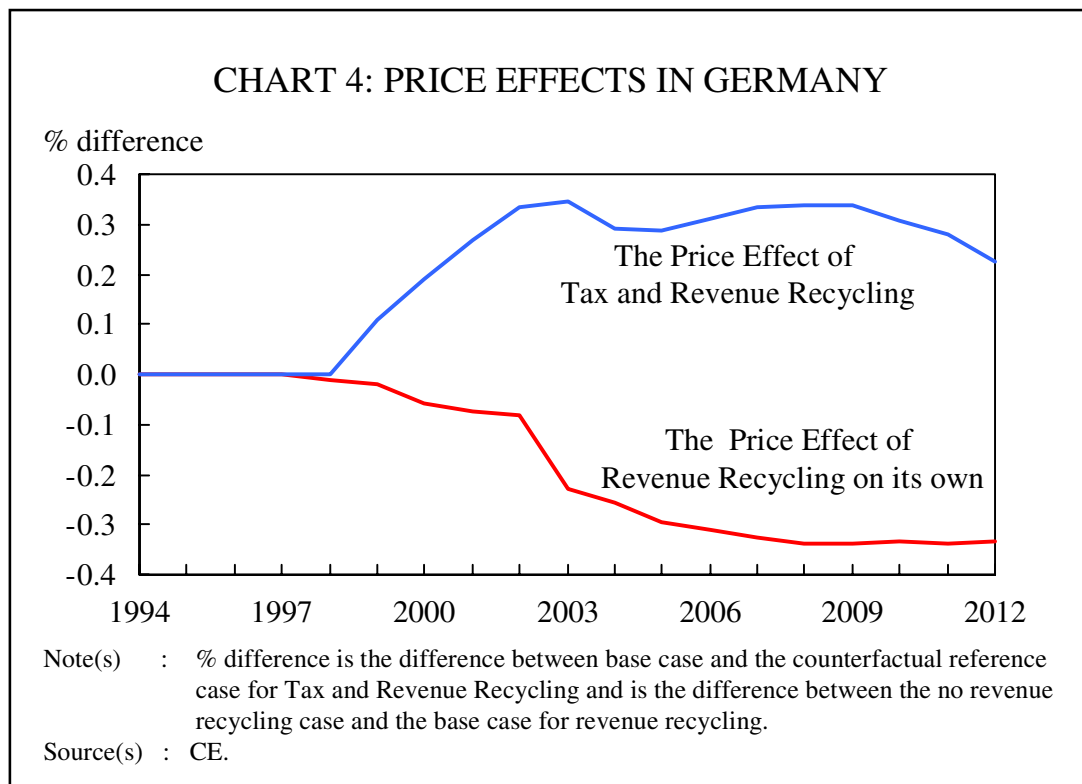
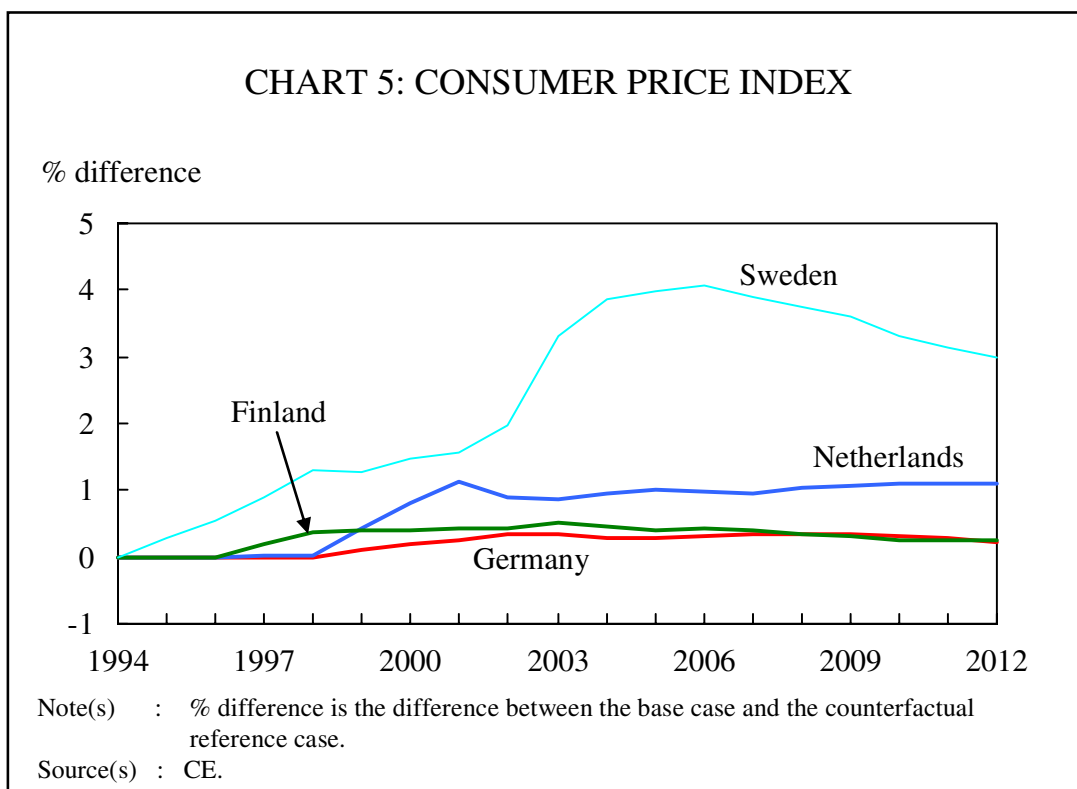


CHART 5: CONSUMER PRICE INDEX



The measure of inflation, the consumer price index, will record a larger increase in cases where the taxes are levied on households rather than industry. The reason for this is that the consumer price index is a weighted average of the price of consumer products, including energy. In the cases where the tax is levied on households the whole tax is reflected in the consumer price index, rather than just the share that is passed on by industry. Therefore it is not unexpected that the largest increases are in the Netherlands and, in particular, in Sweden (see Chart 5).

