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Klinge Jacobsen, Henrik and Wier, Mette

Risoe National Laboratory

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Environmental taxation and distributional implications in Denmark

Henrik Klinge Jacobsen & Mette Wier***

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Abstract

Environmental taxes imposed on households have been introduced in many countries. However, few countries have reached the level of environmental taxation as is seen in Denmark today although many are considering shifting the tax burden towards the consumption that are harming the environment.

*The total tax burden imposed on households in Denmark through taxes on energy use of all kinds, use of water and waste production etc. is of a considerable size. This paper explore the combined size of all these taxes and duties that are **now** justified by environmental concern. The size of taxes on heating, transport fuels, electricity, water, waste, plastic bags, registration of cars, annual car use, pesticides etc. are analysed.*

The distribution of taxes on different household categories is discussed and the fairness of this distribution in relation to the environmental pressure that each household category is responsible for is questioned. The shifting of tax structure from high marginal income tax to consumption based taxes especially environmental taxes might have distributional impacts among different income groups which have not been considered part of the tax policy.

Also the different impact from various taxes are analysed. Are the different taxes characterised by varying distributional properties? The hypothesis could be that some environmental taxes are less regressive than others are. Preliminary results suggest that tax on gasoline and especially registration levies for cars are less regressive than taxes on electricity and water. The paper discuss the extent to which the present composition of environmental taxes are biased towards basic goods as heating, electricity and water instead of consumption of other goods that are using resources and polluting the environment just as much?

The distributional impacts are illustrated using household consumption survey data and data covering household expenditures on energy. The size of energy taxes and the more recently introduced green taxes are compared. Also the composition of taxes as paid directly by consumers or indirectly through their purchase of domestically produced goods are discussed.

Finally the paper argues that distributional issues should be considered also when designing environmental tax policies.

INTRODUCTION

Environmental concern has contributed to a widespread use of environmental taxation in many countries. Ekins (1999) surveys the environmental taxes and charges implemented in Europe. The size of revenues from these taxes is still relatively small but they are rising as a proportion of total taxation. This increase in environmental taxation has raised some concern over the distributional impacts of such taxes. OECD (1994, 1995) examine distributional effects of environmental policy in a broad context including both theoretical results as well

* Risø National Laboratory, Box 49, 4000 Roskilde, Denmark, E-mail: henrik.jacobsen@risoe.dk

** Institute of Local Government Studies, Denmark, E-mail: mw@akf.dk

as empirical findings on distributional effects caused both by the taxation and a reduction of environmental pressure. Bovenberg (1998, 1999) and Bovenberg & van der Ploeg (1998) examine environmental tax reform and its consequences for employment and welfare in a theoretical context. These papers point to the difficulty of achieving both efficiency and distributional objectives by an environmental tax reform. Pirttila and Tuomala (1997) analyse the same problem in analytic models with two types of households: low-ability and high-ability households, which however have identical preferences. The environmental tax can in specific cases serve as an indirect tax on leisure, of which high-ability households consume more, in this theoretical context and thereby the environmental tax could be neutral or even progressive.

Empirical findings¹ for Europe by Pearson and Smith (1991) suggest that carbon taxes tend to be regressive in Northern European countries and less so in Southern European countries. Poterba (1991a) among other issues compare the actual income measure with a lifetime income measure. The findings suggest that using lifetime income measures for distributional analyses produce less regressive tax results than using current income. Especially for low-income households the choice of income measure is important because many households with a current low income are students or pensioners with higher lifetime income.² Poterba (1991b) specifically analyse a gasoline tax in the US that is found to be much less regressive if using lifetime income. Taxes related to motor vehicles are found to be neutral (Smith, 1995) in Europe whereas there is evidence that gasoline taxes in the US can have regressive effects, especially if considered in rural areas. Walls and Hanson (1999) compare four different taxes on private vehicle use in California. They find, also based on a lifetime income proxy, that annual vehicle value taxes are mildly regressive, but using more pollution dependent taxation will increase the regressivity.

Most empirical analyses examine distributional effects through their direct impact on household tax payments. A number of studies examine also the indirect effect via household consumption of goods that have been levied with environmental taxes in their production³. The general finding of these studies is that environmental (carbon) taxes are regressive.

