Harmonizing Energy Taxes in the EU

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Abstract

The paper presents evidence showing the wide variation in taxes on different fuels within and across EU countries. Input taxes are inefficient unless correcting externalities or market failures. The paper quantifies these and considers road fuel taxes as second-best road charges, but finds these inadequate to explain current rates. Nor does energy security, though problems of tax evasion and distributional concerns are clearly important. Distortions appear modest but may be important in electricity generation. EU pressure for harmonizing road fuel and other energy taxes continues, but may be resisted.

Keywords: energy taxes, harmonization, EU, externalities

JEL code: D62, H21, H23, H73, Q48, R48

1. Introduction

Different fuels are taxed at very different rates within almost all EU countries, and the same fuel is taxed at very different rates across the EU. Fig.1 gives the average mineral oil tax rates for 1997 across EU countries, defined as total tax revenue (excluding VAT) divided by final consumption of oil products. To gain a rough sense of the tax rates, oil products in 1997 were probably on average Eur 100/tonne oil equivalent, so the taxes as a percentage of product prices were high (substantially greater than 100%). In contrast, coal is normally untaxed (except in Denmark and Finland), as is gas for industry (with a few more exceptions).

Hydrocarbon taxes are also fiscally important. On average they contribute 2% of GDP to the budget (as shown on the right hand scale of fig. 1), or about 5% of tax revenue. The UK stands out as having heavy oil taxes, primarily but not solely arising from the heavy taxation of road fuels. The ratio of hydrocarbon taxes to total UK government revenue has risen from 4.5% in 1989 to 6.7% in 1999, and the real tax receipts have grown at 6.2% p.a. over this decade. More to the point, hydrocarbon taxes

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account for a significant share of indirect taxes - in the UK 20% of all indirect tax revenue (including VAT), and 46% of indirect taxes if VAT and import duties are excluded.

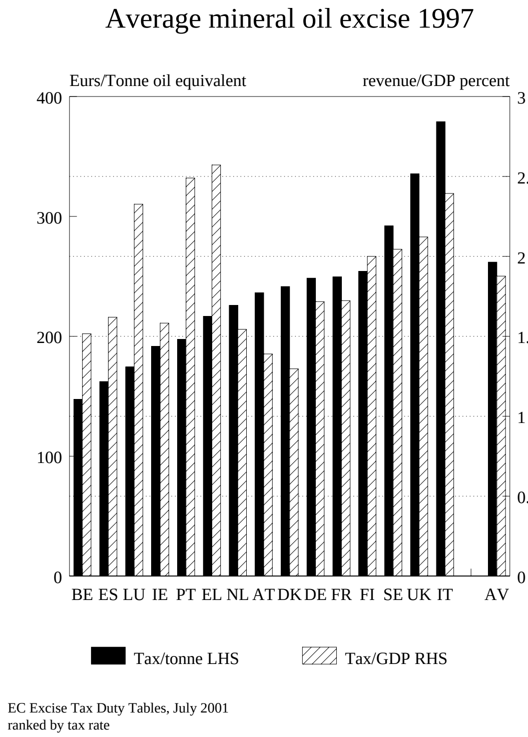

Fig. 1

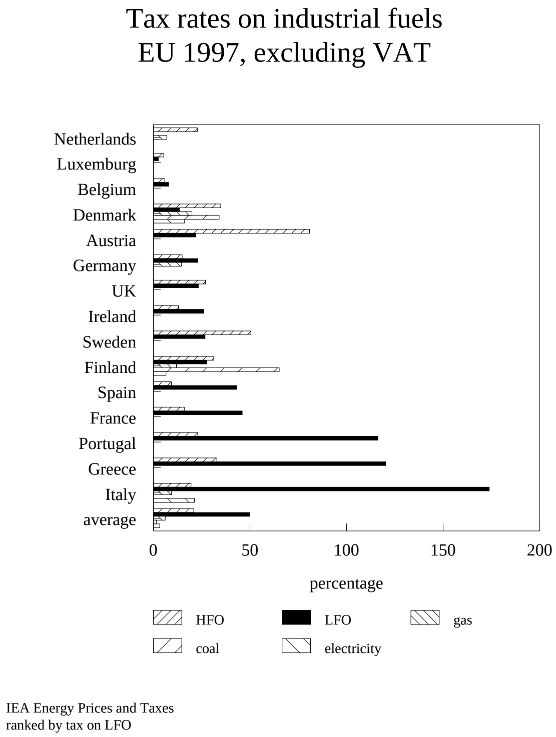

Fig. 2

The variation of tax rates (as a percentage of the pre-tax price, and again excluding VAT) for different fuels for the industrial sector is shown in fig. 2. Light fuel oil (LFO) stands out as heavily taxed in some countries, notably Italy, Portugal and Greece, presumably where there are difficulties in preventing tax evasion on the even more heavily taxed road diesel fuel, for which kerosene can readily be substituted. Heavy fuel oil (HFO) is relatively heavily taxed in Sweden and Austria, while Denmark appears to have the most uniform tax system across fuels, as the base is primarily carbon content.

