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# Distributional effects of taxing transport fuel

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ABSTRACT

This paper[1] takes as its starting point the observation that fuel prices – and thus taxes – are important for good management of climate change and other environmental problems. To economists this should be no surprise yet it seems that the role of fuel taxation as an instrument of climate policy has not been fully appreciated. It is however one of the few policy instruments that, since several decades, has actually reduced fuel consumption appreciably. Thanks to taxation (mainly in Europe and Japan), carbon emissions are considerably lower than they would have been otherwise. In future where carbon emissions are to be cut drastically, this instrument will be crucial. There is however much opposition to the instrument. This opposition uses various arguments, for instance that fuel taxes hurt the poor since they are strongly regressive. We however find that the choice of country and methodology turns out to be of great consequence. We study seven European countries—France, Germany, United Kingdom, Italy, Serbia, Spain and Sweden and do find some evidence of regressivity but the evidence is very weak. It does not apply when lifetime income is used and it does not apply to the poorest country in the group. The best one-line summary is probably that the tax is approximately proportional.



## 1. Introduction

The scale of decoupling between carbon emissions and economic activity needed in the next decades is of unusual magnitude. If we are to continue economic growth in Europe even at a moderate rate of say 3–4% this means increasing incomes between 4 and 7 times in the next fifty years when carbon emissions have to be cut by roughly 75%. This means that emission intensities have to be cut by about 95% in all sectors. It is difficult to see this achieved merely by behavioral changes or by technological changes on their own. Presumably we will need some combination. Definitely we will need higher prices for all fossil fuels to drive both behavioral and technical changes.

One of the most efficient instruments to reduce emissions is high taxes on fossil fuels such as gasoline and diesel. In Europe, these taxes are higher than in the US, which has considerably contributed to lower emissions of greenhouse gases and even on the atmospheric concentrations of carbon dioxide (Sterner, 2007). *Fuel taxes* might not originally have been designed for environmental purposes but their effect is surely environmental.[2] People discuss whether or not there are any sufficiently powerful economic instruments available but fail to see the available evidence: The experience of fuel taxes in Europe, Japan and a few other countries is in fact a full-scale demonstration of how powerful economic instruments can be.

There is, however, a strong opposition against raising fuel taxes and an often heard argument is that they are strongly regressive. This may have originated from early studies in the US during the 80s and 90s (Poterba, 1991). More recent research shows however that regressivity can by no means be taken for granted. The choice of methodology has proven to be of great consequence for the distributional outcome and one might therefore wonder if results vary significantly between countries. In this paper, we study seven European countries—France, Germany, United Kingdom, Italy, Serbia, Spain and Sweden. Section 2 discusses the effects of fuel taxation contrasting the experience in Europe and Japan with that in other industrialized countries like the US, in Section 3 we discuss how to analyze effects on income distribution, Section 4 presents the data and

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[2] The stated motives for gasoline taxes vary considerably. In some countries they are just a convenient tax base. In others they contribute to road building & maintenance plus health effects. These vary geographically and Parry and Small (2005) question their level for such purposes. Historically, climate externalities have played a small role (if any) in motivating gasoline taxes – but the taxes play a big role in reducing emissions of climate gases.

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Section 5 our distributional results for a number of European countries and 6 concludes.

## 2. Fuel taxation and climate change

Fuel consumption demand is determined by demand functions that depend primarily on income and prices—in particular fuel prices (but also all other prices). The effect of fuel price and other factors is usually expressed through elasticities—which show the percentage change in fuel consumption that would result from a one percent change in the exogenous variables.

There are very many studies of fuel demand elasticities—particularly for gasoline. In fact there are even quite a large number of surveys, ranging from Drollas (1984), Dahl and Sterner (1991a, 1991b), Goodwin (1992), Dahl (1995) and Graham and Gleister (2002, 2004). While a range of estimates is found, the consensus is that the long-run price elasticity is around −0.8, while the corresponding income elasticity is around unity. This is higher than many people appear to believe but on the other hand these are really long-run elasticities. Short-term elasticities tend to be about less than a third of the long-term ones. Goodwin shows that the time-series and cross-section methods broadly again concur in giving long-run price elasticities of around −0.8. Dahl (1995) finds long-run price elasticities ranging from −0.7 to −1.0 and income elasticities between 1 and 1.4. Graham and Gleister (2004) find short-term price elasticities tend to be between −0.2 and −0.3, while long-run values go from −0.6 to −0.8. For income, the long-run elasticity is often slightly higher than unity (1.1–1.3) while the short-run elasticity is from 0.35 to 0.55.