This paper addresses the issue from an empirical angle examining the size and composition of Danish environmental taxation and the distributional effect of increased use of environmental taxes in Denmark. The distributional data are based on household expenditure surveys and thereby on actual tax payments.

THE SIZE OF ENVIRONMENTAL TAXATION IN DENMARK

The size of environmental taxation in Denmark has been gradually increased in recent years. Green tax reforms initiated in 1993/1994 introduced new environmental taxes and increased existing taxes on energy. Table 1 shows the composition of the new “green” environmental taxes and other environmentally related taxes.

¹ Speck (1999) includes a survey of empirical results on distributional implications of carbon and energy taxes including most of those referred to in this paper.

² Contrary to this Smith (1992) conclude that the choice between current and lifetime income has only modest influence on the result of distributional consequences from energy and carbon taxes in the UK.

³ Symons et. al (1994) use an input-output approach for a study of carbon taxes in the UK and in Symons et. al. (1997) the analysis is extended to cover a number of European countries. Input-output based studies have also been carried out for Australia (Cornwell and Creedy, 1996 and 1998), for Canada (Hamilton and Cameron, 1994) and Spain (Labandeira and Labega, 1999).

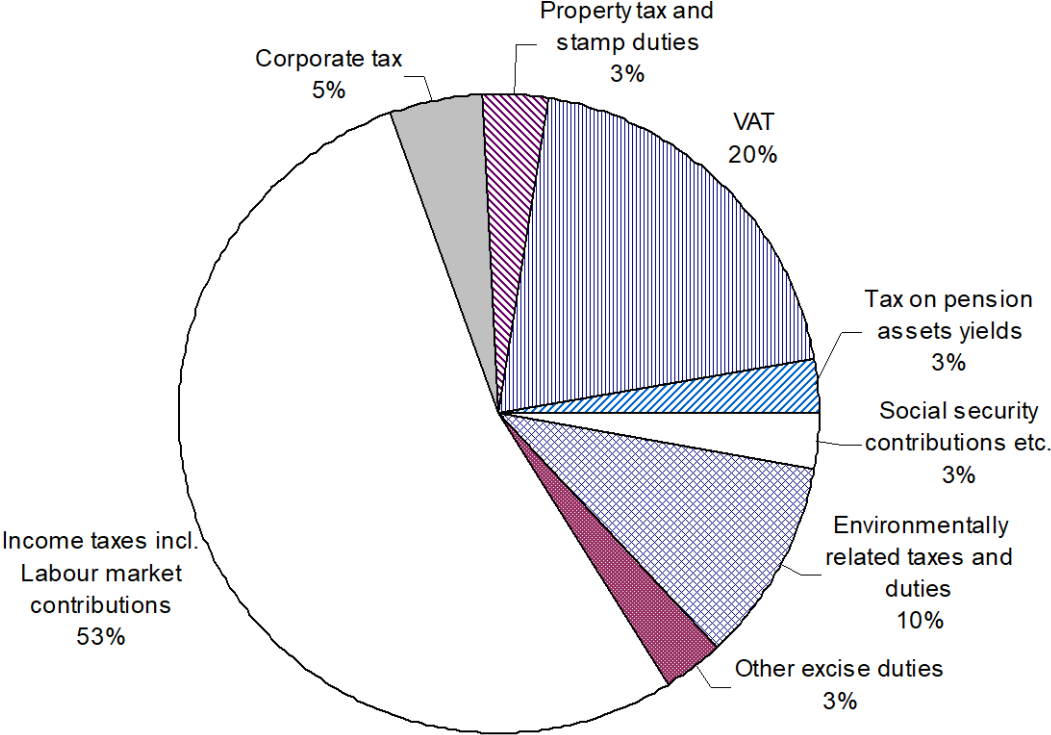
Table 1 Governmental revenues from energy and environmental taxation (mill. DKK)