Fig. 3 shows the taxes on fuel consumed in the domestic sector (excluding road fuel, which is shown in fig. 4). LFO is primarily used for central heating, as is gas, but they are taxed at very different rates (except in Denmark), again probably to prevent tax evasion. The variation across countries is considerably larger than for industrial use, as one might expect on efficiency grounds. The average tax rates are typically higher than for industry, again as expected.

Fig. 4 completes the picture by comparing tax rates on road fuel, showing that gasoline taxes were an astonishing 262% of the pre-tax price on average, and over 300% for France and the UK. Since then the UK has substantially increased taxes (though the pre-tax price has also risen so the average tax *rate* may have decline somewhat). Note that fig. 4 is ordered in increasing rates of diesel tax rate, and again the average rate is high at 189% (but again over 300% in the UK). Road fuel taxes contribute the overwhelming proportion of energy taxes, and raise the greatest conceptual issues, as a considerable part of these taxes are more properly considered as road user charges. Before considering this, though, we first ask why energy should be taxed at all.

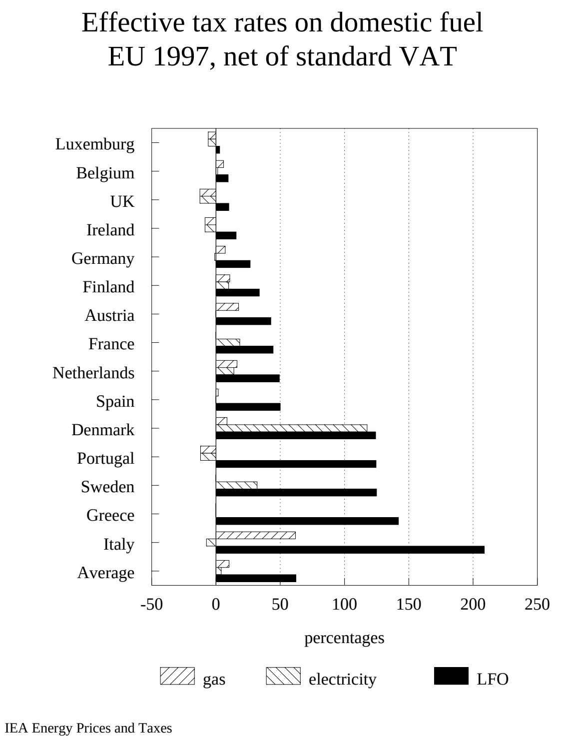

Fig. 3

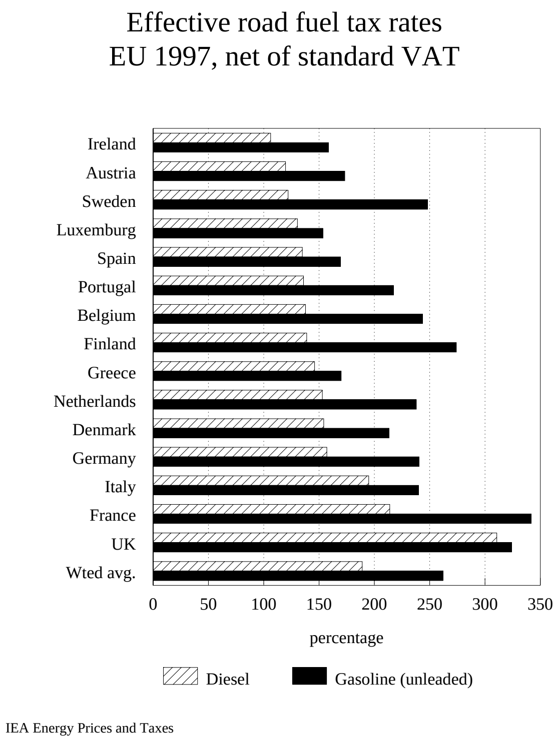

Fig. 4

2. Why impose excise taxes on energy?

Energy taxes are primarily input taxes, and as such fall on production as well as consumption. Standard tax theory (Diamond and Mirrlees, 1971) argues that distortions should be confined to final consumption, leaving production undistorted. In the absence of externalities or other market failures, that suggests that all indirect taxes should be value added taxes. Clearly, the energy taxes identified in the figures, which exclude standard rate VAT,[1] violate this precept, raising the question what market failures or externalities might account for these taxes.