We focus primarily, in this study, on gasoline and do not make an effort to capture the fact that there are several minor auto fuels in addition to gasoline and diesel: gas, alcohol and various other new fuels. Practically all demand sensitivity studies focus on gasoline as opposed to diesel and other fuels. One reason might be that diesel is used heavily in professional transport (busses, trucks and other non-transport machinery such as agricultural equipment and diesel generators) with different explanatory factors from those for private auto use. Another reason may be that estimations with several fuels would also have to deal with the different tax policies for the vehicles themselves and again diesel and gasoline cars often face quite different taxes and other instruments which tend to be complex and vary over time. As noted by Schipper et al. (1993) the problem is partly that gasoline can be used by mopeds, trucks and other machines leading to an overestimate of auto use while on the other hand many cars use diesel which is a source of underestimation. The under- and over-estimation do however not cancel out because they are driven by very different processes and develop at different rates. One of the very few studies which explicitly sets out to estimate total *fuel* elasticities (thus including total fuel diesel, gasoline etc and correspondingly weighted fuel prices) is Johansson and Schipper (1997). They find overall fuel price elasticities of −0.7.

Price elasticities are important because there are big differences among countries in fuel taxation which in turn lead to big differences in final consumer price (Other sources of price difference such as the efficiency, profit margins and costs of the gas stations are fairly small.).The motorist also bears a number of additional taxes and fees levied directly on vehicles (registration fees, yearly taxes, vehicle sales taxes) and on road use (tolls, congestion fees etc). There are also a number of other policies that vary between countries concerning the way in which public transport is financed, taxed and/or subsidized. These policies all have effects on fuel consumption but they are complicated to compare or even quantify.

**Table 1**
Gasoline taxes in US$ cents/liter in selected countries, 2008.
*Source* –IEA, 2009; Unleaded premium gasoline (regular gasoline for Japan).

| Western Europe | Gas tax | Non-European | Gas tax |
|---|---|---|---|
| Italy | 116 | Japan | 59 |
| UK | 123 | Australia | 43 |
| Netherlands | 139 | New Zealand | 51 |
| France | 121 | Canada | 32 |
| Belgium | 125 | Mexico | 10 |
| Germany | 128 | USA | 13 |
| Finland | 129 | **Average** | **35** |
| Portugal | 122 | | |
| Sweden | 120 | | |
| Spain | 90 | | |
| Austria | 100 | | |
| **Average** | **119** | | |

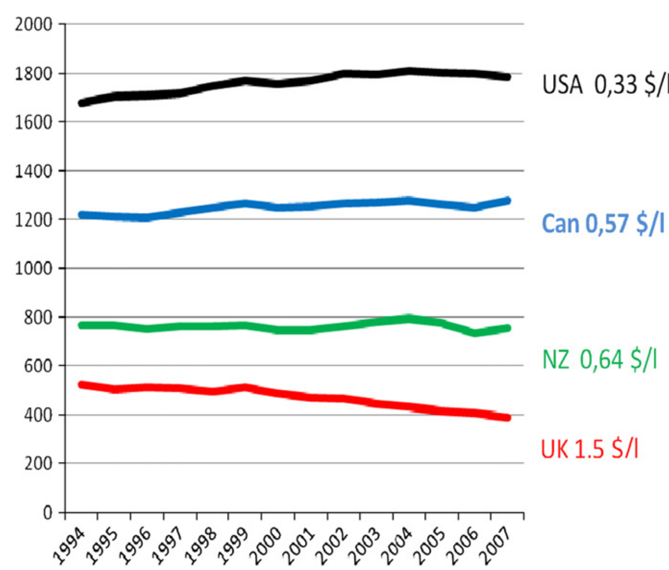


**Fig. 1.** Consumption in litres per capita and price of gasoline in a selection of countries. Source IEA (2009).

Table 1 shows the average tax on gasoline (unleaded premium unless otherwise stated). The tax is in USD cents converted by market exchange rates.[3] As we can see in Table 1 the sample average for the Western European countries selected is 119 cents per liter, which is very high compared to the US and many other non-European countries. It should also be observed that this spread is in fact increasing over time (since 2005, the average in this table for the West European countries went up by 35% while the other countries' average rose by less than 20%). Countries such as Japan and Australia are intermediate. Taxes within Western European countries are not very different and rather tend to converge.