Type of duty	1995	1996	1997	1998	1999*	2000*
CO ₂	3280	3776	3991	4140	4624	4649
Sulphur	0	334	377	375	575	575
Extraction of raw materials	135	135	145	157	159	159
Waste	619	601	867	889	1149	1049
CFC	0	0	0	0	1	1
Insecticides, herbicides, etc.	28	208	240	298	355	375
Disposable tableware	58	57	53	56	55	60
Carrier bags, retail containers etc.	479	520	547	808	949	749
Piped water	733	1064	1334	1544	1625	1600
Nickel/cadmium batteries	10	41	37	29	35	25
Chlorinated solvents	0	5	3	2	3	2
Effluent charges	0	0	164	273	275	300
Specific growth stimulants	0	0	0	16	45	25
Nitrogen	0	0	0	8	25	40
PVC and phthalates	0	0	0	0	0	160
Environmental duties total	5342	6741	7758	8595	9875	9769
Electricity	4444	5111	5542	6979	6900	7850
Coal	631	671	705	787	1500	1600
Gas	51	55	69	0	0	0
Natural gas	0	18	13	122	1200	2800
Certain petroleum products	5785	6230	5832	6242	6025	6700
Petrol	7479	8250	8606	8834	9600	10000
Duty on energy products	18390	20335	20767	22964	25225	28950
Energy and environmental duties	23732	27076	28525	31559	35100	38719
Weight duty	4404	4918	5172	5441	6200	6450
Registration duty	14967	15363	16366	18288	17400	17600
Duty on third party liability insurance	944	1068	1336	1339	1400	1500
Motor vehicle duties total	20315	21349	22874	25068	25000	25550
Flight passenger duty	231	259	279	442	430	475
Electric bulbs, fuses, etc.	166	155	157	168	170	175
Total environmentally related taxes and duties	44444	48839	51835	57237	60530	64744

There are a large number of environmental taxes included in table 1 that are potentially influencing the size of consumption or emissions. However, only a few of these have originally been introduced for environmental purposes. The majority of these are fiscal duties and others were introduced as "luxury" taxes. The "new" environmental taxes constitute only 9.8 bill. DKK corresponding to 15% of the taxes characterised as environmentally related. Around 45% of the environmental taxes are duties imposed directly on the use of energy products and an additional 8% are imposed on the emissions from energy use. The motor vehicle duties constitute another major group of taxes affecting the environment by reducing the private vehicle transport demand (vehicle ownership).

* Figures according to Fiscal Budget (FL 2000)

The environmental taxes are imposed on both households and business, but business has been exempted in a number of occasions especially from the major taxes. This has been argued by concern for international competitiveness of Danish producing sectors.



Source: Fiscal Budget 2000, Ministry of Finance

Figure 1 Taxes and duties from different sources in Denmark 1999

The environmentally related taxes have grown in importance for total tax revenues in recent years. In 1999 environmental taxes constitute 10.4% of the taxed included in the above figure relative to 9% of the taxes in 1995 and 7% in 1990. In the long term the revenue share of environmentally related taxes have only increased from 7.7% in 1980 to 10.4% in 1999⁴ with the increase occurring in the last part of the nineties as evident from the low 1993 share in Figure 2. Of the environmental taxes the “new” environmental taxes have been rising the most corresponding to 1.1% in 1995 and 1.7% of taxes in 1999. However, these new green taxes are still of limited revenue importance compared to the traditional energy taxes and private vehicle taxation. Environmental taxes thus contribute more to total revenues than the sum of corporate taxes and social security contributions⁵.

There is the important difference between the new green taxes and traditional energy taxes that most of the green taxes are paid both by consumers and producers some even primarily by producers, whereas the producing sectors have been exempted from energy

⁴ Ministry of taxation (1998) Appendix 1 (p.34)

⁵ In Denmark social security is mainly publicly financed from total government tax revenues.

taxes and partly from registration duties. In 1998 around 80% of the total environmentally related taxes are paid directly by consumers compared to around 60% of the new green taxes.

Table 2 Distribution of taxes in different countries 1996

Percentage of total tax revenue 1996	Norway	Denmark	Sweden	Netherlands	Finland	USA	EU
Personal income taxes	26	53.2	35.3	17.5	35	37.6	26
Other income and profits taxes	10.5	7	5.6	9.5	6.7	9.6	8.1
Labour market contributions and subscriptions	23.3	3.1	29.8	39.6	25.8	24.7	28.9
Taxes on wealth, real property etc.	2.8	3.7	4.1	5.9	2.3	13	4.6
General sales taxes, customs duties	21.6	19.9	13.9	17.4	18.2	8.8	18.3
Duties on specific goods and services, fees	15.8	13.1	11.2	10.1	12.1	6.4	14
- of which environmentally related	10.5	8.8	5.6	8.1	6.4	2.6	

