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Competitiveness and Exemptions From Environmental Taxes in Europe

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Abstract. A number of European countries have introduced a variety of environmental taxes. A common characteristic of their implementation is the inclusion of exemptions and tax relief, in particular for (some sectors of) manufacturing industry. This paper analyses the pattern and motivation of exemptions as they have developed in Western European countries, making clear the difference between the nominal and effective tax rates once the exemptions have been taken into account. The principal motivation for exemptions relates to concern about competitiveness. While particular environmentally-intensive sectors may have some grounds for concern, even these might be able to achieve cost-effective environmental improvements, such that their competitive position is not over-disadvantaged, while for an economy structured like the UK's, an environmental tax plus rebate scheme, sometimes called an ecological tax reform, would be likely to yield benefits in terms of competitiveness. The exemptions usually run counter to the environmental economic logic of using environmental taxes to internalise social costs and give economic signals that are based on the full costs of production, and they are likely to increase the costs of achieving a given level of emission reduction. With little justification for them also on the grounds of competitiveness, it would therefore be undesirable on both economic and environmental grounds for them to remain a feature of the implementation of environmental taxes in the future.

Key words: Environmental taxes, energy taxes, excise duties, ecological tax reform, competitiveness, exemptions

JEL classification: D62, E62, H23, H25

1. Introduction

Environmental taxes have now been imposed in many countries, and their extension is under active political consideration in most. A principal reason for this interest is the environmental benefits which such taxes can bring. However, a common feature of such taxes, especially insofar as they apply to energy, is that the rate applied to energy-intensive industries is considerably less than that applied to other energy consumers, thereby reducing the environmental benefit which could result from a given tax rate if it were universally applied, or conversely increasing the cost of achieving a given environmental target.

The next two sections examine these exemptions in detail, for energy taxes in Section 2 and for other environmental taxes in Section 3. The examination draws on a new database of environmental taxes that has been developed for the sustainable development charity Forum for the Future as part of a European projet funded by DGXI of the European Commission. This database of environmental taxes permits detailed examination of such complications as tax exemptions and relief. It will be seen that the picture that emerges from this analysis is very different from that if the nominal tax rate alone is considered.

The principle reason for the introduction of the tax exemptions is concern about the effects of environmental, and especially energy, taxes on competitiveness. Section 4 explores this issue from a number of angles: theoretical analysis, sectoral simulation, the past effects of environmental policy, and modelling at both the macroeconomic and sectoral level. While space does not permit a detailed review of these issues, clear conclusions emerge, which are presented in Section 5.

2. Taxes on Energy Products

This section presents taxes on energy products in EU countries plus Norway and Switzerland. The initial presentation is followed by two sub-sections which detail the exemptions from these taxes as they apply to manufacturing industry (2.1) and motor fuels (2.2).

Energy taxation in the countries considered is extremely complicated, with a number of different categorisations which have to be made explicit if the tax levels are to be accurately compared. Such a comparison is worth while because it reveals the different tax rates on energy products which pertain in different European countries. The analysis of exemptions shows that, for industry, the effective rates of tax are often very different from those that nominally apply.

Table I details the Excise Duties (EC) on different categories of fossil fuels. Excise Duties (EC) comprise normal excise duties plus the CO_2/energy taxes that exist in Denmark, Finland and Sweden, as per the 'Excise Duty Rate Tables' published by the European Commission Directorate General XXI, Customs and Indirect Taxation. For consistency, the figure for Norway in Table I also includes the CO_2 tax rate. Table I also shows the minimum excise duties (including CO_2/energy taxes where relevant) that exist in the EU (the row EU min) and the minimum excise duty rates that have recently been proposed by the European Commission for the years 1998, 2000 and 2002 (the rows EU-prop. 1998 etc.).

There is now no prospect of the original timetable for the introduction of these taxes being adhered to, because they have yet to win the support of EU member states.

Table II shows the total taxes on energy products, adding to the Excise Duties (EC) figures both VAT (rates of which differ across countries), sulphur taxes (where relevant and calculable) and national stockpile taxes. Figures 1, 2 and 3 graph these total taxes for each country for the three kinds of motor fuel, distinguishing each

Table I. Excise Duties (EC) on different categories of fossil fuels (situation 1997).

Country	Petrol leaded (ECU/1000 l)	Petrol unleaded (ECU/1000 l)	Diesel/gas propellant (ECU/1000 l)	Gas oil ind./com. use (ECU/1000 l)	Heavy fuel oil (ECU/ton)	Coal (ECU/ton)	Natural gas (ECU/m^3)	Electricity (ECU/kWh)
Austria	482	410	284	284	37	0	0	0
Belgium	564	497	292	19	19	0	0.01200	0.00137
Denmark	533	446	321	236	266	160	0.03091	0.06719
Finland	616	539	307	50	38	29	0.02443	0.00533
France	615	573	355	77	22	0	0.00107	0
Germany	555	504	319	41	15	0	0.00181	0
Greece	410	359	249	249	42	0	0	0
Ireland	440	434	326	50	14	0	0	0
Italy	581	535	391	117	47	0	0.00157	0.00214
Luxembourg	402	350	254	19	6	0	0	0
Netherlands	579	513	302	47	16	0	0.00962	0
Norway	658	627	485	56	79	56	0.10897	0.00397
Portugal	502	467	266	266	28	0	0	0.00505
Spain	395	363	264	77	13	0	0.00049	0
Sweden	597	521	337	210	217	144	0.12031	0.01316
Switzerland	474	427	450	2	2	1	0.00009	0
UK	609	544	544	35	28	0	0	0
EU minimum	337	287	245	18	13	0	0	0
EU prop. 1998	417	417	310	32	18 (22)[a]	6	0.00700	0.00100
EU prop. 2000	450	450	343	37	23 (28)	13	0.01400	0.00200
EU prop. 2002	500	500	393	41	28 (34)	21	0.02220	0.00300

[a] Tax rate is given for heavy fuel oil with low sulphur content (<0.1). Tax rates for heavy fuel oil with high sulphur content are given in brackets.

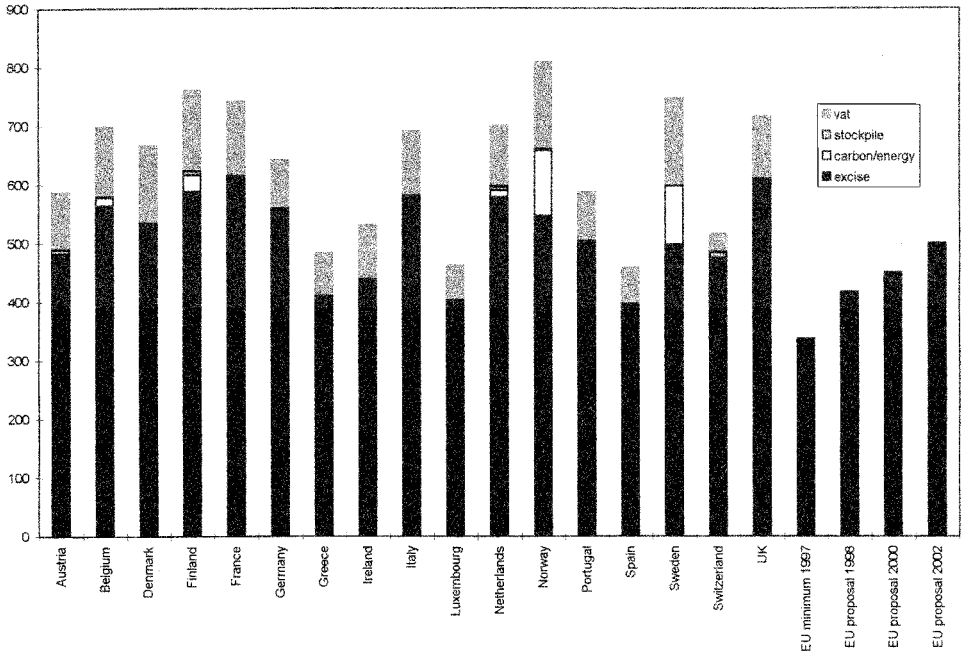

Figure 1. Petrol leaded (ECU/1000 l).

