



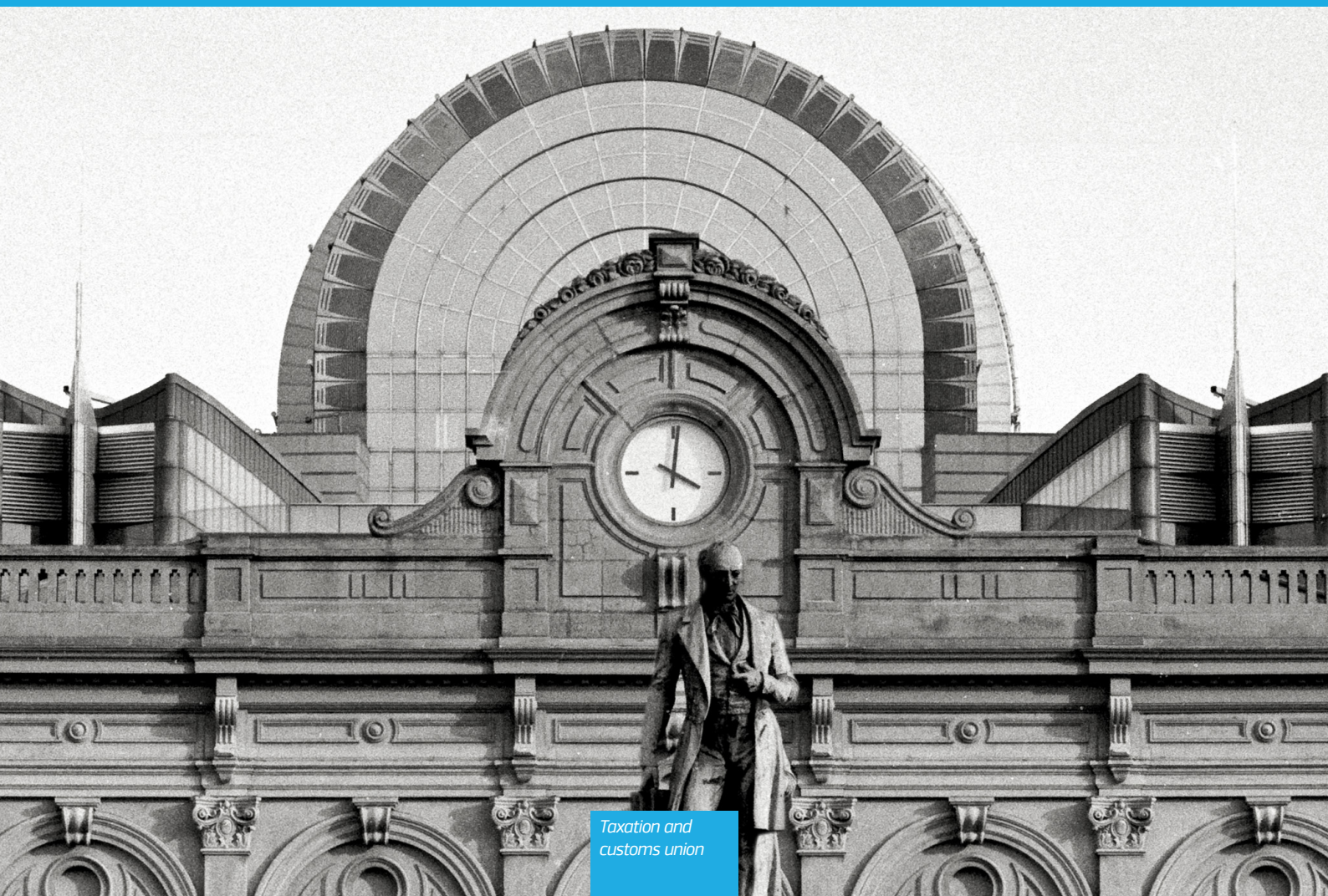
European
Commission

TAXATION PAPERS

WORKING PAPER N.32 - 2012

Katri Kosonen

Regressivity of environmental taxation: myth or reality?



Taxation and
customs union

Taxation Papers are written by the staff of the European Commission's Directorate-General for Taxation and Customs Union, or by experts working in association with them. **Taxation Papers** are intended to increase awareness of the work being done by the staff and to seek comments and suggestions for further analyses. The views expressed in the **Taxation Papers** are solely those of the authors and do not necessarily reflect the views of the European Commission.

Comments and inquiries should be addressed to:
TAXUD TAXATION-PAPERS@ec.europa.eu

Cover photo made by Milan Pein

Despite all our efforts, we have not yet succeeded in identifying the authors and rights holders for some of the images. If you believe that you may be a rights holder, we invite you to contact the Central Audiovisual Library of the European Commission.

This paper is available in English only.

Europe Direct is a service to help you find answers
to your questions about the European Union
Freephone number:
00 800 6 7 8 9 10 11

A great deal of additional information on the European Union is available on the Internet.
It can be accessed through EUROPA at: <http://europa.eu>.

For information on EU tax policy visit the European Commission's website at:
http://ec.europa.eu/taxation_customs/taxation/index_en.htm

Do you want to remain informed of EU tax and customs initiatives? Subscribe now to the
Commission's
e-mail newsflash at: http://ec.europa.eu/taxation_customs/common/newsflash/index_en.htm

Cataloguing data can be found at the end of this publication.

Luxembourg: Office for Official Publications of the European Communities, 2012

DOI 10.2778/30289
ISBN 978-92-79-25026-2

© European Union, 2012
Reproduction is authorised provided the source is acknowledged.

PRINTED ON WHITE CHLORINE-FREE PAPER

Regressivity of environmental taxation: myth or reality?

Katri Kosonen¹

This paper will be published as Katri Kosonen, "Regressivity in environmental taxation: myth or reality ?" in J. Milne and M.S. Andersen (eds), *Handbook of Research on Environmental Taxation*, Cheltenham: Edward Elgar (in press, to be published in 2012). Available here with permission from the publisher.