From a climate viewpoint, the interesting comparison is between the US and Europe. Fuel taxes are very small in the US compared to the European average—and even compared to the lowest tax rates in Europe. This is clearly related to higher fuel use—although the relationship is only apparent in the very long-run: Fig. 1 shows annual gasoline consumption (litres per capita) and current consumer prices.

[3] An alternative used by some researchers is to use purchasing power parities to provide an indicator of the *actual burden* the tax places on the representative motorist but here this would imply some double-counting of the income effect once directly through income elasticities and once indirectly.

**Table 2**
The effects on total OECD fuel use of high or low taxes[a]

| | Real | Hypothetical | |
|---|---|---|---|
| | | UK prices | US prices |
| Fuel use | 1,130,829 | 715,723 | 1,467,748 |
| Percentage | | −36% | +30% |

[a] Sum of diesel and gasoline use in Ktons together with calculations (based on individual country estimates) for total fuel use if the countries had the prices that correspond to the lowest or highest in the OECD area, respectively.

If the EU had followed a similar tax policy to that in the US, aggregate carbon emissions would have been substantially higher. It is, strictly speaking, impossible to calculate such a counterfactual path for the whole transport sector for the whole world but we can get an idea of the order of magnitude by using the average elasticities mentioned above to calculate the equilibrium gasoline consumption for each country with lower or higher prices. This is done in Sterner (2007) which calculates the effect if all OECD countries had as low taxes as the OECD country with the lowest taxes (the US). Total OECD fuel use would then have been 30% higher. This illustrates just how much gasoline taxes have achieved. It may be true that gasoline taxes were not created for environmental but for fiscal or other reasons such as to finance roads but the fact remains that *the effect of gasoline taxes on global carbon emissions is environmental and the effect is sizeable.* The hypothetical OECD total gasoline use with US prices is more than twice as high (+133%) as the corresponding hypothetical OECD total with Dutch prices.

The differences in gasoline demand analyzed are really very large. Part of this is however explained by an increased use of diesel in Europe the inclusion of which reduces the dramatic differences when comparison is made for total fuel consumption per capita between the US and Europe. The difference is however still big: the US still has considerably more than twice the consumption of the UK or Italy and 60–70% more than France or Germany. The best estimate we have of total fuel price elasticity (for gasoline and diesel) is from Johansson and Schipper (1997) and that is −0.7. This is somewhat lower than −0.8 used here and perhaps the difference is a reflection of the effects on diesel or the lower price elasticity of diesel itself.

To get a rough estimate[4] of the effects on total fuel Table 2 shows *total* automobile fuel using the weighted average price (average price of diesel and gasoline weighted by consumption shares). The conclusion is that if the whole OECD had harmonized prices to coincide with the EU countries that have the highest fuel price total fuel consumption would have been about 35% less. Had the whole OECD instead had fuel (gasoline and diesel) prices like the US then consumption would be twice as high which is 30% higher than actual current use. This is one of the few policies that actually has had a measurable effect on the carbon content of the atmosphere.[5] Note that carbon leakage to the benefit of the low tax countries is not considered. Presumably the high taxes in some countries reduced the World price of oil thus encouraging consumption in the US and other low tax countries and partly offsetting the effects discussed here. We have however not attempted to calculate this effect.

[4] Source Sterner (2007).

[5] The difference between the hypothetical use with high/low prices for total fuel is about 750 Mtons of fuel per year. A decade of such differences would correspond to emissions of roughly 25 billion tons of $CO_2$ or a carbon content of 3 ppm.