TABLE 1: DEFINITION OF COMETR SECTORS

E3ME Sector	NACE Definition
5 – Food, Drink and Tobacco	15, 16
7 – Wood and Paper	20, 21
10 – Pharmaceuticals	24.4
11 – Chemicals nes	24 (ex 24.4)
13 – Non-Metallic Mineral Products	26
14 – Basic Metals	27

The Porter hypothesis suggests that environmental regulation can induce efficiency and innovation and improve competitiveness as efficiency gains partially, or more than fully, offset the costs of complying with the regulation. In the COMETR context, environmental regulation has been more narrowly defined, however, as energy taxation implemented to encourage households and industries to behave in an environmentally-sustainable manner. On this definition, our results show, in contrast, that in the absence of revenue recycling mechanisms, ETR leads to a net loss of output in all examined countries (except Finland). However, when there is revenue recycling, ETR, as modelled within E3ME, produces a small ‘double dividend’ effect in every country, with GDP increasing by up to 0.5% compared to the Reference case.

In addition to investigating the effects of ETR at the country level, the COMETR project also focused on four of the most energy-intensive E3ME sectors, plus food and pharmaceuticals to provide a comparison. These are defined in Table 1.

Table 2 gives a good indication of the importance of energy as an input to each sector and region, with the figures being expressed as a percentage of turnover². Table 2 shows that even in the most energy-intensive industries, energy does not represent a large share of inputs. Only in one case, Other Chemicals in the Netherlands, does the share of energy inputs in turnover exceed 10%. In most cases the figure is around 5%, with non-metallic minerals and basic metals apparently having slightly larger

	DK	DE	NL	FI	SE	UK	SI
Food, Drink & Tobacco	1.5	2.0	1.5	1.4	1.0	1.5	1.9
Wood & Paper	1.9	3.3	2.9	5.1	3.7	3.0	6.5
Pharmaceuticals	0.4	7.2	0.0	6.5	0.3	0.9	0.0
Other Chems	4.2	6.5	17.5	8.9	8.4	3.9	4.3
Non-Metallic Minerals	5.4	5.8	4.2	3.5	4.4	4.4	8.9
Basic Metals	3.0	8.7	5.8	6.6	4.5	4.7	9.4

Source(s) : CE, E3ME database

shares.

If energy represents around 5% of an industry’s input costs (turnover – profit), then even a 50% increase in energy costs is going to lead to only a 2.5% increase in total input costs – even assuming that the industry is unable to reduce its fuel consumption or substitute between different fuel inputs. This may or may not be absorbed by firms within the industry (if there were perfect competition within the industry it would be completely absorbed, if there were no competition it would be completely passed on). The effect of any price increases will depend on the relevant price elasticities (domestic and export) for the industry’s products. Typically these would be less than one, so a 2.5% increase in prices would not lead to a 2.5% decrease in product demand. Consequently, even in the energy-intensive sectors we would not expect to see large falls in output.

² Figures for the Pharmaceuticals and Other Chemicals sectors are estimates (except for the UK) as these sectors are not explicitly defined at the NACE 2-digit level. These estimates are derived by summing across the rows and columns of the input-output table and taking relative gross output shares. For Germany and Finland the allocation of fuel use to Pharmaceuticals seems unreasonably high and it is likely that most of this demand should in fact have been allocated to Other Chemicals

Table 3 shows the results for price increases from ETR for 2004. This year was chosen because it is the final data-point in the input series; by 2004 the ETRs are in place, but there is no blurring of results by the assumption that tax rates remain constant in real terms after 2004.

As expected, the largest increases in prices are in the non-metallic mineral products

	DK	DE	NL	FI	SE	UK	SI
Food, Drink & Tobacco	0.01	0.05	0.00	0.46	1.69	0.00	0.04
Wood & Paper	-0.57	-0.40	-0.34	-0.26	-0.33	-0.48	-0.32
Pharmaceuticals	0.01	-0.09	-0.01	0.87	0.05	0.09	-0.02
Other Chems	0.32	0.72	0.11	0.36	0.28	0.36	0.08
Non-Metallic Minerals	0.33	0.46	0.26	0.77	1.06	0.29	0.16
Basic Metals	0.51	0.43	0.50	0.53	0.48	0.62	0.46

and basic metals sectors. Prices fall in the wood and paper sector (which operates in an EU market rather than national markets). This is mainly due to a reduction in labour costs in the sector (which form a much larger share of input costs than energy does), and this reduction is mainly a result of reductions in social security payments in Germany and the UK.

Only two of the sectors show price rises above 1%. These are both in Sweden, where the effects are actually an indirect result of higher consumer prices, particularly in electricity (from the ETR) which in turns leads to an increase in wages. In most other cases (excluding wood and paper) the differences are in the range of 0.2-0.4%.