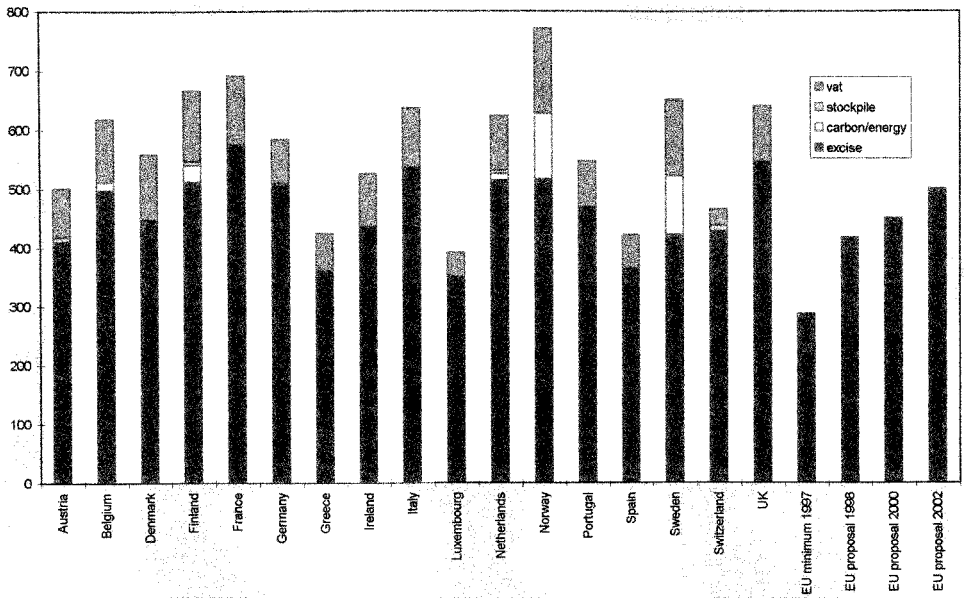

Figure 2. Petrol unleaded (ECU/1000 l).

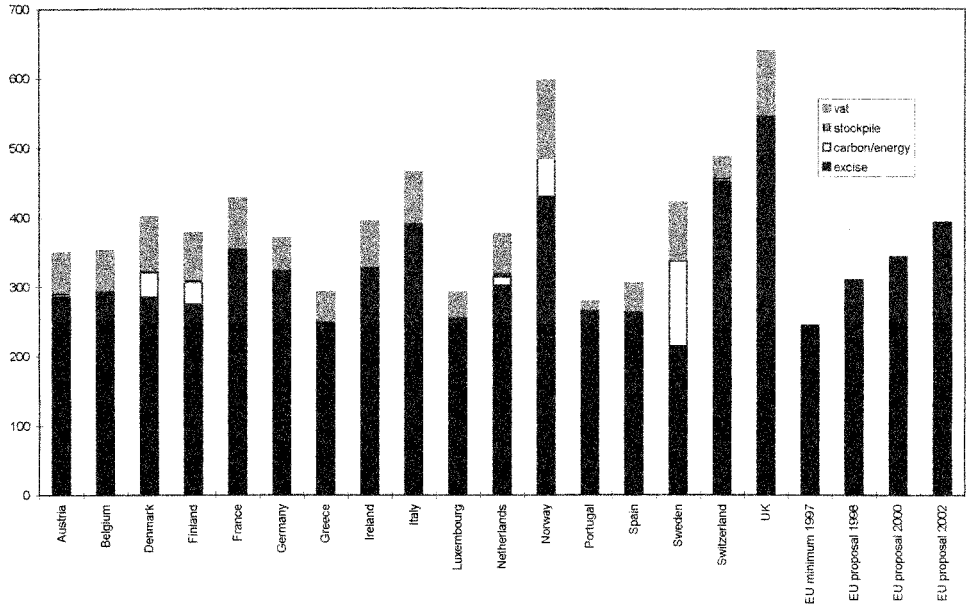

Figure 3. Diesel/gas oil (propellant) (ECU/1000 l).

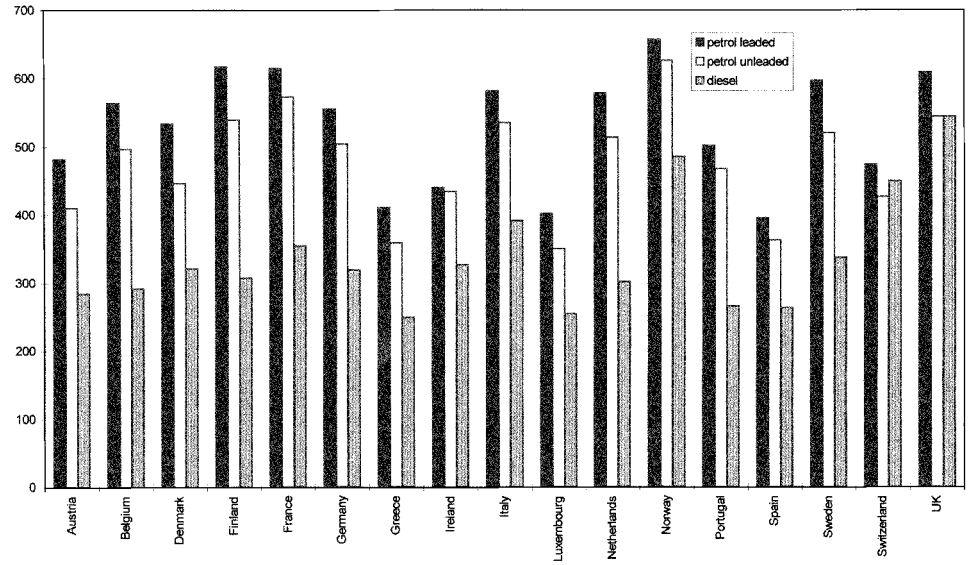

Figure 4. Tax rates: petrol leaded, petrol unleaded, diesel (ECU/1000 l).

component of the total. Figure 4 shows these three taxes for each country and the EU minima.

Figures 1 to 3 show that Finland, France, Netherlands and Norway have the highest tax rates on both kinds of petrol, while Norway, Switzerland and UK tax diesel most heavily. All countries exceed the current EU minimum tax rates, but Greece, Luxembourg and Spain would have to increase tax rates on leaded petrol in the year 2000 if the proposed minimum rates are adopted. With unleaded petrol it is also these three countries, Greece, Luxembourg and Spain, which would have to increase the proposed minimum rate in 1998. In addition to these three countries, Portugal would have to increase rates on diesel to reach the proposed minimum for 1998, with Austria, Belgium, Finland, Germany and Netherlands also having to do so in 2000.

Currently the highest tax rates on leaded petrol, unleaded petrol and diesel are 66%, 79% and 118% more than the lowest respective rates.

Figure 4 shows the extent to which taxes on unleaded petrol and diesel are lower than those on leaded petrol. Switzerland and UK are unusual in that diesel is taxed either at the same rate as or more heavily than unleaded petrol. The petrol/diesel differential is largely a result of the desire to limit the tax burden on road freight transport, and is therefore an example of a partial tax exemption.

Table II gives the total tax rates for gas oil, heavy fuel oil, coal, natural gas and electricity. Substantial differences between these taxes exist in different countries. Denmark and Sweden tax the oil products and coal relatively heavily. Austria, Greece and Portugal have comparably high taxes on gas oil. Norway and Sweden stand out as high taxers of natural gas, and Denmark alone has a substantial tax on electricity. With regard to coal, it should also be noted that a number of European countries subsidise this fuel. Table III shows the extent of these subsidies in four European Union countries in 1993. It can be seen that Germany's subsidisation of coal was substantially greater than that of the other countries, and, according to Roodman (1996, p. 32), had increased to $119/t by 1995. The UK subsidised a similar quantity of coal, but at a much lower rate. Spain and France subsidised at a higher rate than the UK, but a much lower quantity of coal.

The proposed minimum EU excise tax rates would have more of an effect with some of the other fuels than with transport fuels. As shown in Table I, for coal, natural gas and electricity many countries currently have no excise duties at all, and so would have to impose at least the minimum EU rates for 1998. In addition, France, Italy and Spain would have to raise their rates on natural gas in attain the proposed 1998 level; heavy fuel oil rates would have to rise in Luxembourg to meet the same year's proposed rate, and in Belgium, Germany, Ireland and Spain in the following years.