Source: Taxes and duties 1999, Statistics Denmark Table 9.6, OECD Revenue Statistics 1965-1996

	Electricity residential	Electricity industry	Gasoline	Diesel (residential)	Diesel industry	Gas-oil residential	Gas-oil industry
Denmark	61.1	20.3 ⁶	72.3	60.8	36.3 ⁷	62.1	12.4
Sweden	36.4	0	73.1	60.0	49.8	62.3	28.7
Norway	30.8	0	74.7	66.8	59.2	30.0	14.4
Finland	26.2	10.1	74.3	62.6	54.4	41.3	28.4
Netherlands	28.8	1.6	73.3	64.6	58.3	45.9	0
Germany	13.6	0	73.8	67.1	61.9	35.6	25.3
UK	4.7	0	81.5	80.8	77.5	26.3	25.4
USA ⁸	0	0	28.2	38.9	0	0	0

Source: Energy Prices and taxes First Q. 2000, International Energy Agency

Tabel 1-1 Energifgifter i en række lande 1999 (andel af afgift i forbrugerpris)

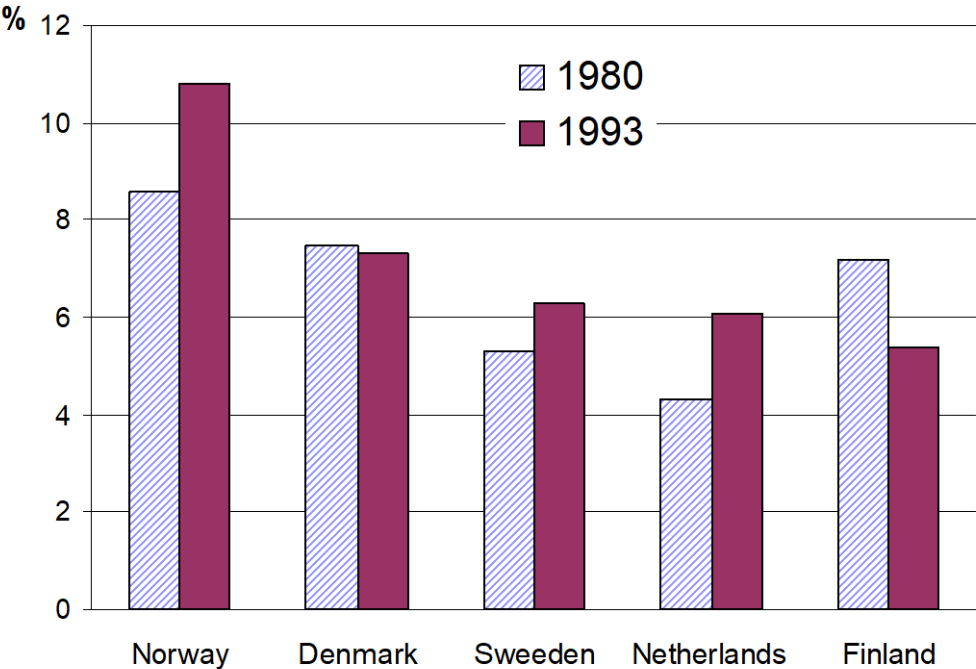
The duties on specific goods and services in Table 2 include the environmental taxes as well as "health taxes" on alcoholic beverages and tobacco. The main difference in tax structure is not due to difference in environmental taxation except for the US that has lower shares for duties on specific goods (that include environmental taxes) and general sales taxes

⁶ Dette reflekterer at den mest udbredte 90% sats for CO₂ afgift er medtaget her og ikke den gennemsnitlige.

⁷ I 1999 var afgiftssatsen lavere for erhverv 66 øre/l blev refunderet. Herudover skyldes forskellen mellem husholdninger og erhverv momsrefusionen for erhverv.

⁸ For flere af energiarterne med 0 afgift i tabellen er der rent faktisk en mindre "sales tax" men gennemsnittet for USA er ikke oplyst i IEA statistikken. Endvidere varierer satser en del mellem forbundsstaterne.

etc. The main difference of Danish tax structure is due to the financing of social security by total tax revenue and not by employers contribution to social security as most other countries.