In most cases the price increases also include a factor for an increase in investment. This mainly represents firms' decisions to purchase new machinery in response to higher energy prices. While this may have a negative short-term effect in price competitiveness, it will improve long-term non-price competitiveness through the production of higher-quality output (which may again command higher prices). The effects of the ETRs on industry output are less easy to interpret because they include a number of different factors:

- price effects outlined above
- non-price effects from additional investment
- consumer demand
- activity in export markets
- production in competing import markets

Table 4 shows the percentage increase or decrease in gross output at factor cost (which excludes tax payments) for each of the examined industries, again in 2004. The results show that, in many, cases the over-riding effect is higher domestic demand from consumers. In most cases, gross output in the affected industries increases slightly. This is not entirely unexpected given the modest nature of the price increases recorded. The scale of the increases varies across sectors much more than across countries. The smallest differences are in the UK where the ETR was smallest. This suggests that domestic demand is a key determinant in industry output.

Food & drink in Sweden is a special case in the results: prices do rise in Sweden in

	DK	DE	NL	FI	SE	UK	SI
Food, Drink & Tobacco	0.65	0.56	0.13	0.64	4.24	0.02	0.28
Wood & Paper	0.29	0.17	-0.27	0.06	0.19	0.04	0.04
Pharmaceuticals	0.08	-0.02	-0.06	0.14	-0.05	0.00	-0.04
Other Chems	0.03	0.00	0.00	0.31	0.46	-0.07	-0.07
Non-Metallic Minerals	0.08	-0.28	0.05	0.54	0.31	-0.03	0.02
Basic Metals	0.08	-0.15	0.63	0.08	0.08	-0.16	0.00

the food and drink industry (see Table 3). However, this is not by as much as the overall consumer price index, which rises primarily due to electricity costs. Consequently, food & drink becomes comparatively cheaper and receives a larger share of consumer spending, in turn consumer spending is boosted overall by reductions in income tax. Consumer demand accounts for half of gross output in the food & drink industry.

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COMETR WP 5 Policy Brief

Carbon Leakage

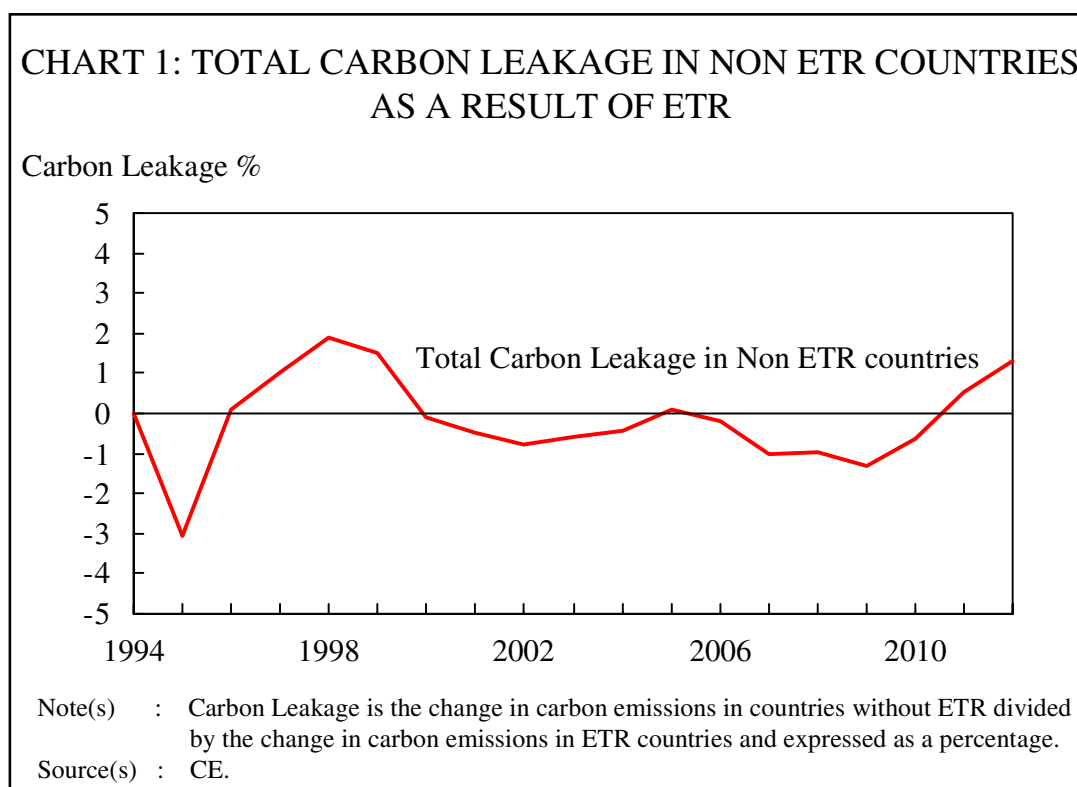
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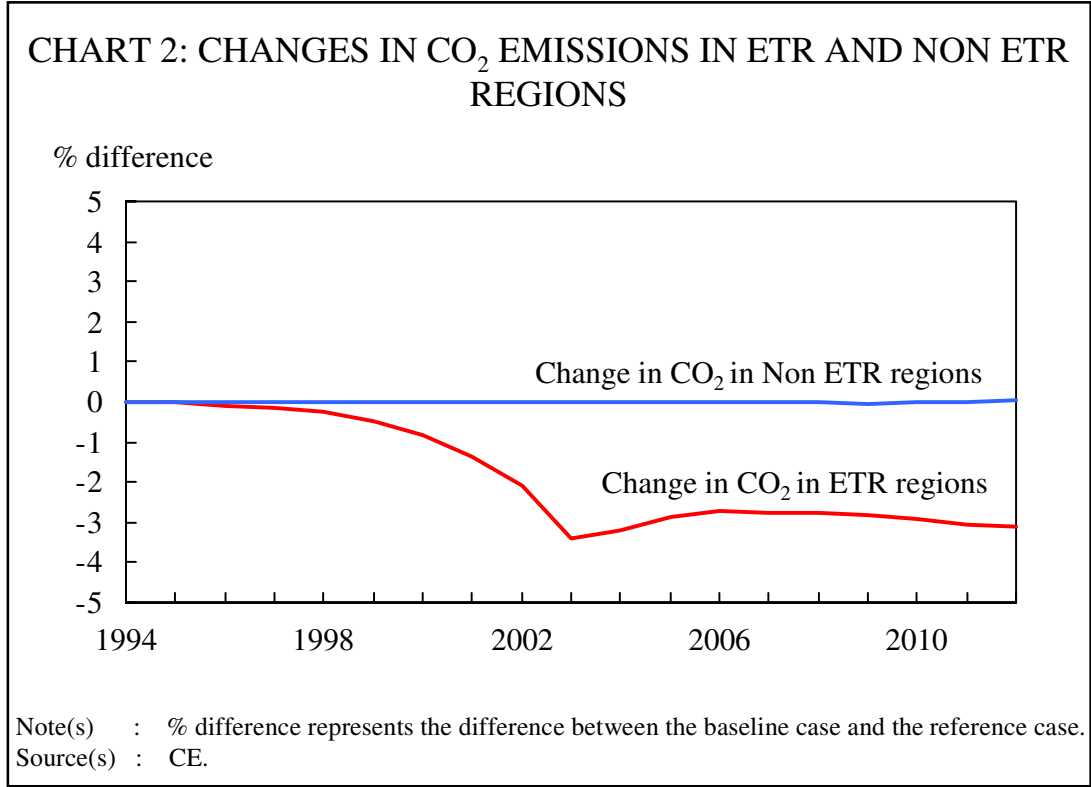
Stefan Speck, NERI