The most obvious externality is environmental pollution, where the main damaging components are particulates, PM_{10} (particulates of size less than 10 microns),[2] SO_2 and sulphates, NO_x and nitrates (the salts are primarily harmful to health in their small

[1] In some countries, notably the UK, domestic energy consumption attracts a lower rate of VAT, and as such is relatively subsidised. This departure from uniformity has been allowed for in fig. 3.

[2] Smaller sizes may be even more damaging, but statistics on their prevalence are less readily available.

particulate form), various volatile aromatic compounds (VOCs), various other combustion products such as CO, NH_3, and of course greenhouse gases, notably CO_2 (see fig. 5). Ideally all should be taxed on the damage they cause, which, with the single but critical exception of CO_2, depends on the composition of the fuel, how it is burned, whether it is subject to tailpipe cleanup, and where and when the combustion takes place.

As a practical matter, fuels should be taxed on carbon content (which is directly proportional to the damage done by combustion), possibly on sulphur content (with credits for abatement), with other emissions dealt with by a combination of input fuel-specific taxes and environmental standards. The special tax treatment of leaded petrol is a good example on a well-targeted input tax on emissions. Otherwise standards are set as a relatively crude second-best way of dealing with harmful emissions, for large plant (under the Large Plant Combustion Directive), for sulphur (under the Second Sulphur Protocol) and NO_x under various standards for large plant and road vehicles. Tradable permits for NO_x and SO_2 have been introduced in the US, and if carefully designed are a superior tax-like solution for internalising these emissions externalities. To the extent that particular fuels are likely to give rise to damage, there is an obvious case for levying taxes appropriate to the untreated rate, combined with some form of rebate or compensation for abatement where this is feasible.

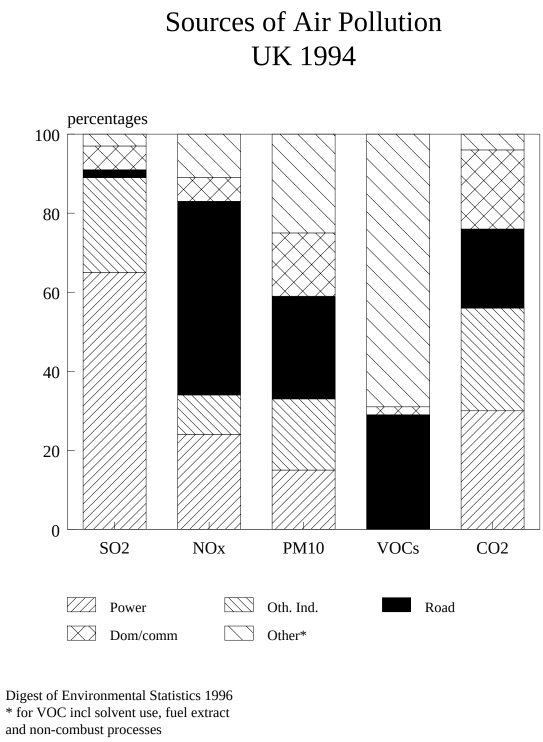

Fig. 5

Although politicians have frequently argued that energy taxes, particularly road fuel taxes, are to be justified on these environmental grounds, with a few exceptions the case is unconvincing. In most cases the taxes predate environmental concerns, the taxes are not related in any systematic way to environmental damage, and they do not meet minimal criteria for so doing. Coal is almost invariably the most environmentally damaging fuel, but it is usually the least heavily taxed, and in many countries its production is heavily subsidised (Newbery, 1995). Environmental or green taxes are often invoked as justifications for heavy road fuel taxes, but Newbery (1998) argued that if environmental and social taxes (or green taxes) are to be both politically attractive and economically effective, they must be clearly distinguished from other taxes or charges, set at levels determined by acceptable methods of computing the cost of the damage done, and applied uniformly to all sources of the same damage. That is, green taxes should be *distinct*, *non-discriminatory*, and *defensibly quantified*.

For green taxes to be *distinct*, the basis for setting other road taxes needs to be clear, and the logical approach is to distinguish road user charges from other road taxes. Road user charges, following the model of Railtrack, would be set by a road regulator to cover the costs of and provide finance for the road transport system. Any additional taxes on road users, apart from the green taxes, would have to be carefully justified if the concept of a distinct green tax were to have any valid meaning.