Source: Ekins (1999), Table 4

Figure 2 Share of environmental taxes in total revenues in different countries

Figure 2 shows that Denmark is not outstanding with respect to the size of environmental taxation compared to other countries traditionally associated with environmental concern. Because 1993 is the final year in this comparison the revenue share of environmental taxes has decreased in Denmark relative to the 1980 share. This is in contrast with the development referred to above with an increase from 1980 to 1999. The share of environmental taxes also varies with the size of registration duties from new vehicle registrations and 1993 was the turning point with large increases in new vehicle registrations the following year.

DISTRIBUTIONAL PERSPECTIVES AND ENVIRONMENTAL TAXATION IN DENMARK

The distributional aspects of environmental taxation has been a major issue in the international debate over carbon taxes and has also in many countries been discussed in relation to energy and gasoline taxes. In Denmark however, this debate has been less intensive and the assumption of government transfers securing the distributional concerns have been generally accepted. A few attempts to introduce energy tax exemptions for pensioners⁹, and recently the suggestion of a tax-free threshold consumption level for energy taxes have been discussed.

In Denmark there is only a flat value added tax rate and no reduced rate has been introduced for the basic need goods such as food and energy. This reflects the fact and generally accepted assumption that the income tax system and government transfers

⁹ Compensation for heating expenses has been transferred to certain groups of pensioners.

assure the necessary redistribution of income sufficient to purchase basic needs goods. Also the fact that heating expenses for low-income households have been reduced by public urban renewal that has supplied these household with relatively cheap district heating is an explanation for the limited debate of energy taxes and distribution. Finally the relative equal distribution of disposable income in Denmark tend to make environmental tax payments a relative small share of total expenditures also for low-income households.

DISTRIBUTIONAL IMPACT OF ENERGY TAXES AND GREEN TAXES

International studies such as those referred in the introductory section find a tendency towards regressive effects of energy and carbon taxes. Most of these studies examine possible effects of CO₂ taxes and they produce mixed results for countries with different production and consumption characteristics. This paper examines already implemented taxes and actual tax payments by household included in the household expenditure surveys conducted by Statistics Denmark. These surveys cover around 1500 households and 1300 goods and services including the environmental taxes in focus as well as information on income sources, geography and other socio-economic data.

The survey is limited to 1500 households and based on registrations from 2 weeks distributed over a calendar year and combined with certain administrative registers. For some of the goods and especially for some of the taxes the uncertainty can be quite large. In some cases the households does not have the knowledge on tax payments. For example, the tax on carrier bags and retail containers has to be calculated from purchase of other goods. For some taxes as registration duties and duty on coal and coke the number of households actual purchasing this item will be rather limited among the 1500 households and distributions of these on income groups will be rather uncertain relative to the actual distribution among Danish households. Further details on the linkage between income and energy taxes can be found in Klinge Jacobsen et. al. (2001).