Environmental effects with specific reference to carbon leakage

Environmental effects including the possibility of carbon leakage as an outcome of ETR implementation are placed high on the political agenda. Economic and environmental effects are studied in other parts of the COMETR project, whereas the focus of this component is to address the effects in a wider and more global context.

The phenomenon of carbon leakage as a consequence of an increase in CO₂ emissions outside the countries taking unilateral domestic policy measures has attracted attention in the IPCC's *Second Assessment Report* (1995) as well as in its *Third Assessment Report* (2001). In addition, numerous studies have been published on this subject during recent years. Results vary widely although it seems that there is a consensus that global leakage for Kyoto-style action is around 10%. However, the estimates of leakage rates are very sensitive, and are critical in relation to the models adopted and the underlying assumptions.





The modelling of carbon leakage with E3ME as a consequence of the implementation of ETRs in several EU member states shows that in some years ‘negative’ carbon leakage was recorded, due to technological spillover effects, measured through increases in carbon-saving investment in some non-ETR member states, suggesting that there was a reduction in aggregated carbon emissions in both ETR and non-ETR countries (see the chart 1).

Chart 2 shows that CO₂ emissions fall in the ETR countries collectively over the period by 3-4% in 2012 as a result of the ETR. In contrast the ETRs have almost no effect on the level of CO₂ emissions in non ETR countries. This suggests that there was no carbon leakage from ETR regions collectively to non ETR regions.

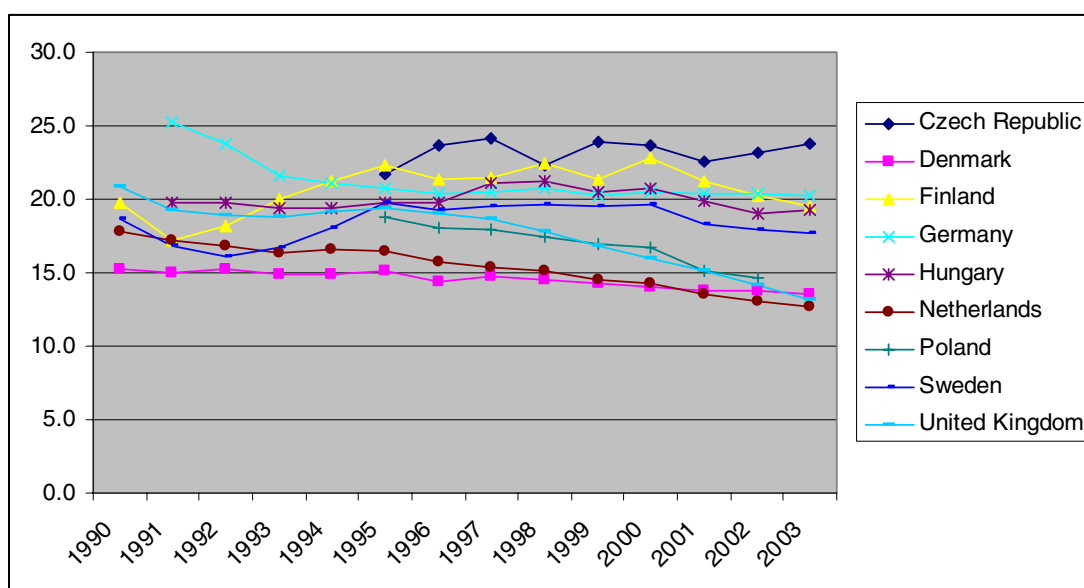
However, an important caveat exists as E3ME is not a world model, meaning that the above-mentioned result is limited to EU member states.