Overall, some countries emerge as consistently high (though not in all cases) taxers of energy products. For motor fuels Norway stands out as the highest taxer of each fuel. For other fuels, Denmark and Sweden tend to levy the highest tax

Table II. Total taxes on energy products (situation 1997).

Country	Petrol leaded (ECU/1000 l)	Petrol unleaded (ECU/1000 l)	Diesel/gas propellant (ECU/1000 l)	Gas oil ind./com. use (ECU/1000 l)	Heavy fuel oil (ECU/ton)	Coal (ECU/ton)	Natural gas (ECU/m^3)	Electricity (ECU/kWh)
Austria	587	501	350	348	52	0	0.05260	0.00877
Belgium	699	618	353	23	23	0	0.01452	0.00166
Denmark	667	558	401	296	333	200	0.03863	0.08398
Finland	760	666 6 379	65	50	37	0.03085	0.00666	
France	742	691	428	93	26	0	0.00129	0
Germany	643	584	371	52	22	0	0.02081	0
Greece	484	423	294	294	50	0	0	0
Ireland	532	525	395	56	16	0	0	0
Italy	692	636	465	140	56	0	0.00173	0.00236
Luxembourg	462	392	293	22	7	0	0.00173	0.00236
Netherlands	700	624	376	107	36	13	0.04575	0.01588
Norway	809	771	597	80	109	69	0.13404	0.00501
Portugal	587	547	279	279	29	0	0	0.00591
Spain	459	421	306	89	15	0	0.00057	0
Sweden	747	651	421	262	272	180	0.15039	0.01645
Switzerland	515	465	487	10	8	12	0.01905	0
UK	716	640	640	41	32	0	0	0[a]

[a] In the UK the fossil fuel levy is imposed on electricity and increases the price by an average of 2.2%.

Table III. Coal subsidies in four European Union countries in 1993.

Country	PSE[a]/tonne, $/t	Total PSE, M$	Subsidised production, mtce[b]
France	43	428	10.0
Germany	109	6,688	61.5
Spain	84	856	10.2
UK	15	873	57.4

[a] Producer Subsidy Equivalents, comprising direct final aid from governments plus price supports.
[b] Million tonnes of coal equivalent.
Source: OECD 1996a, Figure 1, p. 177.

rates. However, when exemptions are considered, these rates can drop dramatically for some consumers. It is to these exemptions that we turn now.

2.1. EXEMPTIONS FOR INDUSTRY

2.1.1. *Sweden*

In 1991 Sweden introduced a carbon dioxide tax, a sulphur tax and a nitrogen oxide charge. The energy and CO_2 tax rates have increased annually since 1993, with the increases linked to the rise of the consumer price index from January 1995.

The Excise Duty (EC) for Sweden shown in Table I consists of the energy tax and the CO_2 tax. Swedish definitions of energy excise taxes also include the sulphur tax, which is levied on fuels if they are used as motor fuels or for heating purposes. The present carbon dioxide tax rate corresponds to 370 SKR (42.5 ECU) per ton CO_2 released and the sulphur tax rate to 30 SKR (3.45 ECU) per kilogram sulphur for peat, coal, petroleum coke and other solid or gaseous products, while on liquid fuels the rate amounts to 27 SKR (3.1 ECU) per m^3 of oil for each tenth of a per cent by weight of the sulphur content. Around 240 enterprises are liable for the sulphur tax in Sweden. The reduction of sulphur emission by cleaning can lead to reimbursement of 30 SKR (3.45 ECU) per kilogram sulphur.

As shown in Table II, the nominal tax burden on non-motor fuels is quite high in Sweden compared to the other countries. But Sweden introduced in 1993 special regulations for manufacturing industry and also for commercial greenhouse horticulture. These regulations reduce the tax burden considerably for these economic sectors: manufacturing industry and horticulture are completely exempt from the energy tax and are only liable for 25% of the general rate of the carbon dioxide tax. Therefore the effective carbon dioxide tax rate for these sectors is 92.5 SKR (10.6 ECU) per ton CO_2. The Swedish government announced in 1995 that the tax relief for these sectors would be reduced from 75% to 50% of the CO_2 tax rate, which came into force in July 1997. Therefore, since July 1997 the effective carbon dioxide tax rate amounts to 185 SKR (21.3 ECU) per ton CO_2 for the

Table IV. Nominal and effective tax rates paid by the Swedish manufacturing industry (1997).

Energy products	Units	Nominal tax rates	Effective tax rates	Nominal vs effective tax rates (in %)
Gas oil	ECU/kl	210	62	29.4
Heavy fuel oil	ECU/ton	217	64	19.4
Ipg; stationary motors	ECU/ton	146	65	44.2
Natural gas	ECU/1000 m^3	120	46	38.2
Coal	ECU/ton	144	54	37.2

manufacturing sector and horticulture. However, the tax exemption with regard to the energy tax is still in force for both these sectors. Energy-intensive industries, such as the steel industry, can receive a further tax exemption, if the tax liability exceeds 0.8% of sales value of the products sold by the individual company. The company can apply to the tax authorities to receive a reduction of the excess tax amount so that the marginal tax burden is not higher than 12% of the general tax level of the CO_2 tax, i.e. the tax rate does not exceed 44.4 SKR (5.2 ECU) per ton CO_2 (Ministry of Finance 1997; Nordlander 1997).

In addition to these tax exemptions and tax reliefs, some very energy-intensive industries, such as cement and lime manufacturing, are entitled to receive further tax reductions.

Table IV shows the difference between nominal and effective tax rates once exemptions and tax reliefs have been taken into account. All the effective tax rates still exceed the current EU minimum excise duty. Certainly these effective rates do much to temper the image of Sweden as a high taxer of energy products, at least as far as industry is concerned.

The special treatment of Swedish manufacturing industry with respect to the taxation of energy is explicitly due to concerns about competitiveness. It was felt that the tax system prior to the reform of 1993 "...had proved to constrain the competitiveness of the Swedish industry" (TemaNord 1994, p. 95) and, in addition, had led to large administrative problems.

In strict economic terms the exemptions from the Swedish carbon dioxide tax must be a source of economic inefficiency. The reason for this lies in the fact that industry and households face different tax rates. This is in contrast to a situation of economic efficiency which requires that the tax burden for emissions has to be the same for all emitters. The grounds for concern about competitiveness, which has led to the introduction of this inefficiency, will be analysed in Section 4.

2.1.2. *Denmark*

The Danish situation of energy taxation is different compared with the approach used in Sweden. Denmark introduced a carbon dioxide tax in May 1992 which is

now levied on all energy products with the exception of petrol. The nominal tax rate is set to 100 DKR (13.7 ECU) per ton of CO_2. The underlying concept for the introduction of the CO_2 tax was not to increase the prices for energy products but rather to establish energy prices differentiated on the basis of the carbon content. This implies a reduction of the excise taxes for many fuels.

The tax treatment of industry shows some differences compared to the tax exemptions and tax relief in Sweden. The new system was introduced in 1996 and replaced a system of exemptions, reimbursement and compensation dating from 1992. The new package of energy taxation distinguishes energy consumption in industry according to the categories of room heating, light processes and heavy processes. The tax treatment of energy products used for room heating in industry is the same as that of households, and will amount on average in 1998 to 600 DKR (82.26 ECU) per ton CO_2. Both the latter categories of energy consumption may qualify for tax exemptions depending on the purpose for which energy is being used and whether an agreement between the individual enterprise and the Danish energy authorities about investment in energy-saving programmes has been reached. The tax rate for energy used for light processes, such as lighting, office machinery and other non-energy-intensive processes will increase gradually to 90 DKR (12.34 ECU) per ton CO_2 until 2000. With regard to heavy (i.e. energy-intensive) processes, a list has been drawn up and energy used for these processes is entitled to a reimbursement of the CO_2 tax which amounts to 85% of the actual CO_2 tax rate in 1998 and to 75% in 2000, i.e. the tax rate is 15 DKR (2 DKR) per ton CO_2 in 1998 and will increase to 25 DKR (3.4 ECU) per ton CO_2 in 2000. Further tax relief is offered for improvements in energy-efficiency for both heavy and light processes. The tax rates taking into account these tax reliefs will be 68 DKR (9.2 ECU) per ton CO_2 for light processes and 3 DKR (0.4 ECU) per ton CO_2 for heavy processes in 2000.