Introduction

Environmental taxes are key instruments for achieving sustainability in the economy. By increasing the prices of environmentally harmful goods in relation to other goods, they encourage consumers to shift their consumption patterns in a more sustainable direction. Environmental taxes may also increase the prices of production inputs and thus induce the producers to adopt more environmentally friendly technologies.

The most common forms of environmental taxes, and the ones that are the most fiscally important, are those on energy and transport. These taxes affect the costs of heating, electricity and transport, which can all be considered as necessities of modern life. It is often believed—and supported by empirical evidence—that imposing taxes on such goods would impose a heavier burden on low-income households than on high-income households, since the former spend a larger share of their income on these goods. This regressive impact of environmental taxes is often found politically unacceptable and makes it difficult to carry out environmental tax reforms. However, there is also empirical evidence indicating that several factors could mitigate, or even eliminate, the regressive impact of environmental tax reforms, and this should be taken into account in judging the distributional effect of a tax reform package. These factors include, in particular, the income concept used in the analysis, the use of tax revenues and the lesser regressivity of transport taxes compared with those on other energy products.

This chapter first presents an overview of the various factors that in light of the economic literature should be taken into account in the analysis of tax incidence of environmental taxation. It

then explores the main empirical findings, in particular those which make a distinction between the distributional effects of transport-related taxes and those of other environmental taxes. This includes also some less well-known evidence from the Nordic countries. In the final section it presents some recent evidence on the distributional impact of energy taxation in the EU member states included in the impact assessment of the revision of the European Union's Energy Tax Directive.

Factors influencing the determination of tax incidence

The analysis of tax incidence

Economic theory usually draws a distinction between the statutory and economic incidence of taxation. Statutory incidence refers to who legally pays the tax, while economic incidence refers to who really bears the burden of the tax. The two are not equal because of the changes in relative prices (Fullerton and Metcalf 2002).

In the partial equilibrium framework, the extent to which the burden of a commodity tax falls on the consumers depends on the price elasticity of demand relative to the price elasticity of supply. The more the demand elasticity is low and supply elasticity is high, the more the tax is shifted to consumer prices. If, on the other hand, the demand is elastic and the supply inelastic, the production side, or the factors of production, would bear the burden of the tax. In a general equilibrium framework one should also take into account the changes in prices in other commodity markets. Moreover, the tax incidence may depend on the competitiveness of the markets. When the producers have market power, it is easier for them to shift the burden of the tax to the consumers. In empirical analyses of energy taxation, it is usually assumed that a tax increase is fully passed through to consumers. This may be a fair assumption in the short run, in view of relatively low short-run price elasticities of energy demand (usual estimates vary between -0.2 and -0.3), assuming that the tax reform is implemented unilaterally without an impact on world market oil prices. In the longer run the price elasticity of demand can be assumed to be higher, however, when more substitutes for the taxed products become available (e.g. non-fossil-fuel-based energy). It is also often pointed out that in the

¹ The views expressed in this paper are those of the author and should not be interpreted as those of the European Commission or the Directorate-General for Taxation and Customs Union.

long run the supply of crude oil in the world is inelastic, which would imply that the burden of carbon taxes, at least if they are applied globally, would fall entirely on the owners of oil resources (Stiglitz 1988). A coordinated carbon tax policy in the EU could have a similar impact, since the EU energy demand forms a relatively large share of the world energy demand.

In cases where the tax burden is shared between producers and consumers, the costs to the factors of production should also be taken into account in the tax incidence analysis. Fullerton (2008) points out that these effects could also be regressive, if environmental policy increases the demand for capital and hence the price of capital relative to labor also increases (such as by increasing the demand for capital-intensive abatement technologies). The effects of environmental taxes could, however, also be contrary. By increasing the price of production inputs they could, in fact, also decrease the price of capital. Some computable general equilibrium (CGE) model simulations indicate, for instance, that in a cap-and-trade system a significant portion of the carbon price is shifted back to the owners of natural resources and capital. This makes the policy as a whole more progressive than the effects only on households would imply (Rausch et al. 2011).

Price responsiveness

Empirical evidence regarding the distributional effects of environmental taxation is often based on a static analysis, which does not take into account behavioral changes. However, when the price of a commodity is increased by a tax, the consumers normally reduce their consumption of the commodity, depending on the availability of substitutes. These behavioral effects would as such reduce the burden of the tax. Moreover, there is empirical evidence showing that the price responsiveness would depend on the income of the households, and notably that low-income households would be more responsive to price increases and would reduce their consumption more than would higher-income households.² This would make the incidence of the tax less regressive, as the tax burden of low-income households would be reduced more than that of higher-income households. Smith (1992) shows, however, that the

² The US evidence on the price responsiveness of different income groups is discussed in Tuuli (2009). Bureau (2010) estimates a model of car use using the data on French households and shows that rich households are less

effect of allowing behavioral responses is fairly small and would not eliminate the regressivity of a carbon tax in the UK.

Indirect effects

Most empirical analyses only take into account direct effects, that is, the increase in the costs of the taxed commodity to the consumers. Environmental taxes could also have indirect effects, if they increase the input costs and thus affect the prices of other commodities. Such indirect effects could affect the regressivity of tax policy. The evidence on indirect effects is relatively scarce. Jacobsen et al. (2001) present evidence on both direct and indirect effects of environmental taxes in Denmark. Their results indicate that although the indirect costs of environmentally related taxes to the consumers are much smaller than the direct ones (on average the direct cost is 7 percent of household disposable income and the indirect cost 1.1 percent), they are a higher burden for low-income households and thus increase the regressivity of environmental taxes as a whole.

Income concept

The income concept used in the calculation of distributional impacts has turned out to have a relatively large impact on the regressivity results. Traditionally the households/individuals are classified in ascending order of their disposable annual income in groups of equal size (quartiles, quintiles or deciles, depending on the level of aggregation used in the study). The share of income spent on the taxed good or on taxes paid on the good is then calculated for each income group. If this share increases when moving from a low- to a higher-income group, the tax in question is progressive, and regressive in the reverse case (abstracting from all the issues that additionally may affect the economic tax incidence, as discussed above).