If green taxes are to be justified as legitimate charges on transport users because of these social and environmental costs, then they should be *non-discriminatory*. That is, similar taxes should also be applied to other similar sources of environmental and social damage, such as coal, heating oil, and gas (all sources of carbon dioxide, some also sources of other pollutants such as acid rain and particulates). Otherwise the taxes will be seen as unjustified transport taxes, not green taxes. Fig. 5 shows the share of road transport in the total production of these (and other) air pollutants in the UK. Clearly, road transport is a major contributor to the total emissions of these three pollutants (and also for volatile organic compounds, or VOCs, though not of sulphur dioxide, SO_2, the other main cause of acid rain). However, in all cases road transport causes less than half the UK's emissions, and in the case of CO_2, singled out as the reason for fuel tax increases, only one-fifth of the total CO_2 in 1994 (though one of the fastest growing components). It follows that to concentrate energy taxes on transport emissions would involve a very partial and discriminatory environmental tax policy.

Finally, if the taxes are to be justified, they will have to be *quantified*. Newbery (1998) argues for estimating the social costs of the health effects of pollution by estimating the number of quality adjusted life years (QALYs) lost through premature mortality and morbidity. These costs should then be compared with what it costs the taxpayer to enable the Health Service to achieve an extra year of quality life. The numbers used in the evaluation of transport should be consistent with numbers used elsewhere in health economics. This would enable the money raised in green taxes (which are mainly the costs of health damage) to be allocated to the National Health Service, which should be able to compensate for the quality life years lost through pollution by an equal saving of quality life years gained from improved health services.

Recent work presented at a UN/ECE symposium *The measurement and economic valuation of the health effects of air pollution*, London, Feb 19-20, 2001 suggests encouraging convergence in estimates of the costs of the more damaging pollutants.[3] Severe urban pollution may reduce life expectancy by about 6 months, and the value of a life year lost seems to be about £30-50,000. The UK National Institute of Clinical Excellence was reported (*Times*, 10 Aug, 2001) as tentatively accepting a figure of £30,000 per QALY, suggesting a convergence on the valuation side. If we take the higher

[3] The NEBEI website of the conference is at http://www.unece.org/env/nebei

figure for a QALY, and figures of traffic related pollution from Department of Health (1998) of 4,000 premature deaths per year caused by air pollution, and attribute half to traffic, then the number of QALYs lost per year would be rather less than 2,000, with a value of £0.1 bn, negligible compared with 1996/97 road taxation of £ 21.4 billion. This figure can be contrasted with earlier of £19.7 billion or 4.3 p/vehicle km (Maddison *et al*, 1996, substantially revised and lowered in Maddison, 1998, and his paper at the UN/ECE conference), or of McCubbin and Delucchi, 1996 for the U.S. where the high value is 5p/veh.km).

Thus the case for high taxes on transport fuels because of urban air pollution is unsound. The case for a general carbon tax is considered below.

2.1 Road fuel taxes as road user charges

Road fuel taxes can to a considerable extent be justified as road user charges (Newbery, 1988, 1990, Newbery and Santos, 1999), pending the political and technical development of more finely targeted road pricing. They are relatively blunt instruments, for whereas fuel consumption per km increases in congested urban conditions (by a factor of 3.5 relative to uncongested roads),[4] marginal congestion costs can exceed fuel taxes by a factor of 20 or more there, while interurban car travel is typically substantially overcharged. Nevertheless, a case can be made that on average road users should pay the average total cost of road provision (primarily road damage, maintenance, and interest on capital), just as other users of privately owned infrastructure (e.g. electricity and gas transmission) must pay a regulated, usually price-capped, charge that covers such costs. Note that the case for an additional scarcity price to reflect marginal congestion costs must rely on either inefficient undersupply, or significant diseconomies of scale in road building (Newbery, 1989).

Although the long-run marginal cost of expanding roads (or the scarcity price where this is infeasible) might be expected to differ across countries, there is little evidence that road taxes are set on this basis. Nevertheless, there are strong arguments for proposing that, until better instruments such as road pricing are available and accepted, road fuels should be set on this basis. Using UK data, Newbery (1998) argued that the road cost alone might be 2.3 p/PCUkm (1996 prices), or 4 Eurocents/PCUkm (2000 prices).[5] That would translate into Eur 400/'000 litres for gasoline, and perhaps

[4] André, Hassel and Weber (1998)

[5] The largest uncertainty is about the capital value of the road network, which is taken as £120 billion for the UK, with interest calculated at 6% real. PCU = passenger car units, a measure of road space demand.

Eur 500/'000 l or more for diesel.[6] Setting tax rates at the same level of diesel can be defended if the balance is collected through annual licence charges. The EU average (unleaded) gasoline tax in 2001 was Eur 577/'000 l, for the UK was Eur 815/'000 l, and the minimum required by EC Directive 92/82/EEC was only Eur 287. The average diesel rate was Eur 443, for the UK was Eur 865, and the minimum requirement was Eur 245 (EC, 2001b).