Table V shows the schedule of these tax rates. The tax rate for energy used for space heating includes the overall energy tax (excise tax) and the CO_2 tax. The CO_2 tax rate alone is 100 DKR (13.72 ECU) per ton CO_2. It may be noted that whereas in Sweden industry receives special tax treatment for all its uses of energy, Danish industry is only entitled to tax relief on energy used as process energy.

The high nominal tax rates on coal in Denmark shown in Table II are somewhat misleading because power stations (electricity and gas production) are completely exempt from coal taxes. Yet 95% of electricity generated in Denmark is coal based and around 90% of total coal inland deliveries are consumed by power stations.

2.1.3. *Norway*

Norway has had a tax on the sulphur content of mineral oils since 1970, the threshold of which is 0.05% by weight. A CO_2 tax was introduced in 1991 affecting the use of mineral oils, natural gas and petroleum on the continental shelf. The use of coal and coke for energy purposes has been subject to a CO_2 tax since 1992. Norway has adopted a different approach in establishing the CO_2 tax rates, which

Table V. The Danish energy tax system (CO_2 tax) on industry.

	1996		1998		2000	
	DKR/ton CO_2	ECU/ton CO_2	DKR/ton CO_2	DKR/ton CO_2	DKR/ton CO_2	DKR/ton CO_2
Heavy process	5	0.7	15	2.1	25	3.4
Light process	50	6.9	70	9.6	90	12.3
Nominal CO_2 tax rate	100	13.7	100	13.7	100	13.7
Space heating (inc. excise tax)	200	27.4	600	82.3	600	82.3

Table VI. CO_2 taxes in Norway (1997).

Energy product	NKR per ton CO_2	ECU per ton CO_2
Petrol	361	43.5
Gas oil	151	18.2
Heavy fuel oil	134	16.1
Coal	179	21.5
Natural gas	363	43.8

vary between different energy products, as shown in Table VI, in contrast to the unique Swedish CO_2 tax rate of 42.5 ECU per ton CO_2. Electricity is subject to a basic tax on consumption as well as on production (electricity generation is mainly based on hydro power).

However, as with Denmark and Sweden, reduced tax rates apply to some industrial sectors. For example, the CO_2 tax on fuel oils for energy-intensive industries, for instance the pulp and paper industry and the fishmeal industry, is reduced by 50%. Further provisions concern the cement and leca industry which is free from the charge on coal. Energy-intensive industries as well as all other manufacturing industries are exempted from the electricity tax on consumption.

The consequence of these special tax treatments can be summarised as follows:

1. The CO_2 tax only applies to about 60% of domestic CO_2 emissions, when exemptions on transport fuels (see below) are also considered (TemaNord 1996, p. 46); and
2. Only around 25% of the domestic SO_2 emissions are taxed (TemaNord 1996, p. 49), because of exemptions on transport fuels (see below) and because there is no SO_2 tax on coal and coke.

Table VII. Comparison between nominal and effective tax rates in four Scandinavian countries (see Figure 5 for graphical illustration).

Nominal tax rate: ECU per ton CO_2					
Energy products	Units	Sweden	Denmark	Norway	Finland
Gas oil (heating)	ECU per ton CO_2	42.3	12.9	18.2	11.3
Heavy fuel oil	ECU per ton CO_2	38	13.2	16.1	11.7
LPG	ECU per ton CO_2	40.9	13.2	0	0
Coal	ECU per ton CO_2	43.4	13.6	21.5	12.1
Natural gas	ECU per ton CO_2	39	12.9	43.8	13.1

Effective tax rate: ECU per ton CO_2						
Energy products	Units	Sweden	Denmark	Denmark	Norway	Finland
		Manufact. industry	Light processes	Heavy processes	Pulp/paper industry	All industry
Gas oil (heating)	ECU per ton CO_2	21.2	11.6	3.2	9.1	11.3
Heavy fuel oil	ECU per ton CO_2	19	11.9	3.1	8.1	11.7
LPG	ECu per ton CO_2	20.4	11.8	3.3	0	0
Coal	ECU per ton CO_2	19.5	11.6	3.2	21.5	12.1
Natural gas	ECU per ton CO_2	19.5	11.6	3.2	0	13.1

Taxes considered: Sweden: CO_2 tax; Denmark: CO_2 tax; Norway: CO_2 tax; Finland: additional duty (CO_2 component).

It is important that these figures are borne in mind when evaluations of these taxes are carried out, in particular when the effects of higher taxes on the demand for energy products are analysed.

2.1.4. *Finland*

Finland in 1990 was the first country in Europe to impose a CO_2 tax, which was levied on fossil fuels depending on the carbon content. The Finnish tax system distinguishes between an excise tax (basic duty) and an environmental tax (additional duty) which is calculated according to the carbon and energy content of the energy products and imposed on primary energy inputs.

The tax reform in 1997 led to some changes in the taxation of energy. Firstly, the basic duty was reduced for all energy products and was completely abolished for heavy fuel oil and electricity. The additional duty is now completely base on the carbon content of the energy product and the rate was set to 70 FMK (12 ECU) per ton CO_2. Unlike Sweden and Denmark, Finland does not impose any tax on the use of liquefied petroleum gas (LPG).

In contrast to the other Scandinavian countries, which generally distinguish between tax rates for private users and industrial users, Finland allows no exemp-

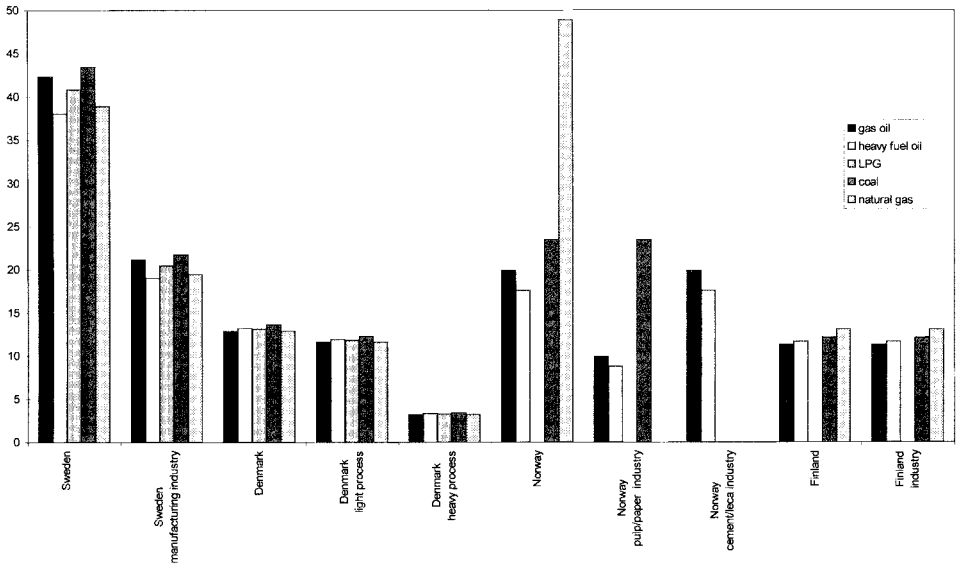

Figure 5. Comparison of nominal and acual CO_2 tax rates (ECU per ton CO_2).

tions or tax relief for industry on these taxes. This means that, although its nominal tax rates are lower than its Scandinavian neighbours', with regard to manufacturing industry the effective tax rates work out at much the same (see Table VII and Figure 5).

However, Finland is reconsidering its 'no exemptions' position (Teir 1996, p. 248). Moreover, the new tax system of 1997 adopts two categories for taxing electricity: category 1 covers the mining of minerals, industrial manufacturing and processing of goods and professional greenhouse cultivation; all other cases are taxed under category 2 for which the tax rate is twice as much as for consumers in category 1. Again, such a difference in CO_2 tax rates must be a source of economic inefficiency.