Poterba (1991) was one of the first to point out that it would be more appropriate to use permanent or lifetime income in the calculation than disposable annual income. This is because annual income may be lower or higher in a specific year than expected lifetime income because of transitory shocks or the lifetime variation of income. People tend to smooth their consumption over transitory

sensitive to increases in the cost of driving than poorer households. Blow and Crawford (1997) present similar

shocks and determine their consumption level on the basis of their expected lifetime income.

Therefore Poterba (1991) used total expenditures of the household as a proxy for lifetime income, divided the households into deciles on the basis of their total expenditure and calculated the shares of the taxed good (gasoline) out of total expenditure. He found out that the gasoline tax was far less regressive than could be observed on the basis of disposable income and that the low-income group actually spent a smaller share of their budget on gasoline than middle-income groups, although the top four deciles had lower shares than middle-income ones.

Similar results were obtained later in other studies. Using total expenditure as the basis of calculation instead of disposable income makes environmental taxation often appear less regressive, but does not eliminate the regressivity of taxation for the necessary household goods, such as domestic heating and electricity. Smith (1992) shows, for instance, that in the UK taxes on domestic fuels remain regressive even using expenditure shares, but that regressivity is somewhat reduced at the low end of the income scale. The results of Barker and Köhler (1998) also indicate that even using total expenditure as the income concept, the expenditure on domestic energy relative to total expenditure decreases with the level of expenditure in the 11 EU member states included in their study. On the other hand, Rausch et al. (2011) do not find any significant difference for the distributional impacts of carbon pricing when they use two different proxies for expected lifetime income instead of annual income in their model simulations.

Use of tax revenues

Tax instruments not only provide incentives for sustainable consumption but they also raise revenues. The way governments use the additional tax revenues can have a strong influence on the final distributional outcome of tax reform involving increases in environmental taxation. The governments can either use the revenues for consolidating public finances, in which case the distributional outcome would not be changed compared with the results of static calculations described above, or they can be recycled back into the economy through reductions of other taxes. The double dividend argument implies the governments can shift the tax burden from the environment toward capital and labor and

evidence on UK households.

would thus obtain efficiency gains, which would outweigh the efficiency losses entailed by environmental taxes (since taxes on labor and capital are assumed to be more distortionary than environmental taxes). The double dividend would thus consist of the environmental benefit and the efficiency gain obtained from the tax shift.³ Reductions in labor and capital taxation would not, however, be necessarily beneficial from the equity perspective. If labor taxes are reduced by cutting marginal income tax rates equally for all income brackets, they would benefit high-income households more in absolute terms. Also, cuts in capital taxes are likely to benefit high-income and wealthy households more. In this situation there is a trade-off between equity and efficiency objectives; both cannot be achieved at the same time.⁴

Tax reductions could also be targeted to low-income households through the reduction of tax rates in low-income brackets or through the increase of basic allowances, which would make the tax reform less regressive. The other form of compensation would be lump-sum transfers to all households (revenues distributed on an equal per capita basis), which in most analyses turns out to be the most progressive way of using tax revenues, although it is less efficient. Tax credits, the size of which would decrease with income level, could also neutralize the regressivity of the tax reform.⁵ These results are confirmed by the model simulation of Rausch et al. (2011). They used three different assumptions of distributing auction revenues in a cap-and-trade scheme: (1) the reduction of personal income tax (by equal percentage of household income), (2) the distribution of revenues on an equal per capita basis (lump-sum transfers) and (3) the distribution of revenues in proportion to capital income. The first form of revenue recycling would have the lowest welfare costs in accordance with the double dividend argument, but would be regressive, while lump-sum transfers would have higher welfare costs but would have a progressive impact. The third form would be progressive at the low end of the income scale, but highly regressive thereafter.

³ Whether the double dividend hypothesis holds or not is a controversial issue in economic literature and depends on many assumptions used in the analysis.

⁴ See Smith (1992) for this argument.

⁵ Grainger and Kolstad (2009) make this point. The simulations of Bureau (2010) also demonstrate that the use of tax revenues could have a dramatic impact on the distributive effects of fuel taxation: 'income-based' recycling would be strongly regressive, while recycling revenues in equal amounts to every household or on the basis of household size would be globally progressive.

Empirical evidence of distributional impact

Different categories of environmental taxes

There is now substantial empirical evidence indicating that not all environmental taxes have a similar distributional impact. This applies notably to taxes on domestic heating and electricity, on the one hand, and transport-related taxes, such as on fuels and vehicles, on the other hand. The former are found to be regressive in practically all studies, even using total expenditure as the basis of calculation, while the latter can be either less regressive or progressive depending on the country. This of course has importance for the design of environmental tax reforms, when both environmental benefit and social fairness are pursued.

The earlier evidence on this issue includes Poterba's (1991) aforementioned pioneering study, which shows that that middle-income groups bear a higher burden of gasoline tax in the US than either low- or high-income groups, when total expenditure is used as the basis of calculation. Thus the gasoline tax is progressive at the low end of the income scale and regressive at the high end. Also, Smith's (1992) paper indicates that in six EU member states the budget shares on motor fuels rise steadily from the lowest to the third quartile of household equivalent income, but tend to level out between the third and fourth quartile. The evidence from the UK presented by Johnstone and Alavalapati (1998) points in the same direction: budget shares on transport expenditure rise quite strongly between the first and seventh expenditure deciles, and thereafter level out. The study of Blow and Crawford (1997) shows similarly that in the UK middle-income households would be affected by fuel duty increases more than poorer or richer households. However, if only car-owning households are considered, the impact of fuel taxation would be regressive. On the other hand, the study of Bureau (2010) shows that a carbon tax on car fuels would be regressive in France, even taking into account behavioral responses, before revenue recycling,⁶ but the final distributional impact would depend entirely on the form of revenue recycling.