Given that the road network in the UK is undersized for the level of traffic, higher values could be justified and would apply in much of the rest of the EU. The average road fuel tax shown in fig. 4 may therefore be defensible, though not the under-taxation of diesel relative to gasoline. Diesel is both more polluting, and used by heavier vehicles that do more road damage, and are more fuel efficient, suggesting a higher tax required per litre to achieve even the same charge per km. Note that if carbon taxes are levied, further adjustments need to be made to road fuel taxes if they are to continue to charge for road use (Newbery, 1992). The principles set out in Newbery (1998) suggest that road fuel taxes should initially be set as the sum of green taxes for environmental damage (including the carbon tax for global warming), and the road user charge. As more sophisticated forms of road pricing are introduced, they can replace the road user charge element of road fuel tax (and vehicle excise duty) on an equal revenue basis, minimising the disruption to both voting motorists and the budget.

2.2 Carbon tax

The best case for a fuel tax is to internalise the damage caused by global warming. There are huge conceptual and practical problems in estimating the correct level of tax to achieve this. The highest level of tax would be justified if it were part of an international binding commitment to reduce carbon emissions to their optimal level, while the lowest level would be that chosen by an individually selfish country, assuming all other countries are selfish, and taking account of possibly partially offsetting increases in emissions elsewhere in response to the individual reduction. Even if we take the collective optimum approach, the range of estimates is considerable. The most recent survey (Clarkson and Deyes, 2001) cites figures for the social cost of carbon (defined as the level of carbon tax required to reach the global optimum) ranging from $9-200/tonne of carbon (tC) in 2000 prices (Eur 10-220/tC). Their best estimate of the marginal cost of an extra tonne of carbon (not assuming optimal emissions) is £70/tC (Eur 110/tC, 2000 prices) with a (rather arbitrary) confidence interval from £35-£140 (Eur 55-220/tC).

The original proposed EU carbon tax was set at $10/bbl (though as a political compromise half was to be levied on carbon content, and half on energy). Updating that

[6] For diesel cars, Eur 540/'000 l, and for heavy vehicles much would depend on the balance between the annual vehicle excise duty, which can discriminate between vehicles on the basis of their road damaging impact, and fuel duty, which is less well designed for that purpose.

to current prices, and assuming that it should all be levied on carbon would yield a tax of £60/tC or about Eur 100/tC, not so far from this estimate of the marginal cost. If we leave on one side the selfish aspect of international negotiations, then one might argue that all EU countries acting together ought to set the same carbon tax, and that this tax might reasonably be Eur 100/tC. On that basis the carbon tax should be Eur 49/'000 litres for gasoline, Eur 53/'000 l. for diesel, and Eur 56.7/'000 l for LFO (heating oil). These translate into 8% of the 2001 EU (weighted) average tax on gasoline, 12% of that of diesel, 68% of that of LFO for industry, and 51% of that for heating oil.

Another way to inquire whether the carbon tax motivates energy taxation is to compare the carbon tax with the minimum excise duty adopted by the Council under Directive 92/82/EEC of 19 Oct 1992. The ratio of the carbon tax to this minimum prescribed tax is 17% for gasoline, 22% of diesel, and 315% for LFO. Both sets of comparisons indicate that road fuels are taxed on a completely different basis to other hydrocarbons (which is logical, as argued above), and that LFO may be under-taxed. That is confirmed by looking at individual countries: Belgium, France, Ireland, Luxembourg, and The Netherlands charge less for LFO than the proposed carbon tax, with the UK on the borderline. Denmark, with its explicit carbon tax, Austria, Greece, Italy and Sweden charge taxes between two and five times the suggested carbon tax on LFO.

2.3 Taxes for energy supply security

A third motivation for energy taxation is that countries have market power over the import price, and/or wish to reduce their import dependence on energy, given the critical and strategic nature of energy for national survival (remembering that Japan went to war when its oil supply was cut off by the US). Some fuels - gas and oil - are more vulnerable than others such as coal, or nuclear power. Determining an optimum oil import tariff is non-trivial and involves subtle issues of commitment and exhaustibility, as shown in Karp and Newbery (1991a, b). Whether or not the EU acts as a single market for this purpose is also unclear, given the considerable variation in important dependence, with the UK roughly self-sufficient, and France heavily import-dependent (which explains her commitment to nuclear power). It would certainly be difficult to explain oil taxes on that basis, as the UK and Denmark are net exporters, but have among the highest tax rates. (All other EU countries are almost completely import dependent for oil, and largely for gas).