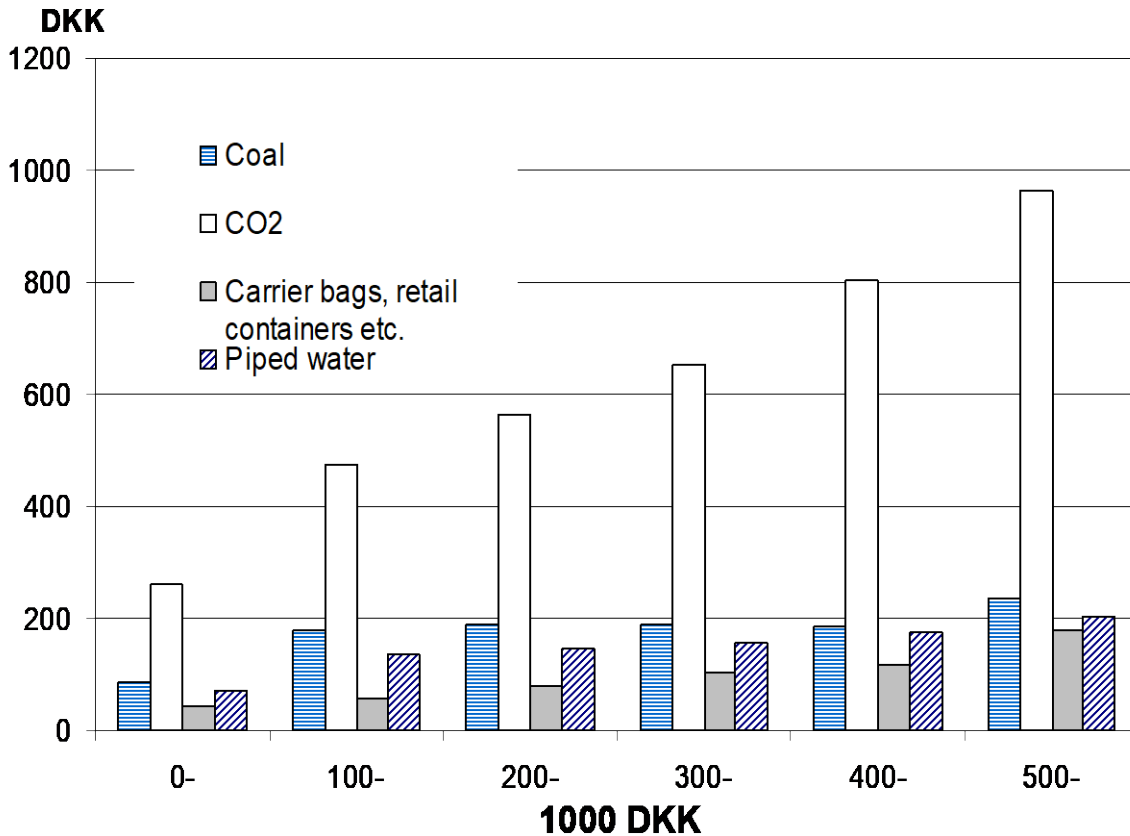


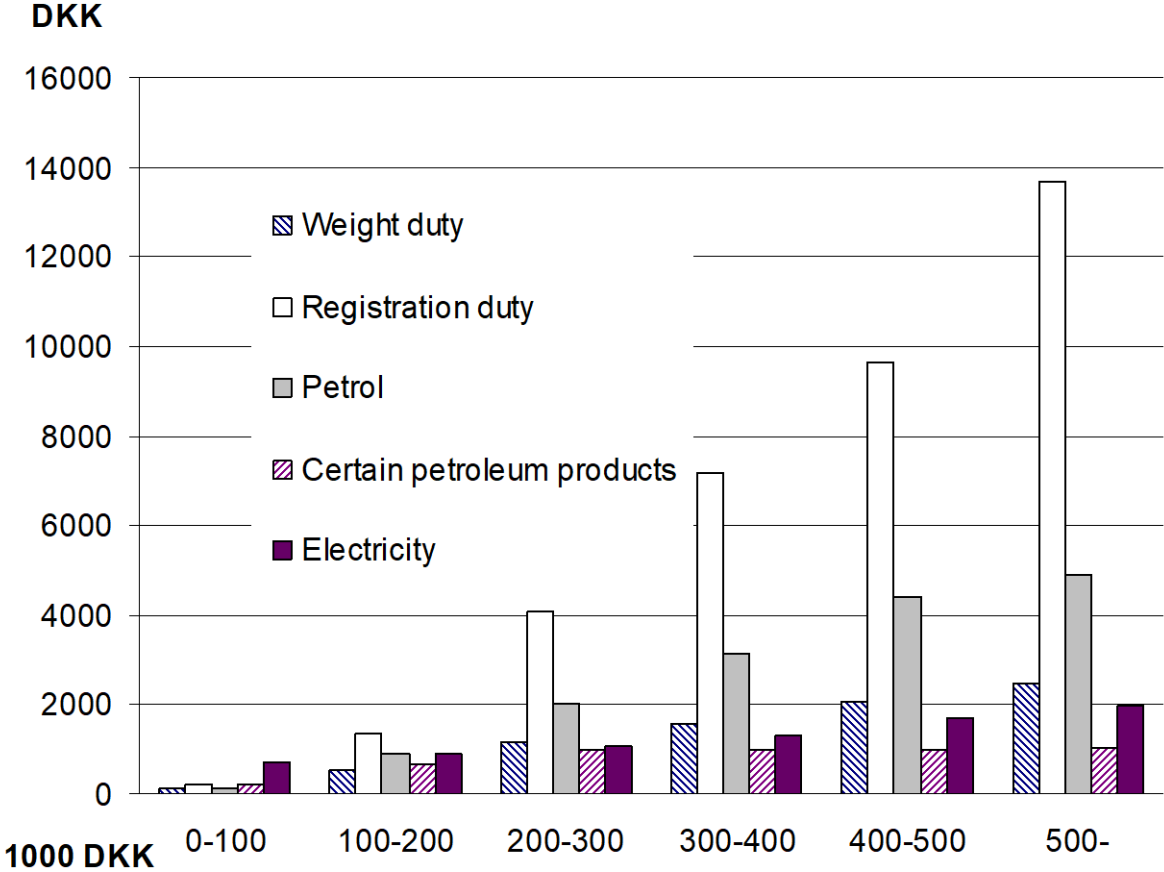
Figure 3 Environmental duties and household income (annual figures 1996)