Evidence from the Nordic countries

⁶ The results are obtained using the consumer surplus measure of tax burden.

The evidence on the regressivity of transport taxes referred to so far indicates that there are some difference among countries, notably that taxes on transport fuels seem to be more regressive in the US than in the EU member countries. In the following this evidence is complemented by an overview of less well-known studies done in the four Nordic countries. This evidence mostly confirms earlier findings on the absence of regressivity of transport-related taxes in the European countries. It should be pointed out that the level of transport and energy taxes is high in Nordic countries, as it is in the EU context. The evidence presented below is based on static calculations and does not take into account behavioral responses or the use of tax revenues.

Finland Evidence regarding the distributional effect of transport fuel taxes in Finland can be found in Tuuli (2009). He uses microdata on household consumption expenditure from the years 1985–2006. The households are divided into ten deciles on the basis of their total expenditure, and the expenditure shares of spending on motor fuels are calculated. The results show a pattern very similar to that in the UK as reported in Johnstone and Alavalapati (1998): the budget shares increase up to the sixth or eighth deciles, depending on the year, and then level out, with the top decile having a somewhat smaller share than middle-income deciles. This is very much due to the fact that the share of car-owning households increases strongly with expenditure level. Among the car-owning households the budget shares spent on transport fuel are relatively equal.⁷ The conclusion of the study is that taxes on transport fuels are not regressive in Finland and do not disproportionately burden low-income households. However, taxes on transport fuels would have regionally unequal impact in that they would put a higher burden on households in rural areas compared with those in urban areas.

Sweden Ahola et al. (2009) provide similar evidence from Sweden using household expenditure survey data from the years 2004–2006. The burden of transport fuel taxes is a higher in low-income deciles than in high-income deciles, when the disposable income is used as a denominator. However, using total expenditure the tax burden would increase from the lowest up to

⁷ This is different from the findings of Blow and Crawford (1997), according to which in the UK transport-related taxes would be strongly regressive among car-owning households.

the eighth decile and slightly decrease thereafter, a pattern very similar to the one found in Finland. Including indirect effects of taxes in the calculation does not change the result. In light of this evidence transport taxes would not be regressive in Sweden either.

Norway The paper by Aasness and Larsen (2003) applies a different methodology than the studies on Finland and Sweden. It calculates so-called Engel elasticities for several different transport modes, using consumer expenditure data from Norway (from the years 1986–1994). Engel elasticity is the percentage change in spending on a good when total expenditure increases by 1 percent. Low elasticities would imply that the good in question is a necessity and that the tax on it would be regressive. High elasticities imply that the incidence would be progressive. Aasness and Larsen find a relatively high Engel elasticity (1.21) for travel and transportation as a whole, which suggests that it is a luxury good. They then calculate Engel elasticities for different types of transport goods and find out that air flights, taxi rides, automobile purchases and road tolls have high Engel elasticities and thus taxing these goods would be progressive. In contrast, bus rides, mopeds and bicycles have very low Engel elasticities, as could be expected. Gasoline has also a relatively low Engel elasticity (0.70), implying that in Norway the gasoline tax would be regressive. This result is clearly different from those obtained in other Nordic countries. It is difficult to judge whether this is due to the different methodology applied, or to truly different consumption patterns in Norway.

Denmark The study by Jacobsen et al. (2001) is very detailed and covers all forms of environmentally related taxes in Denmark. They calculate the shares of taxes paid in relation to household disposable income (adjusted for household size) and in relation to total expenditure, and divide the households into ten deciles on the basis of disposable income. The data is collected from different sources, with most expenditure data taken from 1997. Both the direct and indirect effects of taxes are included in the study.

The results show that all environmentally related taxes in Denmark are mildly regressive, when the tax burden is calculated as a share of household disposable income. There are, however, strong differences among different types of taxes. Transport-related taxes (including both fuel taxes

and vehicle taxes) are strongly progressive, increasing from the lowest income decile to the ninth decile, while energy taxes and pollution taxes (which also include the CO₂ tax) are regressive, energy taxes somewhat more so than pollution taxes. Inside the group of transport-related taxes, registration taxes and fuel taxes are nearly equally progressive. The progressivity of transport-related taxes in Denmark seems, in fact, somewhat stronger than in Sweden or Finland. When total expenditure instead of disposable income is used as the basis of calculation, the regressivity of energy and pollution taxes nearly disappears, while the progressivity of transport-related taxes grows even stronger. . The strong progressivity of transport taxes in relation to the other Nordic countries could be explained by the fact that car registration taxes are very high in Denmark (180 percent of the car price), which makes the car expensive and perhaps more a luxury good than in other countries.

Distributional effects of energy taxation in the EU

Introduction

This section presents empirical evidence on the distributional impact of energy taxation included in the impact assessment for the European Commission's potential revision of the EU Energy Tax Directive (ETD).⁸ Cambridge Econometrics carried out a study for the European Commission in 2008, in which the impacts of several different policy options for the revision of the ETD were estimated. The E3ME model used in the study provided estimates on the impacts of policies on macroeconomic development, energy demand and CO₂ emissions. In addition, distributional effects on households were included in the study.