## 3. Assessing distributional aspects of fuel taxation

Being such a potent instrument for climate change, one might think that fuel taxes would be higher on the agenda. The prime argument against them appears to be that they might be very regressive and this originates from early studies in the US such as Poterba, 1991. Social conditions, however, differ between countries and in the US, a car is often a necessity even for low income earners due to the lack of public transportation. On the contrary, in developing countries, cars and gasoline are luxury goods. It is therefore essential to study this issue in countries with different characteristics. Even in the US, where the tendency towards regressivity may be the strongest, the question is quite intricate. The concept of pro- or regressivity sound simple enough but there are a number of methodological points that need to be addressed.

The essential idea behind the definition of income distribution effects of a given tax are that taxing a good that is used mainly by the rich is progressive while taxing a good used predominantly by the poor is regressive. The most telling metric is the budget share: suppose that a low income person has a budget share for some item, say food, of 40% while a rich person only spends 10% of his income on food. Then clearly a tax that increased the price of food by 10% would take 4% of the low income person but only 1% of the rich person's income and thus such a tax would be regressive. It is common to illustrate the effect of a tax by showing the budget shares for different income groups. The most obvious difficulty we face is that a tax need not have a unequivocal effect since the budget shares do not have to be monotonically increasing or decreasing. So a particular good might be consumed heavily by middle classes but less by both the rich and the poor. A tax on this good would then hurt the rich compared to the middle class which is a progressive effect but it would also hurt the poor compared to the middle class which is a regressive effect. Politically this may be very interesting as it stands, but in case we want a single summary measure to say if a tax is on balance pro- or regressive, we need some manner of devising a synthetic index.

In this paper we use the Suits Index for this purpose. This index is one of the more common to measure the progressivity of taxes, see Suits (1977). The index is inspired by and one might say analogous to the Gini ratio since it is a simple geometric summation over the whole income distribution without using any explicit welfare weights.[6] Suits Index varies from +1 which is extreme progressivity since the entire tax burden is borne by members of the highest income bracket to −1 at the extreme of regressivity when the whole tax burden is borne by members of the lowest income bracket. This index allows us to compare between different taxes on the basis of progressivity. A proportional tax has a Suits Index of 0.

Fig. 2 depicts one example of a concentration curves (note the similarity with the Lorenz-curve). Each income groups' percentage share of the tax paid (out of what is paid by all groups combined) is accumulated on the vertical axis and their percentage share of income or total expenditures on the horizontal. The case of a completely proportional (neutral) tax is depicted by the 45° line from one corner to the other corner. The curve shown is for a progressive tax while the corresponding curve for a regressive tax would lie above the diagonal.

As mentioned the concentration curve may also be progressive in one part but regressive in the rest, thus crossing the proportional line. By calculating the Suits coefficient, a summary

[6] Alternatively one could say that the index uses equal weights for all so that in the example above of a tax that hit symmetrically a poor and a rich decile the effects would in fact cancel out.

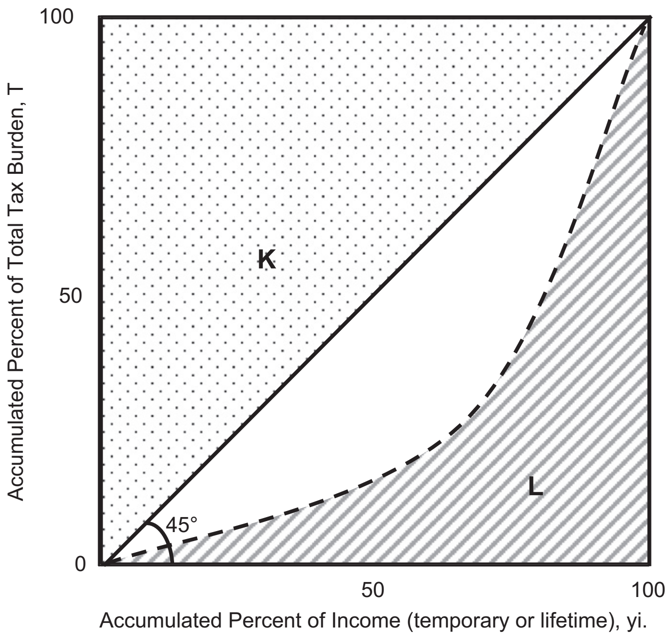


**Fig. 2.** Example of a concentration curve with the areas used to calculate the Suits index.

statistic measuring the degree of deviation from proportionality, we are able to determine whether such a tax is overall proportional, progressive or regressive. The coefficient can then easily be used to compare distributional effects for different taxes.