2.1.5. *Netherlands*

In the Netherlands two tax schemes have a CO_2 component added to the tax base. The first is the 'Environmental Tax on Fuels' which was introduced in 1988, with the CO_2 component being added when the tax was changed in 1990.

The second tax is the 'Regulatory Tax on Energy' which was introduced in 1996 with the purpose of achieving environmental goals, in particular to give an incentive to small energy consumers to conserve energy. The tax rates correspond to the proposed CO_2 energy tax in the European Union.

The former tax is levied on all energy products used as fuels with the exception of electricity which is taxed indirectly via the fuel inputs. The tax rates are 5.16 HFL (2.5 ECU) per ton CO_2 and 0.3906 HFL (0.19 ECU) per GJ. Energy-intensive industries are entitled to tax relief for large-scale consumption of natural

gas and certain kinds of residual fuels, such as blast furnace gas; the rate is 0.16 HFL (0.078 ECU) per GJ for enterprises consuming more than 10 million m^3 natural gas per year. The rate for residual fuels was set to zero until 1998 to promote investments in energy conservation by the petro-chemicals and basic metals industries, which generate and use almost all these residual fuels in their own installations.

The Regulatory Tax applies to small scale energy consumption, in particular being aimed at the energy use of households for non-transport purposes. The tax rates were gradually increased, reaching the final rate in 1998: 27 HFL (13.14 ECU) per ton CO_2 and 1.506 HFL (0.73 ECU) per GJ, which then corresponds to $10 per barrel oil. The tax is levied on natural gas, electricity and other mineral oil products, such as light fuel oil and gas oil, which can be used as substitutes for gas. Fuels which are used for powering road vehicles are not subject to the tax. A small tax-free allowance has been granted for natural gas and electricity. This allowance does not apply to the mineral oil products but in compensation the tax rates on these were lowered by 32%. The revenues from the tax are recycled back into the economy through reductions in personal taxes and corporate income taxes.

The Regulatory Tax only applies up to a certain level of energy consumption. This is both because the main aim of the tax is to stimulate energy efficiency improvements by small-scale consumers and is due to fears of a possible loss of competitiveness of large-scale consumers as a result of this unilateral imposition of an energy tax. The same concern has caused the greenhouse horticulture sector in the Netherlands, which has a high energy/employee ratio and operates internationally, to receive special tax treatment. The tax rate on the use of natural gas in this section is zero. To compensate for this special treatment the sector has entered into a voluntary agreement, which requires an improvement in energy efficiency by 50% between 1980 and 2000. The scale of the exemptions may be judged by the fact that although the tax covers the total gas and electricity use of all households and of about 95% of all Dutch companies, this only amounts to 40% of non-transport, non-feedstock energy use in the Netherlands.

2.1.6. *Other Countries*

Other countries which have imposed energy taxes have also introduced exemptions. For example, in July 1996 Austria imposed an energy tax on electricity and natural gas, neither of which are subject to an excise tax (see Table II). The rates are for natural gas 0.6 OS (0.045 ECU) per cubic meter and 0.1 OS (0.008 ECU) per kWh for electricity. The revenue of the energy tax is earmarked for energy-saving measures and for investments in public transport. A reimbursement scheme was established for energy-intensive industries. The maximum amount of the tax burden is set to 0.35% of the net value of production. In addition, heating oils are exempt from the excise tax when they are used for the generation of electricity (thus avoiding double taxation) and heating oils used in combined heat power plants are

subject to a reduced tax rate. The type of reimbursement scheme of setting a ceiling of the maximum amount of tax burden paid by industry depending on figures such as production costs or net value of production used to be applied in Denmark and in Sweden. For instance, in Sweden the tax burden of the CO_2 tax was limited to 1.2% of the firms' sales value of their manufactured products until 1995 and in Denmark the rate of reimbursement up until 1996 depended on the relation between the tax burden and the so called 'proms' (revenue minus purchases including investment goods).

A similar approach to reimbursements for energy-intensive industries was considered in the proposed CO_2/energy tax of the European Union (COM(92)226 def.) and also in the proposal from the European Commission in March 1997 of a common system for the taxation of energy products by setting new minimum levels of excise taxes and updating the existing ones for hydrocarbons. Again, this tax relief to enterprises is justified by the possible losses of competitiveness of European business compared to the rest of the world. The proposed reimbursement scheme depends on the relation between energy costs and production costs. For instance, a refund can be paid by Member States to firms whose energy costs are between 10% and 20% '. . . on the proportion of their energy costs in excess of 10% of its total production costs' (EC 1997, p. 3). However, a member state is obliged to refund all the tax in excess of 10% of total production costs if the energy costs of the firm are higher than 20% of production costs. However, energy-intensive firms would still have to pay a minimum tax of 1% of their sales value.

The EC proposal extends the current minimum excise tax base of mineral oils to include coal, natural gas and electricity. But only the use of energy products as motor fuel or for heating purposes would be subject to this tax and not their use as raw materials, in chemical reductions or for electrolysis (EC 1997, p. 2).

2.2. EXEMPTIONS FOR TAXES ON TRANSPORT FUELS

So far the principal reason for differentiated tax rates has been to protect vulnerable industrial sectors from possible losses of competitiveness. This issue will be addressed in Section 4. However, for motor fuels the main motivation for tax differentiation is to give incentives for switching to less environmentally damaging fuels or transport modes.

This is a relatively recent development. The taxation of motor fuels in the countries of the EU, Norway and Switzerland has a long tradition, for example, excise duties were introduced in 1917 in Denmark and Norway introduced petrol taxes in 1931 and the autodiesel tax in 1959 (TemaNord 1996). The main purpose of these excise taxes was to raise revenues for the general budget. Now, however, in all European countries taxes on motor fuels are differentiated according to their environmental impacts. One example is the EC directive 92/82/EEC which requires a tax difference between leaded and unleaded petrol of at least 50 ECU/1000 litres. However, this directive is not legally binding for the member states and some coun-

tries (Spain, France, Ireland, Italy and Portugal, see Table I) have not implemented it.

Further environmentally-motivated differentiation in taxes in motor fuels has been introduced in some Scandinavian countries in recent years. In Denmark the rates of the excise tax on diesel vary between ordinary, light and ultra light diesel. Environmental concerns led the Swedish government to impose different tax rates for motor fuels since 1991. Diesel/gas oil is subdivided into three environmental categories (standard, relatively clean and very clean) depending on technical characteristics such as the content of sulphur and aromatics. This tax differentiation has been very successful in terms of the market penetration of more environmentally friendly fuels: the share of very clean fuel rose from 0% in March 1992 to around 66% in March 1995 (EC 1996, Annex B, p. 22). In the Swedish petrol market tax differentiation between leaded and unleaded petrol was probably the principal cause of the share of leaded petrol decreasing from 70% in 1986 to practically zero in 1994 (EC 1996, Annex B, p. 22). Tax differentiation with respect to environmental aspects of motor fuels has also been imposed in Finland and in Norway.

Some countries have instituted automatic increases of the tax rates for motor fuels. In Sweden and the Netherlands the tax rates are linked to the consumer price index. UK policy since November 1993 has been to increase motor fuel taxes by at least 5% per annum above the inflation rate and this was raised to 6% per annum in July 1997. In order to make public transport more attractive both Sweden and Norway have exempted fuels used for rail travel.

Apart from the widespread differential between taxes on petrol and diesel, noted earlier, exemptions due to competitiveness concerns with regard to motor fuels are largely limited to international transport: commercial shipping and commercial aviation are exempt from excise taxes in Austria, Belgium and Germany. In Norway a number of sectors are exempt from mineral oil taxes: air service, shipping, coastal goods transport, coastal fishing, fishing and hunting in distant waters and the supply fleet in the North Sea. The tax exemption of aviation spirit and jet fuels is common to all countries, by international agreement at the 1994 Chicago Convention. This agreement is currently being reviewed. Sweden had a unique environmental tax on aviation fuels used in certain domestic air navigation consisting of a CO_2 tax and a tax based on emissions of hydrocarbons and nitrogen oxides. This tax was called into question by the European Commission and was abolished in January 1997.