Policy scenarios were formed on the basis of policy options, which present several alternatives for the revision of the structure of the EU minimum tax rates on energy products. In the following the results of only the three most relevant policy options are reported. All of these policy options would

⁸ The full impact assessment can be found online at

http://ec.europa.eu/taxation_customs/resources/documents/taxation/sec_2011_409_impact_assesment_part1_en.pdf.

introduce a CO₂ element to the EU energy tax framework. Options 3A and 3B would introduce a CO₂ component to the new minimum tax rates in addition to the energy component, while option 4 would set a uniform EU-wide CO₂ tax on top of the existing national tax rates. The rates are as follows:

- *Option 3A*: Energy component 0.15€/Gj for business use; 0.30€/GJ for non-business use; CO₂ component 20€/tCO₂ for 2013–2020 and 30€/tCO₂ from 2021; transport fuels 380€/1000l for both petrol and diesel (commercial diesel proposal).
- *Option 3B*: 0.15€/GJ for business use, 0.3€/GJ for non-business use; CO₂ component 10€/tCO₂ for 2013–2019, 20€/tCO₂ from 2020; transport fuels as in 3A. This option also includes transitional periods until 2020 for nine member states (BG, CZ, EE, HU, LV, LT, SK, RO, PL) to introduce the CO₂-based tax. In the model simulations it is assumed that these countries are exempted from carbon tax.
- *Option 4*: CO₂ tax 22€/tCO₂ for 2013–2020, 30€/tCO₂ from 2021.
- CO₂ tax is not levied on electricity in any of the scenarios.⁹

Policy scenarios also include other assumptions that are needed for modeling purposes but are not necessarily part of the policy options. The most important one concerns the use of tax revenues. It is assumed in all the scenarios (except one) that additional tax revenues are recycled in the form of reductions in the employers' social security contributions. This assumption turns out to have a relatively large impact on the results, including also distributional effects. To detect the effect of this assumption a scenario 3Blps was also simulated, in which revenue recycling takes the form of lump-sum transfers to households instead of the reduction of social security contributions, but is otherwise identical to the scenario 3B.

Another assumption of importance included in all the policy scenarios is that minimum tax rates remain constant in real terms over the period projected, implying that they are indexed to inflation.¹⁰ The baseline scenario assumes, on the other hand, that current national tax rates stay constant in nominal terms during the projected period. Hence the difference between the tax rates in the baseline and policy scenarios grows over time and minimum rates become more and more binding on the member states.

Both the baseline scenario and policy scenario assume that the EU greenhouse gas emissions trading scheme is in place and that the price of allowances is determined endogenously on the basis of the demand for allowances and the number of allowances available. The baseline is calibrated to be consistent with the projections presented in the DG TREN publication *European Energy and Transport: Trends to 2030—Updated 2007*.

Impact on consumer prices

Since options 3A and 3B would affect only EU minimum rates, their impact on households depends on the extent to which they would increase national tax rates and thus consumer prices in the member states. Annex 12 of the impact assessment report presents calculations on the impact of policy options on the prices of energy products (assuming full pass-through). On the basis of these calculations the most important impact for non-business use would be on the price of natural gas, which would increase under option 3A in 21 member states and under option 3B in 11 member states, in some of them by substantial amounts (the price increases would range from 1 percent in Sweden to 87.5 percent in Bulgaria). Natural gas is the most commonly used heating fuel in the EU: it represents 36.7 percent of final non-business energy consumption in EU-27 (Annex 8). The next-most-commonly used heating oil for the households sector is gas oil (16 percent of the final energy consumption in EU-27). Under option 3A, 10 member states would experience some increase in consumer prices, but less

⁹ It should be noted that the option retained in the policy proposal is not precisely any of these, but a combination of options 3A and 3B, with a new structure added for the tax rates on transport fuels (energy component of 9.6€/GJ to be reached gradually by 2018, plus a CO₂ component of 20€/tCO₂).

¹⁰ This aspect was also retained in the final proposal.

than in the case of natural gas (from 0.04 percent in Poland to 8 percent in Lithuania). There would also be very substantial increases in the price of coal in nearly all the member states (23 member states under option 3A and 12 member states under option 3B, with the price increase exceeding 100 percent in 10 member states) due to its high CO₂ content and the low level of current national tax rates. The importance of coal as a heating fuel is small, only 2.3 percent in the EU as a whole, but it is more important in a few member states, such as Bulgaria, Ireland and Poland.

The price of electricity would not be affected under options 3A, 3B or 4.

The impact of policy options on the prices of transport fuels are not reported, but Annex 9 provides information on the impact of policy options on national tax rates on transport fuels. According to this information those rates would be increased in 15 member states under the commercial diesel proposal, which underlies the E3ME model simulations. (The number of member states affected by the new minima on diesel would be slightly higher, around 17, under the retained option in the proposal.) The national tax rate on petrol would be increased in only three member states.

It should be noted, however, that these numbers represent only immediate effects. In model simulations far more member states would be affected by the end of the projected periods (2020 and 2030), as the scenarios assume that the minima are indexed to inflation, while this is not the case in the baseline. On the other hand, no behavioral responses are taken into account in these calculations.

Distributional effects on households

Table 1 shows the impact of a 10 percent increase in gas and electricity prices on real household disposable income in EU-27 (percent change). In the first part the impact is given for five income quintiles and in the second part for occupational and geographical groups. It should be noted that the tables do not represent any of the policy options and are presented for the sake of comparison. They are based on a simple calculation, in which neither the use of tax revenues nor behavioral responses are taken into account.

Table 1A: Changes in real household incomes (percent) from a 10 percent increase in electricity and gas prices for five income quintiles, EU-27

All households	1st quintile	2nd quintile	3rd quintile	4th quintile	5th quintile
-0.54	-0.69	-0.65	-0.59	-0.53	-0.43

Source: Cambridge Econometrics (2008), reproduced in European Commission (2011).

Table 1B: Changes in real household incomes (percent) from a 10 percent increase in electricity and gas prices for socioeconomic groups, EU-27

Manual workers	Non-manual workers	Self-employed	Unemployed	Retired	Inactive	Densely populated area	Sparsely populated area
-0.53	-0.44	-0.51	-0.59	-0.67	-0.59	-0.51	-0.56

Source: Cambridge Econometrics (2008), reproduced in European Commission (2011).

This evidence corresponds to the findings of many other static analyses. Low-income households would lose a bigger share of their income than high-income households, when the price of domestic energy is increased and when the use of tax revenues is not taken into account. In this sense the taxes on domestic energy are regressive. Table 1B reveals also that unemployed, retired and inactive households would be more affected than the active population, and that households living in rural areas would be slightly more affected than the urban population.