The Suits coefficient is here denoted $S$ and is basically the share of the white area between the concentration curve and the diagonal ($1-L/K$). Let income, $y$, and tax burden, $T$, range from 1 to 100 (since we use percentages), then we define $S$ through (1), see Suits (1977).

$$S = 1 - \frac{L}{K} = 1 - \frac{\int_0^{100} T(y)dy}{5000} \tag{1}$$

In the case of regressivity, $L > K$ and $-1 \leq S < 0$, while proportionality implies $S=0$ and $L=K$. A progressive tax yields $L < K$ and $0 < S \leq 1$. Since our data is arranged in income deciles $i=1\ldots10$, we use an approximation for the integral of $L$, suggested in Suits (1977), see (2).

$$S \approx 1 - \frac{\sum_{i=1}^{10} (1/2)[T(y_i)+T(y_{i-1})](y_i - y_{i-1})}{5000} \tag{2}$$

The Suits coefficient is thus merely a summary statistic and is best interpreted together with a graph or table that describes the fuller distributional picture. A closely related alternative to the Suits coefficient is the Kakwani index (Kakwani, 1977). This index has also obvious similarities to the Gini coefficient. However, Lambert (1993, p 176) points out that while the Suits index is limited between $-1$ and 1, the bounds for the Kakwani index depends on the income inequality. Furthermore, the few previous studies in the field that use an index have chosen Suits index as measure (e.g. Chernick and Reschvsky, 1997, Metcalf, 1999, Walls and Hanson 1999, West, 2004)[7] and for the sake of comparison we choose to do the same.

There still remain a number of methodological issues. With four different types of measure, West and Williams (2004) showed how the choice of method affects the distributional outcome when increasing the gasoline tax. The first of these measures is the most simple and sees the burden of a tax as a share of approximated lifetime income, but leaving out possible changes in consumption behavior. The next three measures introduce more possibilities to such responses and general equilibrium effects. More sophisticated ways of estimating the tax burden generally imply weaker regressivity. A high degree of realism requires however a lot of information which is not always available. An ideal measure of tax incidence starts by calculating all resulting price changes in an economy as the result of a tax change. This does not only include gasoline and public transport—many other effects are possible, for instance profit margins may be affected in the fuel industry which in turn lead to changes in income, rents and profits which have further repercussions etc. The next step would be to work out the changes in welfare for all groups based on these multiple changes. An intermediate step that West and Williams (2004) use is to calculate measures of incidence that take into account some (but not all) behavioral responses. The simplest of these adjusts incidence for changes in fuel consumption using a single price elasticity. The somewhat more sophisticated measure uses decile-specific elasticities.

Another methodological issue is how to measure income. One possibility is to use a household's *annual disposable income*, another is using the *total consumption* (annual expenditures on all goods and services). Earlier research has found the latter to better reflect the capacity to pay taxes over an entire lifetime, since it approximates lifetime income (Poterba, 1989). The annual income is, on the other hand, likely to understate this capacity substantially. Retirees have a small annual income but large savings. The annual incomes for students are also low but they have large expected future incomes. In terms of distributional effects, Poterba (1989) showed that the use of disposable income makes already progressive taxes more progressive and regressive taxes more regressive. To show the difference, we use both approaches in our study. Finally authors such as Fullerton et al. (2008) emphasize the many different avenues through which fuel taxes may influence distribution.