Figure 3 shows tax payments by income groups for some of the new green taxes defined as specific environmental taxes in Table 1. These are all minor taxes by tax revenue as opposed to other energy taxes and vehicle taxation. The carbon tax and to some extent the tax on retail containers etc. are increasing with income. The other taxes are more or less independent of income levels. Piped water consumption will be very dependent on household size and the growth in this tax with income is probably a result of larger household sizes for higher income groups. The weighted¹⁰ household size for the lowest income groups are only 1.0 and 1.1 person compared to 1.9 person for the highest income group. Households mainly pay carbon taxes on electricity and fuel oil for heating. This tax increases with income but it must also be regarded as dependent on household size and the tax increase is less than proportional to the income increase. Hereby a general regressive effect of the taxes included in Figure 3 is suggested. However, the comments on income measures certainly also applies to these data. The income figures of before tax income can certainly be questioned and the consequences of using total expenditures instead still have to be carried out for comparing the outcomes.

The different distributional impact of specific environmentally related taxes can be observed in Figure 4. The duty on certain petroleum products that are mainly for heating is around the same level for the different income groups. This can be a result of different heating technology in the way that high-income groups are located in cities with natural gas or district heating grids. There is a small tendency for electricity duties to increase in

¹⁰ Second person counts only .5 and children under age 14 counts .3.

absolute terms with income but it increases much less than income. The more proportional duties seem to be the petrol duty and weight duty, whereas the registration duty seems to be the only progressive duty. Compared to the taxes in Figure 3 the absolute size of the tax payments in Figure 4 is relatively large. For high-income households registration duty corresponds to 53% of total environmentally related taxes whereas this tax is only 11% of the environmental taxes for low-income households. This is a consequence of the fact that low-income households in Denmark rarely possess private cars.



Source: Household expenditure survey

Figure 4 Household duties expenditures by household income 1996

As the Table 1 suggests this paper has enlarged the number of environmental taxes to include also registration duties on new vehicles. This is because the distributional impact of such a duty might differ from other transport duties and this duty certainly has contributed to reduce private car density and car average size in Denmark.