The issue of carbon leakage is definitely not a new topic in assessing environmental policy measures in an international context. Consequences of international trade on the environment are studied by many scholars and often circle around the pollution haven hypothesis (PHH); that, under free trade, multinational firms may close plants in countries with stringent environmental standards and establish new ones in countries with laxer standards, in particular in developing countries. There is an ever-increasing body of academic and empirical literature attempting either to verify or to reject the PHH. However, a definitive answer does not exist due to methodological problems with regard to analysing the PHH and also of lack of appropriate data. It seems that a consensus has been found as the ‘prevailing conclusion of the pollution

haven literature is that environmental requirements have a small negligible effect on relocation' (Oikonomou et al., 2006, p.3663, see also Smarzynska and Wei, 2006).

However, adoption of a wider view is necessary when assessing whether the introduction of an ETR may have caused the relocation of industries to foreign countries. Empirical evidence shows that the significance of the manufacturing industry has diminished in the majority of EU member states over recent years when measured as value added generated compared with development in GDP.

Chart 3: Evolution of value added of manufacturing industry as % of GDP in selected EU member states



Source: OECD STAN database, Eurostat and author's own calculations

The development paths shown in the figure are not consistent but the overall trend is, as the importance of manufacturing industries in 2003 declined in relation to 1990, and since has declined further. The decline can be seen in the UK over the period as a whole in contrast to the situation in Finland and Sweden where the significance of the manufacturing industry increased in the mid to late 1990s but dropped thereafter. It should be mentioned in this context that during the 1990s these two countries implemented ETRs and increased the carbon energy tax rates levied on energy consumed by manufacturing industries.

A rather intriguing aspect and closely related to the reduced importance of the manufacturing industry in developed countries is the loss of global market share for a whole range of different products, many of which must be described as energy-intensive products (see the figure below).

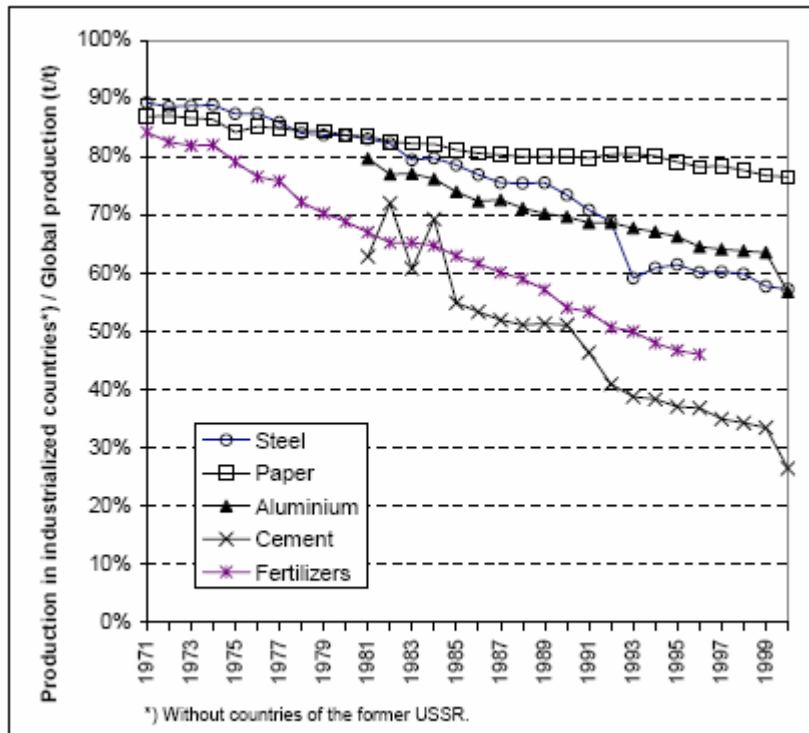


Figure 2: Global production shares of energy-intensive products in industrialised countries (source: Sijm et al., 2004, p. 152)

This loss of global market share started already in the 1970s, parallel with an increase in foreign direct investment (FDI) to developing countries, in particular in Asia, which has accelerated even further during the 1990s. It is hard to imagine that stricter environmental policies in industrialised countries was the mechanism initiating the process of investment in developing countries, thereby triggering relocation of industry. However, the majority of direct foreign direct investment is still between industrialised countries (UNCTAD, 2003).

It may therefore be useful to link the analysis of the pollution haven hypothesis with the flow of foreign direct investment (FDI) as the source for establishing new production capacities in foreign countries, in particular when thinking of relocation of industries to developing countries. Studies analysing the PHH generally do not take into account the underlying reasons and determinants for FDI, although the trade literature offers some plausible arguments for FDI and distinguishes between the main types of FDI (see for example Christie, 2003 and Demeskas et al., 2005):

- Horizontal FDI (market-seeking investment): FDI is undertaken with the aim of satisfying demand in the market in which investment is made (i.e. foreign market from the perspective of the investor).
- Vertical FDI (cost-minimising investment or efficiency-seeking investment): a multinational company invests in a foreign country as the costs are lower and production costs are minimised.

It may be argued that investments according to the horizontal FDI type are of limited significance with regard to the PHH as the main motivation is to produce for the domestic markets and not for export. This contrasts with vertical FDI by multinational companies as this type of investment aims to produce at lowest cost and to sell globally.

The economic, environmental and technological performance of specific sub-sectors in ETR countries

Decoupling analysis is progressively being used by international organisations, such as the OECD, Eurostat and the Nordic Council of Ministers, to assess the economic and environmental performance of economies as well as economic sectors. The concept of decoupling is rather simple, as it shows the change in environmental pressure, such as energy consumption, against the evolution of the driving force, i.e. an economic variable such as the GDP, over a predetermined period. Decoupling analysis is useful as it indicates the growth rate of an environmental pressure relative to an economically relevant variable to which it is causally linked.