Except for increasing the price on fuel, fuel taxes also change prices of other goods and services. In order to come up with a *total tax* burden, one would have to include this *indirect* effect in the analysis, in addition to the *direct* effect arising when households' purchases fuel from the pump. A more ambitious attempt for doing so would be to use an input–output model together with detailed information of fuel use for every industry in the economy. Such an analysis is done in Datta (2008) which finds auto fuel taxes to be progressive in India. However, doing such an analysis for all seven countries in our study would require a lot of data, we choose a strongly simplified approach. By taking some key items into account, we hope to still arrive at a satisfactory estimate. Earlier research has indicated that it is mainly prices for public transportation and taxi that are affected when increasing the fuel tax (see Metcalf, 1999). Hence, we include expenditures on both these services.

Only few studies have focused on Europe. For instance, Santos and Catchesides (2005), concluded that the British fuel tax is very regressive as long as only car owning households are included, but more or less neutral if one also includes those without a car. Asensio et al. (2003) showed that for Spain, the largest burden from fuel taxation falls on the middle income earners. Our study fills a gap by comparing seven European countries. Five of them are chosen due to their size and importance in the political and environmental context—France, Germany, Italy, Spain and United Kingdom. In order to broaden the analysis, we also include Sweden and Serbia—two small countries with very different characteristics. We start by examining the various tax rates on fuel in the year 2006.

[7] Walls and Hanson (1999) and West (2004) studies a tax on vehicle miles travelled (VMT). These results should be very similar to a tax per quantity of fuel consumed.

In Sterner (2007), tax rates on gasoline were concluded to be considerably higher in Europe than in the rest of the world. For Western and Eastern Europe the average of these rates were on average of 80 and 120 cents per liter, respectively, compared to an average of 30 cents/liter for rest of the world (for year 2005, but in PPP-constant 2000 dollar cents). Table 3 below shows the tax rates in our selection of countries for both gasoline and diesel fuel. Column 2–5 gives the tax rates and prices in US$cts/liter, while column 6 and 7 show the tax as a percentage share of the fuel price.

Among the EU countries, gasoline taxes are now well harmonized with the slight exception of Spain. As for diesel, the disparity is bigger with the UK having almost twice the tax of Spain The share for Serbia is considerably lower.

## 4. Data

The data we use comes from seven European household budget surveys (Table 4). From these we use information on households' disposable income, total expenditures and specific expenditures on gasoline, diesel, public transportation and taxi. This information is available per income deciles, for all countries except Italy, where it was only possible to acquire the information by expenditure deciles, and Spain where only income quintiles were available (the point estimates were not significant for deciles). The data is furthermore adjusted according to an equivalence scale, i.e. adjusted for each household's size and composition (number of children and adults etc.).

As already mentioned, we wanted to include an *indirect* component of tax burden through the indirect use of fuel in public transport in the analysis. To do so, we needed the share of fuel tax costs in expenditures on public transport. Such data are hardly available at the national level and for illustrative purposes we have therefore chosen to estimate them. The shares differ due to various nation-specific factors, e.g. the rate of fuel tax, the type and price of the fuel used and other costs in public transport and taxi. Moreover, in some countries (like UK and France), fuel subsidies are given for public

**Table 3**
Prices and excise taxes on gasoline and diesel (in $cts/liter) and the excise tax as a share of fuel price (%) in seven European countries for 2008.
*Sources:* IEA Energy Prices and Statistics, for Serbia: UNECE (2007a) and GTZ (2007).

| | Gasoline tax | Diesel tax | Gasoline price | Diesel price | Gasoline tax as % | Diesel tax % |
|---|---|---|---|---|---|---|
| France | 121 | 93 | 198 | 186 | 61.1 | 50.0 |
| Germany | 128 | 100 | 205 | 195 | 62.4 | 51.3 |
| Italy | 116 | 94 | 202 | 196 | 57.4 | 48.0 |
| Serbia | | | | | 34.9 | 19.9 |
| Spain | 90 | 67 | 162 | 165 | 49.4 | 40.6 |
| Sweden | 118 | 104 | 191 | 202 | 61.8 | 51.5 |
| United Kingdom | 123 | 124 | 196 | 215 | 61.7 | 57.7 |

*Comment:* The table only includes national excise taxes, thus excluding VAT's.