2.4 Sumptuary taxes

The most obvious reason why gasoline is singled out for heavy taxation is that in Europe, large cars denote extravagance that can politically be taxed, to reduce envy and aid redistribution (and because it is so easy to conceal the actual tax rate). Heating oil, domestic gas use, and domestic electricity are in contrast (income) inelastically demanded, and in colder climes, such as the UK, fuel poverty (defined as spending more than 10% of income on energy) is a serious issue (with 20% of UK households fuel poor in 2000). The exceptions to low taxes on domestic heating fuels are interesting: Italy and Greece, perhaps less efficient at collecting other taxes (at least when the current tax regime was chosen) and with mediterranean climates, Denmark (carbon tax) and Sweden (heavily reliant on cheap hydro electricity for heating), have higher taxes on these fuels.

2.4 The special case of coal

Coal is nominally untaxed except in Denmark and Finland, neither of which mine coal. Coal production has until recently been heavily subsidised in most significant coal producing countries, and until recently the protection was provided by a combination of hydrocarbon taxes and above world-market domestic prices. In the early 1990s, Germany had the largest indigenous coal industry, one of the most protected in Europe, as measured by the producer subsidy equivalent (PSE) per tonne (IEA, 1992, p38 estimates Germany's PSE as $105/tonne coal produced in 1992). Germany also paid the highest prices for coal for generation, and had the highest industrial electricity price. The UK had the lowest PSE/tonne of the European coal producers ($18/tonne of coal in 1992) but one of the highest coal prices for generation. Interestingly, it also had one of the lowest industrial electricity prices of coal-intensive countries, as British coal was protected by high contract prices with the generators that were passed on primarily to non-industrial customers. Spain had an even more protected coal industry. Newbery (1995) estimated that the PSE raised the effective domestic price for coal producers about 450% above import parity in Spain (compared to the IEA's estimate of 100%), about 250% in Germany, and about 50% in the UK.

Since then, the system of supporting coal producer prices in Germany has changed so that industrial consumers (mainly power stations) can buy at import prices. Coal-backed contracts have essentially ended in the UK, so many of the past distortions have disappeared. On the other hand, the Climate Change Levy in Britain has been carefully designed not to be a carbon tax, but an energy tax, and electricity is taxed on production, not inputs, to protect coal. In addition a gas moratorium was imposed in 1998 to prevent the building of gas-fired Combined Cycle Gas Turbine (CCGT) generating units, and hence protect the market for coal (but not necessarily for British coal). Coal escapes carbon taxes (except in Denmark) which at Eur 100/tC would be about Eur 67/tonne for bituminous coal. Import prices into the EU were $35/tonne or about Eur 40/tonne in 1999, so a carbon tax of 167% of the producer price (but specified as Eur 100/tC) could be justified. Clearly coal is still treated rather leniently compared to most other fuels.

3. The case for harmonization

The standard case for harmonizing taxes within a customs area is to reduce trade distortions and enhance welfare. That becomes even more important with capital and labour mobility, as in the EU Single Market. If so, then the prime concern would be with differences in tax rates on inputs to production, and possibly for consumer products where consumers can arbitrage across frontiers (as with road fuels near country borders). The CEC commissioned a paper on the impact of fuel taxation on technology choice for the Green Paper on Energy Security (EC, 2001a, Annex 2). The aim was to see whether fuel taxation distorted the choice of technology for new investment compared to no taxation (not compared to the appropriate level of carbon tax). The paper studied power generation, industrial steam raising, household space heating, and private cars, using tax and price data for 2000. The results are as follows. For base-load (7,000 hrs/yr) power generation, excise taxes favoured coal instead of the efficient choice of gas (in CCGT) only in Denmark (surprisingly, coal is the efficient choice in France and Germany, perhaps because of uncompetitive gas pricing). At 5,000 hrs/yr Italy and Denmark are dissuaded from using the more efficient CCGT, and Germany is not given adequately strong signals (coal appears cheaper when it is effectively no cheaper than gas). The same pattern holds for industrial heat raising (at both 7,000 and 5,000 hrs/yr). For domestic space heating Ireland and Spain are dissuaded from using gasoil instead of the more costly (pre-tax) gas, but otherwise gas dominates pre and post-tax. Belgium, France, Germany and Sweden encourage diesel-powered cars instead of the preferred gasoline powered cars at 18,000 km/yr, though excises have no effect on the least-cost choice at 13,000 km/yr.