Table 1: Decoupling factor³ between energy consumption and output of economic sectors in EU member states during the period 1995-2002 (output measured in 1995 prices⁴)

	Meat and meat products (15.1)	Paper and paper products (21.2)	Basic chemicals (24.1)	Pharmaceuticals (24.4)	Glass and glass products (26.1)	Cement, lime and plaster (26.5)	Ferrous metals (27.1-3)	Non-ferrous metals (27.4)
UK	0.31	0.11	-0.07	0.04	0.23	0.48	-0.07	-0.20
DE	0.38	0.14	0.11	0.16	0.02	-0.04	-0.11	0.12
DK	0.00	-0.16	0.06	0.27	-0.61	0.15	-0.39	0.19
NL	-0.29	-0.22	-0.05	0.44	-0.04	0.12	0.01	-0.16
FI	-0.16	0.07	0.12	0.32	0.22	n.a.	-0.22	-0.12
SE	0.24	-0.47	-0.35	0.29	0.30	-0.19	-0.24	-0.08
SI	-0.45	-0.28	-0.32	-0.56	0.12	-0.34	-0.23	-0.15

Note: DK - time period is 1995-2001 for all sectors; FI – time period is 1995-2000 for sectors 21.2, 24.4, 26.1, 27.1-3 and 27.4; NL – time period is 1995-2000 for sectors 26.5, 27.1-3 and 27.4

Source: author's own calculation based on COMETR database

³ Decoupling factors are positive in the presence of decoupling with a maximum of 1 in cases when environmental pressures reaches zero. A decoupling factor of zero or negative states that no decoupling occurred during the past analysed.

⁴ All monetary figures were adjusted to 1995 prices by using national GDP deflators.

The results of the decoupling analysis presented in the table above show no consistent pattern of development – either within countries or within sectors. However, detailed case studies of the eight sub-sectors written as part of this work package show some interesting features with regard to improvements in energy efficiency measures, sometimes also connected to negative costs. These case studies are furthermore attractive in the sense that they describe the most current developments in technologies applied in the sub-sectors as well as indicating the international trade in the products of these sectors. For example, international trade of cement is relatively unprofitable where it is transported over land due to its very low value/mass ratio; and this fact is reflected in trade statistics with a considerable share of exports generally being sold to the closest geographical neighbours of the producing country.

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COMETR WP 6 Policy Brief

Mitigation and Compensation

by

Mikael Skou Andersen, NERI

The OECD distinguishes between mitigation measures which are ex-ante and compensation measures which are ex-post; while ex-ante measures provide for reductions in tax rates or modification of tax bases, ex-post measures are outside the realm of the taxes as such and mitigate via other policy instruments. Ex-post measures include revenue recycling, subsidies and border tax adjustments.

The OECD claims that ‘Mitigation measures reduce the environmental effectiveness of the tax by cancelling out some of the incentives to change consumption and investment behaviour’. This statement is difficult to question, but it should be noted that loss of environmental effectiveness is conditional upon insertion of the term ‘*financial*’ before ‘incentives’, as in some cases other incentives may be embedded in the mitigation measures (e.g. agreements). Where mitigation alters the tax rates or tax bases, such ex-ante measures will distort the effective reduction of emissions, whereas when ex-post mitigation provides for additional incentives the environmental results may still be attained, although the claim for optimality may be difficult to justify. Voluntary sectoral agreements, for instance, rely on a presumption for a collective norm which will commit companies to deliver a similar level of CO₂ reductions as that which would follow from purely economic incentives. In a similar vein the recycling of tax revenue, e.g. for targeted subsidies to energy efficiency measures, may help lower the marginal cost curve and hence mitigate the need for more substantive tax rates.

While the overall rationale for mitigation measures stems from competitiveness concerns, it appears to be too simplistic to conclude that mitigation will by definition take place at a cost for the environmental targets. There is also the additional concern of carbon leakage, i.e. that environmental tax reform will merely lead to dislocation of production to countries with no or lower carbon-energy taxes, and hence that mitigation can be justified by the need for a ‘balanced’ approach in the case of certain very energy-intensive industries.

The six member states that have introduced ETR have implemented quite different mitigation measures. The differences in scope are interesting to study and contrast, as they reflect somewhat different strategies for mitigating competitiveness concerns. In recent years member states have increasingly been constrained by the EU’s regulations on state aid in the environmental sector and the 2003 Energy Taxation Directive. Under these regulations the *exemptions* from environmental taxes are regarded, functionally, as a potential form of state aid and have become subject to a range of restrictions and procedures. Although there are significant differences in member state approaches to ETR and ETR-mitigation, under EU-law a common legal

framework has gradually emerged. This legal framework constrains the options of member states when considering mitigation approaches.

Ex-post measures (compensation)

It is relevant to compare the different approaches to revenue recycling. On basis of the very detailed review of the revenue recycling in DL1.3 it is possible to make the following observations;

- Sweden and Finland have mainly recycled revenue by lowering income taxes. For Sweden it has for many years been a tax policy aim to lower the pressure of income taxation on labour income. The tax reforms in these two countries have aimed at lowering direct income taxes, and the carbon-energy taxes have contributed to securing alternative revenues for some, but not all, of the income tax reductions. This observation applies for Sweden's early environmental tax reform (1990) as well as the most recent phase (after 2001). It also applies to Finland for the more comprehensive tax shifts introduced since 1996, whereas in the first phase revenues were small and the recycling not very transparent. It would have been difficult for both countries to follow the recommendations from the fiscal literature to aim at employers' social security contributions, because such contributions are relatively small in both countries.