3. Other Environmental Taxes and Exemptions

With regard to other environmental taxes in European countries, there is a variety of special tax treatments, in particular tax exemptions, tax allowances and tax reliefs, which seem to be inconsistent with the underlying environmental concern on which the taxes are based. An example is the pesticides tax in Belgium which

was introduced in July 1996. Products such as atrazine, diuron etc. are subject to an ecotax when these products are used as active matter in a pesticide. But pesticides are exempt from the tax when '... they are sold to agricultural and horticultural firms, to recognised users (except to marked-gardeners), to stockbreeders and to companies involved in seeds disinfecting' (Ministry of Finance of Belgium 1996, p. 146). This special treatment of farmers, the major users of pesticides, can only be described as environmentally perverse. In some countries (e.g. France, Greece) pesticides and fertilisers are subject to a reduced VAT rate. A VAT rate of 4% compared to the normal rate of 19%, is applied in Italy and the VAT rate for fertilisers is set to zero in Ireland.

As with energy taxes, annual water and sewerage charges differ significantly between and within European countries. For example, the annual water charge for a family consuming 200 cubic meters of water per year would have been around 22 ECU per year living in Milan/Italy and 95 ECU per year in Naples/Italy. The water bill would have been higher for the same family living in Brussels (303 ECU per year), Copenhagen (203 ECU per year) or The Hague (243 ECU per year) (IWSA 1995, p. 4). Also like energy taxes, exemptions to water charges exist which undermine the charges' environmental effectiveness. In Denmark in 1994 a tax on clean water was introduced in order to encourage water conservation. The rates for household water consumption were gradually increased from 1 DKR (0.14 ECU) per cubic meter in 1994 to 5 DKR (0.69 ECU) per cubic meter in 1998. But the water consumption of the agriculture and industry sectors is exempted from the tax which will reduce the water conservation achieved. With regard to waste water charges, in many countries these do not even cover the cost of constructing and operating treatment facilities. Only in Denmark, the Netherlands and the UK do charges cover these costs. In all other countries water treatment plants are subsidised by government funds.

Vehicle-related taxation is another area which in a number of countries gives rise to environmentally-perverse incentives. In this category are the tax allowances for commuting operating in countries such as Austria, Denmark, Finland, Germany and Sweden. These tax allowances give incentives to use private transport to go to work, an incentive that is strengthened by the rates for using private transport being higher than those for public transport. Also the tax treatment of company cars can have adverse environmental effects. The Netherlands has introduced some tax incentive for car pooling but the financial incentive seems ineffective.

4. The Effects of Environmental Taxes on Competitiveness

The reason that energy-intensive industries are, against all environmental and economic logic, wholly or partially exempted from environmental taxes is because of fears of the negative impact of such taxes on these industries' competitiveness. Considerations of competitiveness are important to environmental policy for both economic and environmental reasons:

1. *Economic.* If environmental policy produces negative impacts on competitiveness it will be associated with corporate, sectoral or national economic decline, which will make its introduction politically difficult or impossible.
2. *Environmental.* If domestic 'dirty' (environmentally-intensive) industry declines, to be replaced by a growth in foreign 'dirty' industry, overall environmental impacts may not change. If the environmental effect was local, then a cleaner domestic environment will have been bought at the cost of a loss of competitiveness (and gain in foreign competitiveness will entail a worse environment there). If the environmental effect was global (e.g. greenhouse gas emissions), then loss of national competitiveness will have brought no environmental gain at all.

Competitiveness basically denotes the ability of a national economy, or a productive sector, to sell its goods and services in domestic and world markets. There are many possible indicators of competitiveness, some of which become policy targets in their own right and even become taken for competitiveness itself. Underlying these indicators is the insight that being competitive is important because it enables goods and services to be produced and sold, which contributes to or increases national or sectoral output and incomes. These indicators include: income per head; balance of trade; exchange rate movements; unit labour costs; generation of employment; labour productivity; market share; profitability; firm growth; share of world exports. Exports are relevant because they indicate competitive success in markets outside national borders. Opportunities to trade are advantageous to competitive firms because they give them access to larger markets, enabling them to increase output and, perhaps, realise economies of scale.

At the firm level the logic behind the fear of impacts on competitiveness from environmental taxes is simple and persuasive: taxes on business inputs inevitably add to business costs; where these taxes are imposed in one country only, these extra costs will impair the international competitiveness of the business or sector concerned. However, it may not always be the case that environmental policy imposes costs on firms; even where it does the costs may not be substantial enough to affect competitiveness; or the policy may generate benefits for the firm to set against the costs. These are some of the issues which are discussed below. In principle, however, it is clear that environmental taxes could affect industrial competitiveness.

From the aggregate performance of a country's firms, national statistics of output, exports, employment and so on may be derived. If a country's firms are generally competitive, then the country will have a constant or rising share of world exports, a strong exchange rate with a consequent ability to increase imports, and an above-average income growth. If a country's firms are not generally competitive, then its share of world exports will decline, a weak exchange rate will limit the possibility to import and income growth will be below average. Although the economy will restructure so that new firms or sectors take the place of those in decline, reductions in the competitiveness of important economic sectors will be

marked by significant bankruptcies and job losses, possible exchange rate adjustments and a reduction in economic activity. The new activities may not be as productive as those they replace. There may be substantial transition costs and, perhaps, a higher equilibrium rate of unemployment. Economic restructuring could be very painful and politically unpopular. Potentially affected businesses are clearly concerned by this possibility, politicians share their concern, and exemptions from environmental taxes are the result.

It should be clear that affects on competitiveness will only arise if environmental policy in different countries imposes different levels of costs on competing firms. Thus, although the economic effects of environmental policy may be measured in terms of reduced labour productivity, or reduced rates of economic growth, these are only effects on competitiveness if they differentially affect some firms and not their competitors. However, because in practice environmental policy and the regulations to which it gives rise are not harmonised between countries (although such harmonisation is more apparent in groups of countries like the European Union), such measures are often interpreted as indicating effects on competitiveness.

There is now a substantial literature on the effects of past environmental policy, and the possible effects of future environmental policy, on the competitiveness of businesses and countries. Here it is only possible to summarise the main arguments and results of this literature (for a fuller treatment see Ekins and Speck (1998) and, more generally, Barker and Johnstone (1998)).

On the past impacts of environmental policy the evidence is fairly conclusive and is summarised thus by the OECD: 'The trade and investment impacts which have been measured empirically are almost negligible' (OECD 1996b, p. 45). More specifically, Jaffe et al. (1995, p. 157)'s review concludes that 'studies attempting to measure the effect of environmental regulation on net exports, overall trade flows, and plant-location decisions have produced estimates that are either small, statistically insignificant or not robust to tests of model specification'.

However, the slight effect of environmental policy on competitiveness to date may not hold true for the future. Three observations are pertinent in this regard. The first is that past environmental policies have not resulted in a diminution of environmental concern and the new goal of sustainable development seems to be requiring more stringent policy, with more potential effects on competitiveness, than in the past.

Second, there is widespread agreement that in today's global economy 'ever fiercer competition prevails' (HMSO 1993, p. 1), which, according to the US Office of Technology Assessment raises the possibility that 'environmental regulations could be more of a competitive disadvantage than before' (OTA 1992, p. 8).

Finally, it seems likely that environmental policy in the future will make more use of environmental taxes than in the past. Such taxes have distinctive implications for competitiveness.

Most importantly, environmental taxes are payable on all a particular use of the environment, unlike regulations which permit its free use once the regulatory

requirements have been met. While this feature of environmental taxes results in the advantage over regulation that they give an incentive for continual environmental improvement at all levels of use, it also means that affected businesses pay more under an environmental tax regime than under regulations. Therefore the impacts of environmental taxes need to be examined separately from an assessment of the impacts of an environmental policy which has so far relied largely on regulation.

As has been seen, fear of the competitiveness effects of environmental taxes has resulted in most countries that have introduced environmental taxes giving vulnerable firms or sectors tax exemptions or concessions. Theory suggests that these reduce the economic efficiency of the environmental tax and reduce the economic advantage to be gained from clean production systems. They also slow down the process of structural change in the economy such that energy- and environment-intensive economic sectors both become less intensive and less important economically relative to less environment-intensive sectors. It is therefore important to note that the overall effects on business competitiveness from the tax will depend on how the tax revenues are recycled through the economy: while environmentally-intensive sectors may end up worse off, clean businesses are likely actually to benefit from it.