These distortions seem relatively minor, though the limited number of technology choices studied certainly do not exhaust their extent. Thus heavy excises on gas-oil discourage dual-firing of CCGT during winter periods, which would be a direct substitute for gas storage (which is probably more expensive). Similarly, excise taxes on fuel may distort the merit order for electricity generation from existing plant, bearing particularly heavily on oil-fired power stations which in Britain might be better placed to serve heavy load centres in the South. Carbon taxes at Eur 100/tC would make coal (and oil) significantly less competitive than gas, and could considerably alter the scrapping/new investment decision, as well as the merit order for generation. The "dash for gas" in Great Britain, in which new gas-fired plant replaced over one-quarter of electricity generated within five years, and almost eliminated the GB coal industry, is an indication of how rapidly price advantages can impact on investment decisions.

Even where fuel excises do not affect the choice of technique, their differing level affects the cost of production and hence potentially distorts trade within the EU. Very different diesel prices may favour foreign compared to domestic haulage (as argued in the UK) and may fail to properly charge for road use costs when vehicles transit without refuelling. There are other solutions to these problems, such as vignettes, but there are also strong pressures from the Commission to harmonize road fuel taxes to avoid more bureaucratic and intrusive alternatives.

Apart from road haulage, where fuel excises (and other vehicle excise duties) are a significant fraction of production costs, and a few energy-intensive industries (metallurgy, fishing, some chemical processes), energy taxes are a relatively small fraction of the final price, and are unlikely to lead to major trade distortions. At present modest gas prices and high gas efficiencies, gas is so obviously the preferred choice where feasible (which rules out transport), that high oil and low coal taxes have relatively minor effects. That could cease to be true if gas prices were to rise (though this is likely to be associated with oil price rises) and coal were again to be the preferred fuel for power and steam raising. At that point the lack of intelligent taxation could have adverse effects, though the strict environmental constraints placed on coal burning partially offset this risk. Moreover, gas is arguably the one fuel where a security premium (perhaps via the requirement to hold adequate gas in store) might well be justified, suggesting some benefits from a more rational approach to energy taxation.

This leads to the final argument for harmonizing taxes. If there is a logical set of energy taxes, and if these hold fairly uniformly across the EU (as they do for carbon taxes, and might approximately at least for road user charging), then most countries should have similar tax rates. The main reason why this might not be the case is that the Diamond-Mirrlees argument of not taxing inputs assumes that it is no more costly to collect value added than input taxes. Energy taxes are particularly cheap to collect, so it may well be that in less tax-compliant countries they remain an advantageous instrument compared to VAT and/or income taxes (Newbery, 1997). If different EU countries face different collection and compliance costs, they may well be advised to choose different energy tax structures, quite apart from the political opprobrium attached to changing the existing form of tax collection. EU energy taxes score quite well on the "silence of the plucked goose" test.

4. Conclusions

Fiscally the most important energy taxes are those on road transport fuels. They can be defended as a second-best mechanism for charging for road use and environmental damage. The EC adopted its Transport White Paper on the future of the common transport policy on 18 July 2001, which sets out a new charging policy:

> The principles for infrastructure charging will be aligned and fuel taxation for commercial use harmonized. The integration of external costs must also encourage the use of modes with a lower environmental impact and facilitate investment in new infrastructure. The current Community rules need to be replaced by a modern framework for charging infrastructure use.

Until more efficient charging methods are evolved, fuel taxes will continue to play an important part in charging for road use. The two main arguments for harmonizing commercial road fuel taxes are that it will discourage tax arbitrage between countries and encourage the adoption of sensible road tax policies. It seems likely that the efficient levels of road user charges are more similar across the EU than the present pattern of diesel taxes (whose unweighted coefficient of variation, CV, was 22% in 2001). The same arguments apply with somewhat less force to gasoline taxation (CV 15%), as this falls primarily on final consumption. The main distortionary effect of differential gasoline and diesel taxes is the inappropriate choice of diesel for passenger vehicles. This can be discouraged by increased vehicle excise duties on diesel cars.

The other striking feature about energy taxation is the low taxation on coal relative to a sensible carbon tax policy, and the very variable taxes on LFO and HFO. Gas is also relatively under-taxed compared to its main substitutes in power generation, which, given the heavy import dependence on insecure supply sources, is somewhat surprising. Protecting domestic customers from high energy taxes is understandable in colder countries where fuel poverty continues to be a serious problem. Ensuring efficient relative prices of power generation fuels is a logical counterpart to pressures to integrate the single European electricity market.

There is likely to be considerable political resistance to energy tax harmonization, at least in some countries. The UK collects substantial excess revenues from energy taxes compared to the harmonized level, and the Chancellor has already indicated that they are justified for financing social expenditures on health and education. Countries that have to raise their transport fuel prices risk arousing the organised opposition of transport operators with the support of the motoring public, as was demonstrated dramatically in Britain and France in 2000. Progress on introducing carbon taxes to date has been patchy at best. Nevertheless, as energy markets become more integrated, pressures for harmonization will continue and may lead to steady, if slower than desired, convergence.