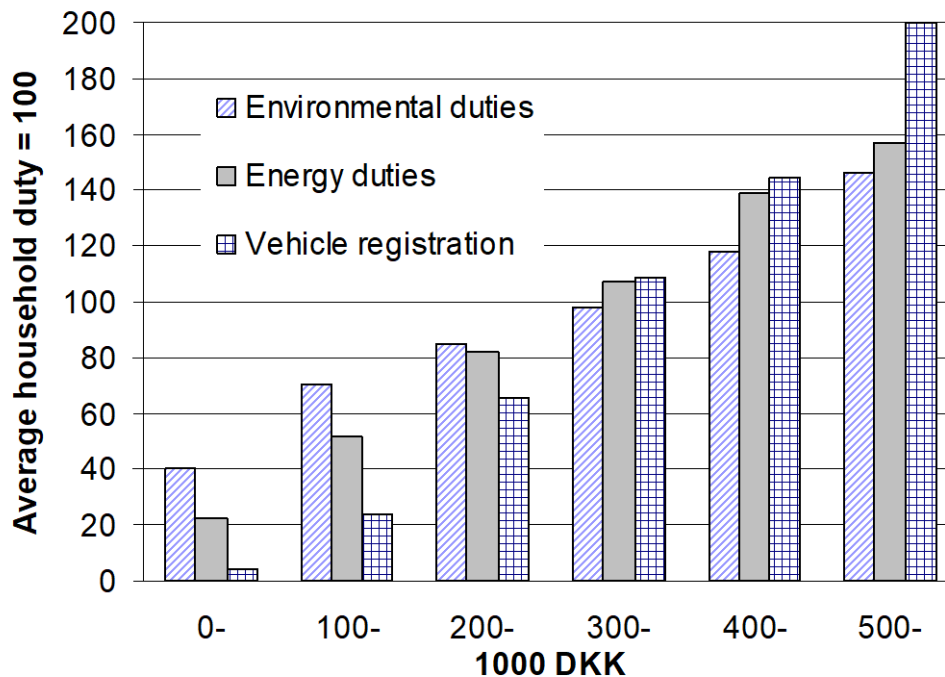


Figure 5 The distributional effect of various environmental taxes 1996

Figure 5 compares the distributional effect of the three aggregate types of environmental taxes. All three categories have been indexed by the average tax payment of all the households in the survey. Vehicle registration and weight duties show to increase much more with income than the “new” environmental duties with energy taxes being a little less regressive. For energy duties the main reason for the increase in tax with income can be referred to electricity and transport fuels. The increase in tax per household member is even less as the higher income households also have more members. The regressive effect would thus have been more pronounced if shown per household member. This aspect will be further investigated in a following phase of this study by using micro data with distributional impacts within households of the same size but different income. The comparison of the three categories in Figure 5 leads to the conclusion that the new green environmental taxes on average are rather regressive compared to the less regressive energy tax in the neutral or even progressive tax on private vehicle ownership.

The finding of Speck (1999) and Symons et. al. (1997) that the northern European countries exhibit more regressive effects of carbon and energy taxes than in Southern Europe corresponds to the data analysed in here. The energy and specific environmental taxes are found to be regressive. However, this is not the case for the registration duty, which seems to be even progressive. This corresponds to the findings of Smith (1995) that found transport fuel taxes to have no regressive effect in the English case. This is not the case for the US where Walls and Hanson found value based registration duties to be mildly regressive.

POLICY PERSPECTIVES

The pressure to reduce the high Danish registration duties and replace those with other taxes might have negative distributional impacts without improving the environment. There is evidence that private transport taxation is the least regressive environmental tax. The registration duty implies that the large cars or the most luxurious cars that also have largest engines are taxed more than the average family car.

The argument that lower registration duty will improve the average fuel technology by reducing average car age will not necessarily reduce fuel consumption and CO₂ emission although other emissions might be reduced.

For the discussion of environmental tax reform it is important to consider the general tendency for environmental taxes to be regressive as well as the different impact among the various environmental taxes and duties. Increased environmental taxes in combination with reducing marginal income tax rates could reduce total tax progressivity through both the income taxes and the environmental taxes.

The indirect effect through environmental taxes on domestic production might also have mixed distributional effects as energy taxes though food products (high energy content) would tend to be regressive, just as any energy taxes on public transport fuel consumption.

CONCLUDING REMARKS

Denmark levies a variety of environmentally related taxes on both households and producing sectors. However, the producing sectors have been exempted from many of these taxes whereby the majority of the direct tax burden is on households. The "new" environmental taxes have been introduced since 1992 and now constitute around 15% of the environmentally related taxes and the degree of exemption is less for these taxes. In international comparison the environmental taxes, as a share of total tax revenues is not especially large at least not if compared to other European countries. The specific characteristic of Danish tax composition is instead related to the high direct income taxation and lack of employer contribution to social security.

The preliminary results from this study suggest that the environmental taxes in Denmark are regressive in line with the results from most other studies. It must specifically be noted that in the Danish case many of the minor "new" environmental taxes on piped water, carrier bags etc. are more regressive than the traditional energy taxes especially electricity.

The distributive consequence of the passenger tax on flights has not yet been examined but this Danish tax is certainly another candidate for a progressive environmentally related tax.

The project will extend the analysis of distributional issues to include indirect tax effects by using input-output calculations. The data from the household survey will also be linked to the comprehensive administrative data for 240.000 Danish households covering consumption of electricity, heat and water along with detailed income and other socio-economic data.

ACKNOWLEDGEMENTS

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