In fact, the effect on competitiveness of, for example, a carbon tax will be determined by a number of influences, including:

- The size of the carbon tax and the nature and extent of the offsets (how the revenues are recycled through the economy);
- The carbon intensity of the product;
- The trade intensity of the product (ratio of exports plus imports to production).

Pezzey (1991) calculated the cost impact on 10 different sectors of a carbon tax of $100 per tonne of carbon levied on the fuel inputs. He found that as long as the revenues are returned to industry, losses of price-competitiveness in the four relatively carbon-intensive sectors will be counter-balanced by gains in the six non-carbon intensive sectors. Moreover, the carbon-intensive sectors will only lose competitiveness to the extent that they do not reduce their carbon-intensity at a rate equal to the tax being applied. This point is discussed further below.

International competitiveness depends not only on cost increases but also on the trade intensity of the affected products. Relative price rises of untraded goods may affect demand for those goods in domestic markets, but they will not affect international trade. In Pezzey's simulation the low trade intensity of iron and steel and non-metallic minerals (both sectors comprising heavy, bulky goods including iron and cement) substantially reduces the trade impacts that these sectors will suffer from the carbon tax. Indeed, the trade impacts on chemicals are also reduced by the medium trade intensity of this sector, leaving non-ferrous metals as the only sector in which a high trade intensity and high cost increase from the tax may cause significant trade effects from the tax. Against this it may be noted that 57% of UK exports in 1995 were to EU countries, so that if the carbon tax was imposed on an

EU-wide basis (as was the proposal from the European Commission in 1992), all the trade effects for these sectors would be much attenuated.

While such a simulation only takes account of immediate, first-round effects of the relative price-changes, rather than eventual adjustments to equilibrium, the main mechanisms through which imposing environmental taxes influences sectoral competitiveness are clear, as is the difference between the impacts from environmental taxes on sectoral and national competitiveness. The cost increases in the four most affected sectors will impair their position in domestic markets with respect to the products of other sectors. The six sectors whose costs are decreased by the revenue-recycling will be particular beneficiaries from the shift in relative prices. For the country as a whole, however, there is no reason for thinking that its competitiveness will be affected at all by the shift.

This conclusion would appear to be borne out by the experience of Denmark, which has a small, open economy, and which has been a pioneer in the area of environmental taxation. According to its Ministry of Economic Affairs: 'Danish experience through many years is that we have not damaged our competitiveness because of green taxes. In addition, we have developed new exports in the environmental area' (Kristensen 1996, p. 126). The study of the Norwegian Green Tax Commission (1996, p. 90) has also endorsed this essential conclusion: 'Reduced competitiveness of an individual industry is not necessarily a problem for the economy as a whole. . . . It is hardly possible to avoid loss of competitiveness and trade effects in individual sectors as a result of policy measures if a country has a more ambitious environmental policy than other countries or wishes to be an instigator in environmental policy. On the other hand, competitiveness and profitability will improve in other industries as a result of a revenue neutral tax reform.'

It might be thought that a tax-plus-rebate imposition of an environmental tax is of academic interest only, in that no government would actually proceed in this way. On the contrary, Sweden has implemented an environmental tax in precisely such a way. Its NO_x charge, introduced in 1992, '. . . is the first and only emission charge introduced in the Nordic area' (TemaNord 1996, p. 50). The production of final energy is levied with the NO_x charge tax and applies only to plants with an energy production above 25 GWh/year as from 1 January 1997. The burning of fuels within industrial processes is exempt from the NO_x charge. The rate of the charge is set to 40 SKR; 4.6 ECU per kg emitted nitrous oxide and all the revenue is recycled back to the power plants according to their energy output. In this case the competitiveness of those plants with greater than average energy output per unit of NO_x emissions will be improved, while that of those with less than this average will deteriorate. Competitiveness overall with not be affected. This is exactly the result an environmental tax should achieve, relatively benefiting the better environmental performers.

A continual increase in the price of energy through the imposition of a carbon tax raises a number of other issues which can affect competitiveness: the scrap-

ping of existing capital; the take-up of energy-efficiency opportunities; and the stimulation of technical change. They will be briefly discussed in turn.

One would expect that the least disruptive imposition of a carbon tax would be one introduced initially at a low level, with modest annual increases over a substantial, pre-announced period of time. This would allow responses to the tax to be synchronised with normal investment schedules and minimise the need for early scrapping of existing assets. If a carbon tax were introduced in this gradual, expected way, it is unlikely that experience gained in response to the energy price shocks of the 1970s would provide a reliable guide to the economy's response. Modelling results using elasticities derived from these responses should, therefore, be treated with caution when applied to this different situation.

With regard to energy efficiency, many analysts have argued that market failures are preventing the implementation of some cost-efficient energy-conservation measures now (e.g. Lovins and Lovins 1991; Jackson and Jacobs 1991; Jackson 1995). It is possible that complementary government initiatives to encourage energy conservation and efficiency, and investment in clean energy technologies, would cost relatively little and significantly increase the energy elasticities on the basis of which the costs of a carbon tax are calculated, thereby reducing the cost of achieving any given CO_2 reduction target. The IPCC survey of this literature (Bruce et al. 1995, pp. 310, 318) finds that zero cost emission reductions by 2025/2030 estimated by various studies ranged from >61–82% (for the US) and from >45–60% for other OECD countries. Clearly a rising energy price would increase the number of cost-effective efficiency measures and the probability that they would be implemented.

If energy efficiency could be increased at the same rate as the price of energy, then any negative effect of a rising energy price on costs would be cancelled out. There would also be a positive stimulus with regard to the development of non-fossil energy technologies. Technologies do not emerge from on high. They evolve in response to pressures, which may be the competitive forces of the market, or the demands of public policy. Grubb (1995, p. 305) calls this latter kind of technical change 'induced technology development', and concludes: 'If price rises stimulate technical development and in addition governments take further associated action to encourage energy saving, long-term solutions may emerge at relatively lower cost as a result of the accumulation of technical change in the direction of lower CO_2 – emitting technologies, infrastructure and behaviour' (ibid, p. 309).

This brief analysis of the possible impacts on sectoral and national competitiveness from the imposition of environmental taxes leads to several important conclusions:

1. Where the revenues from the tax are recycled back to the affected industries, there are no grounds for thinking that there will be any long-term effects on national competitiveness. For the UK, sectors which would benefit have a higher share of exports than those which might be negatively affected, so that UK trade performance might even be improved by such a measure.

2. Even those sectors which might be negatively affected could offset the effects of the tax if they were able to increase the rate at which they improved environmental efficiency in those areas affected by the tax. There are good theoretical and empirical grounds for believing that the tax itself, and the rise in relative price of environmental inputs that it would induce, would help to bring about such improvements.
3. In order to avoid the costly premature scrapping of capital, to give time for industrial adjustment, and to influence future investment plans, environmental taxes should be introduced at low levels and gradually escalated according to a pre-announced schedule.

4.1. THE FUTURE EFFECTS OF ENVIRONMENTAL POLICY ON COMPETITIVENESS: MODELLING ENVIRONMENTAL TAXES

The conclusions from the previous section about the effects of environmental taxes on competitiveness largely derive from simple simulation and theoretical analysis. However, there are now numerous studies which have sought to estimate competitiveness effects through detailed modelling of environmental taxes. Most of this modelling relates to the possible introduction of carbon/energy taxes.

The models used for this purpose vary in terms of theoretical underpinning, structure, basic assumptions and the treatment of different parameters. The implications of these differences for their results are dealt with in detail elsewhere (Barker and Johnstone 1998), and will only be discussed briefly here. In fact there are only a few studies which tackle competitiveness and energy taxation questions directly and even these do not deal with the issue of competitiveness separately. It is mainly regarded as an issue synonymous with other questions such as changes in economic growth and employment and in the rate of inflation. In what follows, first the studies of the macroeconomic effects of an energy tax will be analysed and then those of the sectoral effects.