The distributional impacts of policy options 3A, 3B and 4 are shown in Table 2. These results are the outcome of the simulation of the policy scenarios described above and hence also include an assumption of the use of tax revenues, which is the reduction of the employers' social security contributions in all the scenarios except 3B1ps, in which lump-sum transfers to households is assumed instead. Option 4bis is otherwise the same as option 4, but it excludes transport fuels.

Table 2: Change in real household incomes (percent) in 2030 in comparison with the baseline, EU-27 weighted averages

	Option 3A	Option 3B	Option 3Bfsp	Option 4	Option 4bis
All households	0.11	0.09	-0.05	0.41	0.12
1st quintile	0.10	0.09	-0.01	0.39	-0.23
2nd quintile	0.10	0.09	-0.04	0.36	-0.16
3rd quintile	0.10	0.09	-0.05	0.36	-0.01
4th quintile	0.11	0.09	-0.05	0.39	0.18
5th quintile	0.13	0.09	-0.06	0.49	0.47
Manual workers	0.11	0.09	-0.06	0.39	0.21
Non-manual workers	0.13	0.09	-0.06	0.46	0.39
Self-employed	0.11	0.09	-0.06	0.42	0.22
Unemployment	0.10	0.09	0.03	0.40	-0.05
Retired	0.09	0.09	0.02	0.37	-0.24
Inactive	0.13	0.11	0.03	0.43	-0.07
Densely populated area	0.12	0.10	-0.05	0.47	0.21
Sparsely populated area	0.08	0.07	-0.05	0.31	0.02

Source: Cambridge Econometrics (2008), reproduced in European Commission (2011).

The table gives rise to several observations. First, household real disposable income would increase in all income quintiles and socioeconomic groups under policy options 3A, 3B, and 4 compared with the baseline. This is largely due to the revenue recycling assumption underlying the three scenarios. The reduction of the employers' social security contributions would decrease labor costs, and in the E3ME model this would have the effect of boosting employment and decreasing domestic prices, which in turn would have a positive impact on real income, consumption and economic activity in general.

Secondly, the beneficial impact is fairly equally distributed across income quintiles and socioeconomic groups and thus the policy package as a whole is distributionally neutral. The regressivity that can be observed in Table 1 disappears. In scenarios 3A and 4 one can, however, observe slight regressivity in the sense that the highest-income quintile would benefit somewhat more than the other quintiles.

Thirdly, the impact of revenue recycling can be seen by comparing options 3B and 3Blps. Lump-sum transfers would make this scenario highly progressive, as the low-income groups would benefit the most, but at the same time would also be economically less efficient, as all the households would lose somewhat compared with the baseline scenario. One can also observe that socioeconomic groups usually considered to be the most vulnerable (retired, unemployed and inactive) would be the greatest beneficiaries of this policy.

A comparison of options 4 and 4bis reveals the importance of taxes on transport fuels for distributional outcome. Excluding transport fuels from option 4 makes the policy highly regressive, even taking into account the favorable effects of revenue recycling: the lowest quintiles would lose and the higher quintiles and the socioeconomic groups representing non-manual workers and the self-employed would reap the gain. The results imply that taxes on transport fuels alone are, at the EU average level, sufficiently progressive to counteract the regressivity of other types of energy taxes. These results are very much in accordance with the evidence found earlier in the other European studies.

Differences among the member states

Tables 1 and 2 show distributional effects only at the EU average level, and could hide substantial differences among individual countries. The same information as in Table 2 is contained in Annex 18 of the impact assessment report for each member state separately, except that the latter projects up to 2020 instead of 2030.

An inspection of this information reveals that options 3A and 3B would be distributionally fairly neutral in most member states with the exception of UK, Ireland, Hungary, Luxembourg and Romania, where slight regressivity can be observed. This corresponds to the findings of Barker and Köhler (1998), who also found that energy taxation tends to be more regressive in the UK and Ireland compared with other European countries. Concerning Ireland and UK it should be noted that the exemptions from taxes on domestic energy accorded to the household sector in these two countries are not taken into account in the baseline or in the policy scenarios, so there is an impact of higher prices on domestic fuels.

The progressivity of option 3B and thus the inequality-reducing effect of lump-sum transfers are confirmed in practically all countries.

With respect to options 4 and 4bis there is somewhat more variation. Option 4 would be slightly regressive in a number of countries (AU, BE, DE, EE, FR, HU, IT, LU, RO) but would be progressive in a number of other countries (CZ, DK, FI, LT, LV, NL, PL, PT, SE), while in the remaining countries it would be neutral or somewhat nonlinear. Excluding transport fuels from this scenario would make the policy option more regressive in all cases, that is, it would change from progressive to neutral or regressive or from regressive to more regressive, which is in accordance with the evidence on the progressivity of transport taxes in the EU as a whole.

Conclusions

It is often believed that ecological tax reforms are as a whole regressive, which would imply that their costs are disproportionately borne by low-income households. For this reason political resistance to such reforms is strong in many countries. The evidence presented in this chapter shows that this conclusion should be qualified in a number of ways.

First, the distributional outcome of the reform depends on the combination of tax bases on which the reform is applied. Taxes on electricity and heating tend to be regressive in most countries, while taxes on transport fuel and vehicles are not necessarily so. In fact, they seem to be sufficiently progressive in most European countries that they offset the regressivity of other energy taxes. Hence, the tax reforms which relied on both energy and transport taxation could be distributionally neutral in European conditions.

Secondly, the final distributional impact of the reforms also depends crucially on how the tax revenues are used. Cutting labor or capital tax rates without targeting low-income households, although economically efficient, would not make the tax reform more progressive, but could have an opposite impact. On the other hand, 3EME modeling results suggest that both economic efficiency and a distributionally neutral tax reform can be achieved, if tax revenues are recycled in the form of cuts in the employers' social security contributions. This is because in the model context such cuts would considerably boost employment and private consumption. It should be kept in mind, however, that the

distributionally neutral outcome is achieved in this case also only if transport-related taxes are included in the reform.