- Denmark and UK, on the other hand, have more closely followed the recommendations from the fiscal conventionalists, e.g. revenues have been aimed predominantly at a lowering of employers' social security contributions, so as to avoid inflationary effects. However, because of the imbalance between energy consumption on the one hand and numbers of employees on the other, the lowering of social security contributions, at the company level, does not necessarily lead to full compensation for the individual company. The imbalance has then, in Denmark as well as in the UK, been mitigated via the various mechanisms for energy-intensive industries such as agreements and reduced rates for heavy industries. The real purpose of the exemptions seems to have been to avoid the tax interaction effects (See WP1). Finally, both countries have earmarked some revenues (5-20%) for direct energy efficiency subsidies, e.g. via the Carbon Trust, perhaps out of concerns that incentives would otherwise be too weak.

- Netherlands and Germany have followed 'mixed' approaches. The Dutch reduced income taxation in the initial phase, and a particular issue here was social concerns, which led to the increase of the basic tax free allowance for income as well as to complicated formulae for exempting basic consumption of electricity and gas (Vermeend and van der Vaart, 1998:11). In the second phase the Dutch adhered more to the side of fiscal conventionalists and reduced the employers' wage component, but they also reduced corporate taxes. In Germany the ecological tax reform split the revenue recycling equally between a reduction of employers' and employees' social security contributions, hence establishing a programme of revenue recycling less concerned with fiscal orthodoxy and more with political appeal, taking into account that the eco-tax reform aimed equally at gasoline prices and fuels as such.

- Slovenia did not introduce an environmental tax reform as such, it mainly restructured its existing energy taxes into fuel taxes with a carbon-energy tax base – so the issue of revenue recycling does not really arise in the Slovenian context.

Hence we can summarise the observations on the revenue recycling approaches by dividing the member states in question into three different groups; the fiscal conventionalists (UK and Denmark), the fiscal pragmatists (Sweden and Finland) and finally the political pragmatists (Netherlands and Germany). The pragmatists are labelled so, because reforms were designed so as to accommodate the pressing concerns with the tax systems and the electorate, rather than with fiscal theory.

Ex-ante measures (mitigation)

The state aid guidelines offer certain opportunities for reducing the tax rates of energy-intensive industries, especially if these are higher than the EU's minimum tax rates. These opportunities are to some extent modelled on the basis of the 1995 decision regarding the Danish CO₂-taxation scheme, which was the first member state to obtain explicit Commission approval of its carbon-energy taxation system. As agreements between energy-intensive industries and the relevant authorities played a certain role in obtaining tax rate reductions in the Danish scheme, it was natural that the Commission's state aid guidelines reflected the role of agreements vis-à-vis selective tax reductions as accepted in the Danish case.

Hence the Danish scheme, and the subsequent state aid guidelines, provided a menu of acceptable solutions to mitigation efforts that surfaced in the decisions on the German and UK schemes. It is therefore not surprising that agreements as an instrument play a key role in both the German and British cases. Conversely agreements as a policy instrument are absent in the Swedish, Finnish and Slovenian schemes which were devised prior to the EU membership of these countries. And although the Dutch have a notorious practice of long-term agreements for energy efficiency, these agreements are not directly linked with the derogations from energy taxes, as the Dutch established their tax system as a response to the relative failure of the agreements to deliver the desired CO₂ reductions.

The Swedish and Finnish systems share with the German and Dutch schemes the use of a 'threshold' above which one or more reduced tax rates apply for a range of fuels. The thresholds themselves vary significantly; however, in the Finnish case only about 12 companies find themselves above the threshold, whereas in the German case thousands of companies rely on the 'spitzen-ausgleich'. The state aid guidelines are relatively taciturn on the use of thresholds, as well as on the principles of establishing these. While it would appear that a threshold is not discriminatory, because all firms with energy consumption above the threshold would be able to benefit from the reduced rates, some doubts must be expressed when the threshold is selective; for instance, applies to some energy carriers but not to others, or in other ways applies in a narrow fashion, favouring particular sectors or companies. It appears that these four member states have designed the thresholds to accommodate to some extent the specific competitiveness concerns related to *their* domestic industries and the conventional fuel choices; while Finland appears to have concerns for its pulp and paper industry mainly, the Dutch scheme appears to be designed especially to mitigate

competitiveness concerns for the very energy-intensive chemical industry. As for Sweden and Germany a broader range of energy-intensive industries are of concern.

In contrast to the four above-mentioned member states, the UK and Denmark provide relief to a range of sectors and industrial processes in terms of reduced tax rates. These reductions are to some extent contingent upon agreements and binding targets for energy efficiency. While the UK provides reduced rates for coal, gas and electricity, Denmark allows for reductions for all fuels and electricity. Germany also offers reduced tax rates for industries, but in the German case there are no requirements for new agreements, instead the reference is to the voluntary self-commitment of German industry from 1995. The German reductions are available for all sectors, contrary to the availability for certain processes or sectors only in the Danish and British cases. The non-discriminatory reductions in the German system imply that no state aid issues have apparently arisen here, although the use of the EU minimum tax rate for coal, but no other fuels, seems to convey a specific advantage to the iron and steel industry.

Mitigation in a combined ETR-ETS policy mix

The establishment of a CO₂ emissions trading system in the European Union has created a more complicated regulatory environment, in which carbon-energy taxation now coexists with trading of emission certificates.

The emissions trading system covers large installations, i.e. power plants larger than 20MW, as well as refineries and certain energy-intensive industries, notably ferrous metals, cement, glass, ceramic products as well as pulp and paper. Member states can further extend the trading system to other energy-intensive industries.