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Appendix 1: Details of individual tax regimes

IEA *Energy Prices and Taxes* gives detailed descriptions of the tax regime for each country. The following details have been extracted from IEA (2001).

All countries charge excises for transport fuels, and many have hydrocarbon excises for other liquid fuels. The notes below relate to additional taxes or atypical tax treatment of fuels or consumers. A large proportion of countries charge emergency stock fees for hydrocarbons, and sometimes for oil and gas. In some countries these are counted as taxes, in others not. Where they are set to cover the actual cost of required storage, they should not probably be counted as a tax. Details are presented under each country.

Austria 1 Euro = 13.7603 S
The stock fee is about 100 S/tonne. The excise tax for gas and electricity can be refunded to certain enterprises.

Belgium
Domestic coal is subject to a lower rate of VAT (12% instead of 21%).

Denmark 1 Euro = 7.455 DKR (floats)
Carbon Tax: For private consumption, 100 DKR per tonne CO_2; for VAT registered enterprises, 50 DKR/t CO_2.
Oil is subject to an additional environment tax - 320 DKR/t, 10 percent refundable to industry. There is in addition a sulphur tax of 100 DKR/t and a non-tax storage fee - 25 DKR/t for HFO, slightly more for higher value fuels. The diesel excise tax of 2.30 DKR/litre has 0.66 DKR/litre refundable to industrial consumers.

Finland 1 Euro = 5.94573 FMK
Carbon tax is levied on all energy at about 500 FMK/tC. There is a precautionary stock fee of 17 FMK/t and an oil pollution fee of 2.2 FMK/t. There are similar stock fees for gas, coal and electricity.

France 1 Euro = 6.55957 FF
From 1 October 2000 the excise tax on LFO, diesel and premium gasoline varies inversely with the benchmark Brent crude price, compensating for increases in oil prices.
A lower rate of VAT is applied to the fixed charge for electricity and gas by households. Gas for industrial use is taxed at 90.8 FF/10^7 Kcal up to 18000 GJ/year. Electricity is subject to a municipal tax for consumption below 250KVA.

Germany 1 Euro = 1.95583 DM
The storage charge is not a tax and is about 8 DM/t.
From 1996 the price of steam coal was set equal to the imported price, before that it was about three times the import price. The electricity tax to support the coal industry of 8.5% ended in

1996.

Greece
VAT on natural gas was reduced from the standard 18% to 8% from January 1999. Domestic electricity has an additional turnover tax of 10% to the standard rate VAT of 18%.

Ireland
The standard rate VAT is 12.5% but gasoline has a 20% VAT as well as excise taxes.

Italy
The excise tax on gas is exempted for petrol chemical plants, levied at differential rates depending on volume for industry and substantially lower (essentially negligible) levels on electricity generation. Domestic gas use in the south but not the north is subject to half the standard VAT rate (10% instead of 20%) and the excise tax which varies by use is lower in the south. Household coal is subject to VAT at 9%, electricity at 10% but pays an additional excise tax exempted for the first 150kWh/month for residential consumers up to 3kW and rebated 50% for the south. There are various local and provincial taxes in addition.

Netherlands 1 Euro = 2.20371 DFL
The compulsory storage fee is included in taxes. An eco tax was introduced on 1 January 1996 to stimulate energy savings on gas, linked to the price of LFO, with low rates (0.022 DFL/m^3) up to 800m^3, higher rates (0.23 DFL/m^3) between 800 and 5,000m^3, decreasing steadily to 0.015 DFL/m^3 at above 10 million m^3. There is a similar eco tax confined to domestic electricity consumption.

Portugal
There is reduced VAT of 5% for domestic electricity (standard = 17%).

Sweden 1 Euro = 8.527 SKR (floats)
There is a charge of 40 SKR/kg NO_x emissions which is not included in the tax shown. There is a sulphur tax of 28 SKR/t on sulphur content exceeding 0.1% by weight, reduced if emissions are abated. Since 1991 there has been a carbon tax of about 900 SKR/tC.

UK £1 = 0.6 Euro (floats)
Domestic LFO, gas, electricity and coal pay VAT at 5% instead of the standard 17.5%. There is a Fossil Fuel Levy on the final electricity price, originally to finance nuclear power, now used to raise modest sums for renewables, originally about 10% and currently less than 2% (?).
It is proposed to levy a climate change levy on energy (not carbon) consumed by industry, with exemptions for negotiated reductions in consumption, with households exempt.