Targeting income tax cuts to low-income households or using the tax revenues to finance lump-sum transfers are effective ways to ensure the distributionally fair outcome of the reform, although economically they are not as efficient as the other forms of revenue recycling.

Thirdly, the evidence indicates that with respect to regressivity there are considerable differences among countries. The US studies imply that in the US ecological tax reform would be regressive also if they include transport-related taxes, and thus energy taxation as a whole is more regressive in the US than in the European countries. There are also differences among the European countries. The results of Smith (1992) and Barker and Koehler (1998) indicate that energy taxation tends to be more regressive in the UK and Ireland compared with other European countries (Smith [1992] only compares the UK and Ireland to Southern European countries). The results of the Cambridge Econometrics study, which includes all EU-27 member states, points in the same direction. The evidence from the Nordic countries also implies that ecological tax reforms would be only mildly regressive or not regressive at all in these countries, if transport taxes are included.

There is no obvious single explanation for these differences. One factor that could play a role is pointed out in the Copenhagen Economics study of 2007. The study showed that the difference in food consumption shares between poor and rich households is greater in the countries with higher income inequality (measured by the Gini coefficient) than in the countries with lower income inequality. The countries with low income inequality and a small difference in food consumption shares include in this comparison Continental European and Nordic countries, while the countries with higher income inequality and a greater difference in food consumption shares include the UK, Portugal, Greece, Italy and Spain.

It could be assumed that this applies also to domestic energy, which is a similarly necessary good as food. If this were the case, the high equality of initial income distribution would make the tax reforms relying on energy taxes less regressive and could be one of the factors explaining the observed differences with respect to the regressivity of energy taxes among the US, the UK and other European countries. (But this could not explain the differences observed by Smith [1992] among the UK, Ireland

and Southern European countries, since all these countries have higher income inequality than Continental European or Nordic countries.) If such a negative correlation between income equality and the regressivity of an ecological tax reform indeed existed, which at this stage can only be considered a working hypothesis, then the policy implication would be that progressive income taxation would be a good way to counteract the regressivity of indirect taxes levied on goods such as food and domestic energy.

Concerning the observed cross-country differences in the regressivity of transport fuel taxes, there are again several possible explanations. One of them could be the difference in the quality of public transport. The supply of good-quality public transport could make a private car more a luxury good, the use of which would increase strongly with income level. Also the high level of vehicle taxes, exemplified by Denmark, could have a similar impact. As a whole, the cross-country comparison of evidence on the regressivity of energy and transport taxation reveals some interesting patterns and could have potentially important policy implications. These observations are, however, preliminary and it would require much more empirical research to draw any firm conclusions in this regard.

References

Aasness, J. and E.R. Larsen (2003), 'Distributional effects of environmental taxes on transportation', *Journal of Consumer Policy*, **26**, 297–300.

Ahola, H., E. Carlsson and T. Sterner (2009), 'Är bensinskatten regressiv?' (Is the gasoline tax regressive?), *Ekonomisk Debatt no. 2, 2009*, pp. 71- 77.

Barker, T. and J. Köhler (1998), 'Equity and ecotax reform in the EU: achieving a 10 per cent reduction CO2 emissions using excise duties', *Fiscal Studies (1998) vol. 19, no. 4*, pp. 375-402.

Blow, L. and I. Crawford (1997), '*The Distributional Effects of taxes on Private Motoring*', London, UK: The Institute of Fiscal Studies.

Bureau, B. (2010), 'Distributional effects of a carbon tax on car fuels in France', CERNA Working Paper 2010-19.

Cambridge Econometrics (2008), 'Review of the Energy Taxation Directive: final modeling results'. A report for DG TAXUD, European Commission.

Copenhagen Economics (2007), 'Study on reduced VAT applied to goods and services in the Member States of the European Union'. Final report to the European Commission.

European Commission (2011): Impact assessment SEC (2011) 409. Accompanying document to the proposal for a Council Directive amending Directive 2003/96/EC restructuring the Community framework for the taxation of energy products and electricity.

Fullerton, D. (2008), 'Distributional effects of environmental and energy policy. An introduction', NBER Working Paper 14241.

Fullerton (2010), 'Six distributional effects of environmental policy', CESifo Working paper 3299.

Fullerton, D. and G.E. Metcalf (2002), 'Tax incidence', in *Handbook of Public Economics*, volume 4. Edited by A.J. Auerbach and M. Feldstein. Elsevier Science B.V.

Grainger, C.A. and C. D. Kolstad (2009), 'Who pays a price on carbon?', NBER Working Paper 15239.

Jacobsen, H.K., K. Birr-Pedersen and M. Wier (2001), 'Fordelningsvirkninger af energi- og miljøafgifter', (Distributional effects of energy and environmental taxes), Risø National Laboratory, Roskilde.

Johnstone, N. and J. Alavalapati (1998), 'The distributional effects of environmental tax reform', International Institute for Environment and Development, Discussion Paper 98-01.

Metcalf, G.E., A. Mathur and K.A. Hassett (2010), 'Distributional impacts of comprehensive climate policy package', NBER Working Paper 16101.

Poterba, J.M. (1990), 'Is the gasoline tax regressive?', NBER Working Paper 3578.

Smith (1992), 'The distributional consequences of taxes on energy and the carbon content of fuels', *European Economy*, **51.**, pp. 241- 267.

Stiglitz, J.E. (1998, 2nd ed.), *Economics of the Public Sector*. W.W.Norton & Company Inc. W.W. Norton & Company. New York, London.

Rausch, S., G.E. Metcalf and J.M. Reilly (2011), 'Distributional impacts of carbon pricing: a general equilibrium approach with micro-data for households', NBER Working Paper 17087.

J. Tuuli (2009), 'Polttoaineverojen ja muiden ympäristöverojen tulonjakovaikutukset'. (Distributional effects of fuel and other environmental taxes), VATT muistiot, Valtion taloudellinen tutkimuskeskus. Helsinki 2009. (VATT memorandum, Government Institute for Economic Research), Helsinki, Finland.