As emission certificates are grandfathered to industries the costs from the scheme arises along two routes. Direct costs may arise as industries need to acquire certificates for additional production activities. Indirect costs arise as power plants factor the value of certificates into power prices. Due to the pass-over ability of power producers the national allocation plans have in most cases provided certificates matching the historical emissions to industries, whereas allocation to power plants for several member states have been restricted to less than the historical emissions. This implies that the main route along which the ETS can impact the competitiveness of firms proceeds along the pass-over on power prices.

Numerous studies have investigated the pass-over on power prices. The most pessimistic studies assume a 100 per cent pass-over rate, e.g. McKinsey comes to a figure of 10 €/MWh for a 20€ allowance price. However, several studies show that the pass-over rate will only be 100 per cent during the times where power demand exceeds the base load, and it is coal or lignite plants that set the marginal price. In the seasons and periods where hydropower or nuclear power sets the marginal price, it is not likely that power operators will be able to factor-in the full value of the certificates. One study for Germany and the Netherlands hence comes to a pass-over rate of 40-60 per cent. The IEA furthermore points out that large parts of the European electricity market are not yet fully liberalised and that price regulations will restrict pass-over (Reinaud, 2007). Nevertheless, the IEA points to the Nordic electricity market (Nordpool) as one region where electricity trade has been successfully liberalised and where pass-over of ETS costs should be expected. Due to

the significance of hydro and nuclear power one Finnish study (Honkatukia et. al., 2006) concludes that the average pass-over rate on the Nordpool exchange should be in the range of 75-90 per cent, e.g. 7-9€/MWh for a 20€ allowance price. This would mean that the range indicated by the various studies and market analysts runs from 0,4-0,9 eurocent/kWh for the power sector for a 20€ allocation price. For the present forward price of 15€/tCO₂ the range would be from 0.3-0.7 eurocents/kWh. This pass-over cost can be compared with CO₂ taxes on electricity in the range of 0.6-1.2 eurocents/MWh for smaller business users in Netherlands, UK, Germany and Denmark and 0.005 eurocents/kWh for the large users (energy-intensive industries). Effectively the ETS system might, from 2008, increase the CO₂ costs per kWh for the energy-intensive industries covered to the level of smaller business users.

It is in this context that a debate on double-regulation has evolved and that concerns about the need for additional mitigation efforts have arisen.

The double-regulation concern was raised as the European Council passed the ETS-Directive. The concern relates to the need for carbon-energy taxes as a regulatory instrument in view of the existence of the ETS-system. The ETS-system divides stationary emitters into two sectors; ETS and non-ETS. The argument in support of the double-regulation concern is that as emissions from the ETS-sector are fully regulated from the trade with certificates, there is no further need for a regulatory tax. The ETS sets a cap for emissions from the ETS-sector; if emissions exceed this cap additional allowances must be acquired on the market, possibly with the use of other flexible instruments as well.

Both Denmark and Sweden have requested the Commission to approve that carbon-energy taxes should no longer be levied for the ETS-covered installations. In Denmark and Slovenia legislation has been passed to this effect several years ago, but Commission approval is still pending. The concerns are with the state aid rules as well as with possible violations of the Energy Taxation Directive, and no decision has yet been reached. On one hand the Energy Taxation Directive foresees that installations covered by tradable quotas can be fully exempted from the minimum tax rates. The issue remains, though, whether the grandfathered allowances qualify as a fully-fledged scheme of tradable quotas. On the other hand the Energy Taxation Directive has also a broader scope than carbon taxation; it also concerns security of energy supply and harmonisation of tax rates. As the ETS-system has created a market where prices have shown to be very volatile, and as pass-over rates are very dependent on regional specificities of the power markets, the ETS-system as such will not be likely to create a level playing field, as was the intention of the minimum tax rates.

The findings of the COMETR project call into question the grave concerns about negative impacts on competitiveness that have been put forward frequently in response to carbon-energy taxation. Placed in a broader perspective the positive impacts associated with the principles of environmental tax reform and the properties of tax-shifting have not been disproved, despite the extensive and detailed scrutiny of data and experiences. Whereas many of the modelling results that were published in the mid-1990s were based on coarse energy-sector models and parameters that had to be assumed, the firmer empirical basis for the E3ME macro-economic modelling as well as for the panel-regression techniques calls for more confidence in the results.

If the intention is to meet the Kyoto-protocol's targets at least cost, can there be doubts that carbon-energy taxes should be removed for ETS-installations? As the present level of taxation has had an impact on emissions, there will be additional

domestic emissions if the taxes are removed. This would affect the domestic shortfalls in relation to the Kyoto targets. The additional domestic emissions would need to be offset by additional allowances, acquired on the European ETS-market or on the international market for flexible mechanisms. These allowances are only available at a price. For a particular company it may be more cost-effective to opt for the allowances. However, from the welfare economic perspective of the member state, it implies that a tax source needs to be shifted, as an alternative source of revenue needs to be identified.

If the policy aim is to raise taxes with a minimum of excess burden, some caution is advised. It is no simple task to identify taxes with properties as desirable as those of carbon-energy taxes. Shifting the tax burden back to labour would not be desirable. Taxing other greenhouse gases not subject to taxation, or other external effects, would probably be a more desirable method with less adverse effects. If revenue sources of such a similar nature cannot be identified, then the member state will face both the cost of the additional allowances and the distortionary costs related to the new tax base. On the basis of this observation it can be concluded that the new tax base needs actually to be better than the present one, which means that the alternative tax-base should provide sufficient extra benefits to compensate for the additional cost of allowances.

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