4.1.1. *Model Results of Macroeconomic Competitiveness Effects*

Many of the studies that model carbon/energy taxes have found the imposition of the tax to result in reductions in GDP, or costs, which have tended to predominate in discussion of this issue. Typical are the results of the Stanford Energy Modeling Forum exercise, which specified standardised scenarios for fourteen widely differing models of the US economy, and found: 'The costs of achieving a 20% reduction in CO_2 emissions (in the U.S.) relative to today's level range from 0.9% to 1.7% of U.S. GDP in 2010' (Gaskins and Weyant 1993, p. 320).

A feature of these results is that carbon tax revenues were returned to households on a lump-sum basis, rather than being used to reduce distortionary taxes. It is clear that such a procedure is suboptimal. For example, Jorgenson and Wilcoxen argue: '(Lump-sum recycling) is probably not the most likely use of the revenue. . . . Using the revenue to reduce a distortionary tax would lower the net cost of a

carbon tax by removing inefficiency elsewhere in the economy' (Jorgenson and Wilcoxen 1993, p. 20). This is precisely the effect that is obtained in all models that do in fact reduce distortionary taxes to offset a carbon tax. Jorgenson and Wilcoxen (1993, Table 5 p. 22) themselves find that a 1.7% GDP loss under lump-sum redistribution is converted to a 0.69% loss and a 1.1% gain by reducing labour and capital taxes, respectively.

Similar results have been found in many other modelling exercises. Where the models permit unemployment, and where the tax revenues are recycled by reducing labour taxes, a further result is often that employment is increased (and unemployment is reduced), which may give a further stimulus to output growth. An example of such an outcome may be found in the wide-ranging report from DRI and other consultancies, commissioned by the European Commission (DRI 1994). Table VIII shows some of its results. DRI modelled three scenarios for six of the larger European Union economies (EU-6): a Reference scenario (REF) containing 'all policy measures and actions agreed by the end of 1992' (DRI 1994, p. 27); a Policy-in-the-Pipeline scenario (PIP), incorporating policies or proposals that had been the subject of a directive, mainly comprising 'command and control' measures, except for the European Commission's carbon-energy tax; and an Integrated scenario (INT), mainly using market instruments, including environmental taxation, to internalise environmental costs. DRI also modelled a variant of the INT scenario, called INT+, in which all the revenues from INT's environmental taxes were used to reduce employers' non-wage labour costs such as social security payments or, in the UK, employers' National Insurance Contributions.

All the scenarios yielded environmental improvement compared to the base (REF), but PIP resulted in not inconsiderable costs as well. In contrast, as Table VIII shows, INT, and especially INT+, had broadly neutral macroeconomic results, with both scenarios showing an increase in employment and output. These results are in line with the theoretical conclusions that market-based instruments are less costly than direct environmental regulation, and that environmental policy need not incur macroeconomic costs.

4.1.2. *Model Results of Sectoral Competitiveness Effects*

Analysing the impacts of an environmental tax on the sectoral level requires a disaggregated modelling framework. The estimation of the price effects induced by the imposition of an environmental tax is often carried out using a cost driven input-output price model. The impacts on competitiveness are then analysed by the development of the sectoral prices following the introduction of an environmental tax and the respective recycling measures of the generated revenues. The price increase induced by, for example, an energy tax affects not only the economic sectors producing energy products. The prices of all economic sectors are increasing depending on how much energy is required, directly and indirectly via intermediate goods, in the production of the goods. By taking into account indirect

Table VIII. Change in key economic variables in 2010, INT and INT+ vs. REF in the EU-6.

	INT vs. REF	INT+ vs. REF
Real GDP at market prices, per cent	0.91	1.06
Final consumption	0.90	1.04
Fixed investment	1.44	1.68
Consumer price index, per cent	3.39	2.51
Wholesale price index, per cent	3.35	2.49
Employment, per cent	1.28	2.74
Unemployment rate[a]	−0.58	−1.17
Trade balance, US$ million[a]	57.39	46.97
Current account balance, US$ million[a]	86.82	74.63
Government borrowing, %GDP	3.60	3.77
Change compared to REF	−0.51	−0.34

[a] Difference in unemployment rate in 2010 between scenarios.
[b] Change in levels in 2010 between scenarios.

and feedback effects from the carbon tax, this goes further than the Pezzey analysis discussed earlier, which only analysed the carbon tax's direct effects.

Using such an approach, Barker (1995) has examined the issue of competitiveness using the MDM-E3 model for the UK economy analysing the implications for industrial costs of a $10 per barrel carbon/energy tax in the UK, with compensating cuts in employers' National Insurance Contributions (NIC). Barker's result shows again the importance of how the generated revenues are redistributed: 'If the taxes are not compensated, most industries' prices rise as they face higher energy and labour unit costs. However, if NIC contributions are reduced to keep the PSBR ratios at base levels then all industries' costs fall depending on their use of labour – and the most labour-intensive industries will have the largest reduction in costs', (Barker 1995, p. 19). For most sectors the effects from the reduction in labour costs more than offsets the effects from the increase in energy costs. The macroeconomic differences from the base case scenario are negligible: growth and inflation are slightly higher while the balance of payments experiences a small fall. A very similar result emerged from the study of Germany by the German Institute for Economic Research (DIW 1994).

All these studies confirm that, while environmentally-intensive sectors may be challenged by, and some may lose competitiveness from, environmental taxes on industry, such taxes, if accompanied by redistribution of the revenues to industry, are likely to be neutral or slightly beneficial for the economy as a whole.

However, it is not the case that the kinds of exemptions introduced out of concern for competitiveness, which were detailed earlier, have a neutral effect on the

economy. On the contrary, a study by Oliveira-Martins et al. (1992) showed that, for a given emission-reduction target, the tax exemption of energy-intensive industries in the EU does not affect the output level of these industries. This outcome arises because the exemptions result in higher tax rates for the rest of the economy, so that the costs of the other sectors are higher and total output falls. A similar result has been reported by Böhringer and Rutherford (1997) in their analysis of the consequences of exempting energy-intensive sectors from a carbon tax. They find that wage subsidies to export- and energy-intensive sectors, rather than tax exemptions, retain more jobs and are less costly. The study's general conclusions are: 'Welfare losses associated with exemptions can be substantial even when the share of exempted sectors in overall economic activity and carbon emissions is small. Holding emissions constant, exemptions for some sectors imply increased tax rates for others and higher costs for the economy as a whole' (Böhringer and Rutherford 1997, p. 201).

5. Conclusions

The achievement of sustainable development is likely to require two kinds of changes in patterns of production and consumption: the reduction of the environmental-intensity of all economic sectors that have significant negative environmental impacts; and a change in the structure of the economy so that environmentally-intensive sectors become less important within it.

It is improbable that these changes will be achieved in a market economy unless the price mechanism complements and reinforces other instruments of environmental policy in giving incentives to both consumers and producers for changes in the desired direction. With regard to the structural change in particular, prices play a crucial role in signalling the long-term direction of economic development. Unless the prices of environmentally-intensive activities undergo a sustained increase from current levels it is most unlikely that consumption patterns and technological development will react so that necessary environmental improvements will be achieved.

The routine exemption of the most environmentally-intensive sectors even from the modest environmental taxes that have so far been imposed is therefore a matter of great concern.

Where such exemption has been accompanied by the conclusion of negotiated agreements to reduce individual sectors' environmental impacts, this is doubtless better than nothing, but such agreements do nothing to give the unequivocal signals to consumers as well as producers of the need for fundamental restructuring that result from sustained price increases.

This paper analysed the exemptions that have so far been introduced and it is clear that they represent a significant constraint on the environmental achievements that can be expected from environmental taxes. Conversely, they will increase the social cost of achieving any given level of environmental improvement.

The exemptions are motivated mainly by concerns about competitiveness, with politicians reacting to the expressions of concern of a relatively few industrial sectors. The paper has shown that environmentally-intensive sectors are right to feel challenged by environmental taxes, but that with appropriate policy support there is no reason why even these sectors should not make environmental improvements that will maintain their competitive position. For the economy as a whole, the paper has shown that the available evidence, from theory, simulation and modelling, suggests that a programme of environmental taxes plus rebates could increase employment and at least maintain output, while achieving substantial environmental benefits and setting the economy on the necessary path of structural change. It would be unfortunate if the successful lobbying of a few powerful sectors intent on maintaining their sectoral economic importance were to prevent these environmental and economic benefits from being realised.

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