TAXATION PAPERS

Taxation Papers can be accessed and downloaded free of charge at the following address:
http://ec.europa.eu/taxation_customs/taxation/gen_info/economic_analysis/tax_papers/index_en.htm

The following papers have been issued.

Taxation Paper No 32 (2012): Regressivity of environmental taxation: myth or reality? Written by Katri Kosonen

Taxation Paper No 31 (2012): Review of Current Practices for Taxation of Financial Instruments, Profits and Remuneration of the Financial Sector. Written by PWC

Taxation Paper No 30 (2012): Tax Elasticities of Financial Instruments, Profits and Remuneration. Written by Copenhagen Economics.

Taxation Paper No 29 (2011): Quality of Taxation and the Crisis: Tax shifts from a growth perspective. Written by Doris Prammer.

Taxation Paper No 28 (2011): Tax reforms in EU Member States. Written by European Commission

Taxation Paper No 27 (2011): The Role of Housing Tax Provisions in the 2008 Financial Crisis. Written by Thomas Hemmelgarn, Gaetan Nicodeme, and Ernesto Zangari

Taxation Paper No 26 (2010): Financing Bologna Students' Mobility. Written by Marcel Gérard.

Taxation Paper No 25 (2010): Financial Sector Taxation. Written by European Commission.

Taxation Paper No 24 (2010): Tax Policy after the Crisis – Monitoring Tax Revenues and Tax Reforms in EU Member States – 2010 Report. Written by European Commission.

Taxation Paper No 23 (2010): Innovative Financing at a Global Level. Written by European Commission.

Taxation Paper No 22 (2010): Company Car Taxation. Written by Copenhagen Economics.

Taxation Paper No 21 (2010): Taxation and the Quality of Institutions: Asymmetric Effects on FDI. Written by Serena Fatica.

Taxation Paper No 20 (2010): The 2008 Financial Crisis and Taxation Policy. Written by Thomas Hemmelgarn and Gaëtan Nicodème.

Taxation Paper No 19 (2009): The role of fiscal instruments in environmental policy.' Written by Katri Kosonen and Gaëtan Nicodème.

Taxation Paper No 18 (2009): Tax Co-ordination in Europe: Assessing the First Years of the EU-Savings Taxation Directive. Written by Thomas Hemmelgarn and Gaëtan Nicodème.

Taxation Paper No 17 (2009): Alternative Systems of Business Tax in Europe: An applied analysis of ACE and CBIT Reforms. Written by Ruud A. de Mooij and Michael P. Devereux.

Taxation Paper No 16 (2009): International Taxation and multinational firm location decisions. Written by Salvador Barrios, Harry Huizinga, Luc Laeven and Gaëtan Nicodème.

Taxation Paper No 15 (2009): Corporate income tax and economic distortions. Written by Gaëtan Nicodème.

Taxation Paper No 14 (2009): Corporate tax rates in an enlarged European Union. Written by Christina Elschner and Werner Vanborren.

Taxation Paper No 13 (2008): Study on reduced VAT applied to goods and services in the Member States of the European Union. Final report written by Copenhagen Economics.

Taxation Paper No 12 (2008): The corporate income tax rate-revenue paradox: evidence in the EU. Written by Joanna Piotrowska and Werner Vanborren.

Taxation Paper No 11 (2007): Corporate tax policy and incorporation in the EU. Written by Ruud A. de Mooij and Gaëtan Nicodème.

Taxation Paper No 10 (2007): A history of the 'Tax Package': The principles and issues underlying the Community approach. Written by Philippe Cattoir.

Taxation Paper No 9 (2006): The Delineation and Apportionment of an EU Consolidated Tax Base for Multi-jurisdictional Corporate Income Taxation: a Review of Issues and Options. Written by Ana Agúndez-García.

Taxation Paper No 8 (2005): Formulary Apportionment and Group Taxation in the European Union: Insights from the United States and Canada. Written by Joann Martens Weiner.

Taxation Paper No 7 (2005): Measuring the effective levels of company taxation in the new member States : A quantitative analysis. Written by Martin Finkenzeller and Christoph Spengel.

Taxation Paper No 6 (2005): Corporate income tax and the taxation of income from capital. Some evidence from the past reforms and the present debate on corporate income taxation in Belgium. Written by Christian Valenduc.

Taxation Paper No 5 (2005): An implicit tax rate for non-financial corporations: Definition and comparison with other tax indicators. Written by Claudius Schmidt-Faber.

Taxation Paper No 4 (2005): Examination of the macroeconomic implicit tax rate on labour derived by the European Commission. Written by Peter Heijmans and Paolo Acciari.

Taxation Paper No 3 (2005): European Commission Staff Working Paper.

Taxation Paper No 2 (2004): VAT indicators. Written by Alexandre Mathis.

Taxation Paper No 1 (2004): Tax-based EU own resources: an assessment. Written by Philippe Cattoir.

European Commission

Taxation papers – Regressivity of environmental taxation: myth or reality?

Luxembourg: Publications Office of the European Union

2012 — 21 pp. — 21 x 29.7 cm

ISBN 978-92-79-25026-2

DOI: 10.2778/30289

HOW TO OBTAIN EU PUBLICATIONS

Free publications:

- via EU Bookshop (<http://bookshop.europa.eu>);
- at the European Commission's representations or delegations. You can obtain their contact details on the Internet (<http://ec.europa.eu>) or by sending a fax to +352 2929-42758.

Priced publications:

- via EU Bookshop (<http://bookshop.europa.eu>).

Priced subscriptions (e.g. annual series of the *Official Journal of the European Union* and reports of cases before the Court of Justice of the European Union):

- via one of the sales agents of the Publications Office of the European Union (http://publications.europa.eu/others/agents/index_en.htm).



Publications Office

ISBN 978-92-79-25026-2



9 789279 250262