**Table 4**
Sources of data.

| *Country* | *Name of survey* | *Provider* | *Year* |
|---|---|---|---|
| France | Enquête Budget de Famille | Institut national de la statistique et des études économiques | 2006 |
| Germany | Wirtschaftsrechnungen | Statistisches Bundesamt Deutschland | 2006 |
| Italy | I consumi delle famiglie | Istituto nazionale di statistica | 2006 |
| Serbia | Living Standard Measurement Study | Republicki Zavod Za Statistiku - Republike Srbije | 2007 |
| Spain | Encuesta de Presupuestos Familiares | Instituto Nacional de Estadística | 2006 |
| Sweden | Hushållens utgifter | Statistiska Centralbyrån | 2004–2006 |
| United Kingdom | Family Spending | Office For National Statistics | 2006 |

**Table 5**
Share of taxation on fuel in expenditures on bus and taxi for seven European countries.
*Source*: Own calculations based on information from various national transport statistics and sources.

| | | **Country** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Expenditure variable | Type of fuel | *France* | *Germany* (%) | *Italy* (%) | *Serbia*[a] (%) | *Spain*[a] (%) | *Sweden* (%) | *United Kingdom* (%) |
| Bus | Gasoline | 8.3% | 8.8 | 6.3 | | 6.3 | 9.2 | 12.4 |
| | Diesel | 5.6% | 4.0 | 4.6 | | 4.6 | 9.5 | 5.9 |
| Taxi | Gasoline | Exempt from fuel tax < 5KL/year | 4.6 | 5.0 | | 5.0 | 2.1 | 3.9 |
| | Diesel | | 3.3 | 3.7 | | 3.7 | 1.9 | 4.1 |
| Bus and taxi combined | Gasoline | | | | 7.0 | | | |
| | Diesel | | | | 4,0 | | | |

[a] We did not find data for these countries and therefore made some assumptions. For *Serbia*, the share of fuel in public transport expenditures is assumed to be 20%. For *Spain* we used the same shares as for Italy, since that country had the closest income level. In addition to the shares above, we have also used information on the share of each fuel type for bus and taxi, for all seven countries (from national databases on the vehicle stock). Using these weights, we calculated the indirect tax burden for each decile and country.

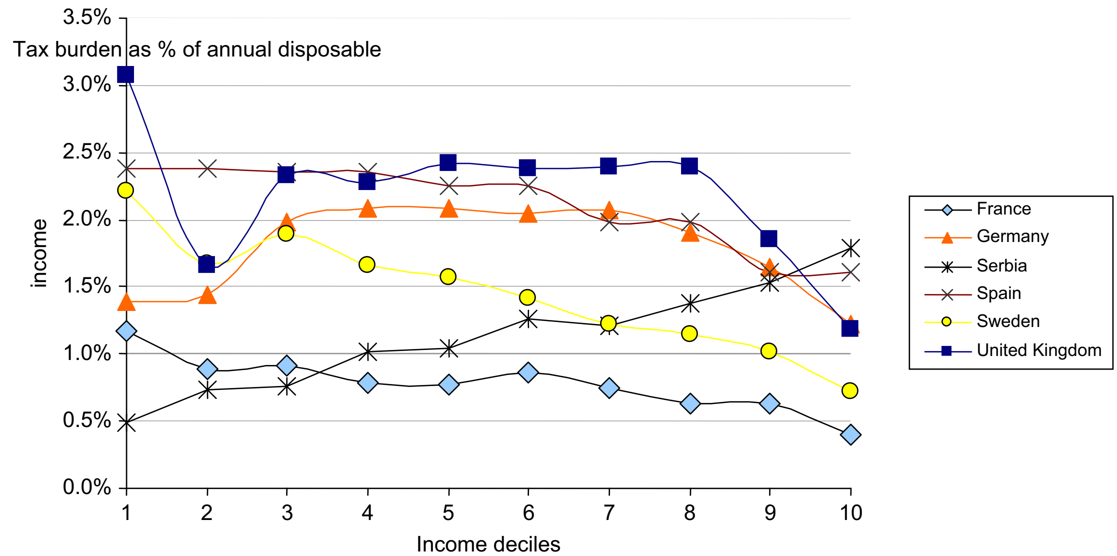


**Fig. 3.** Fuel tax shares as % of annual disposable household income, per income deciles. (NB including indirect use through public transport).

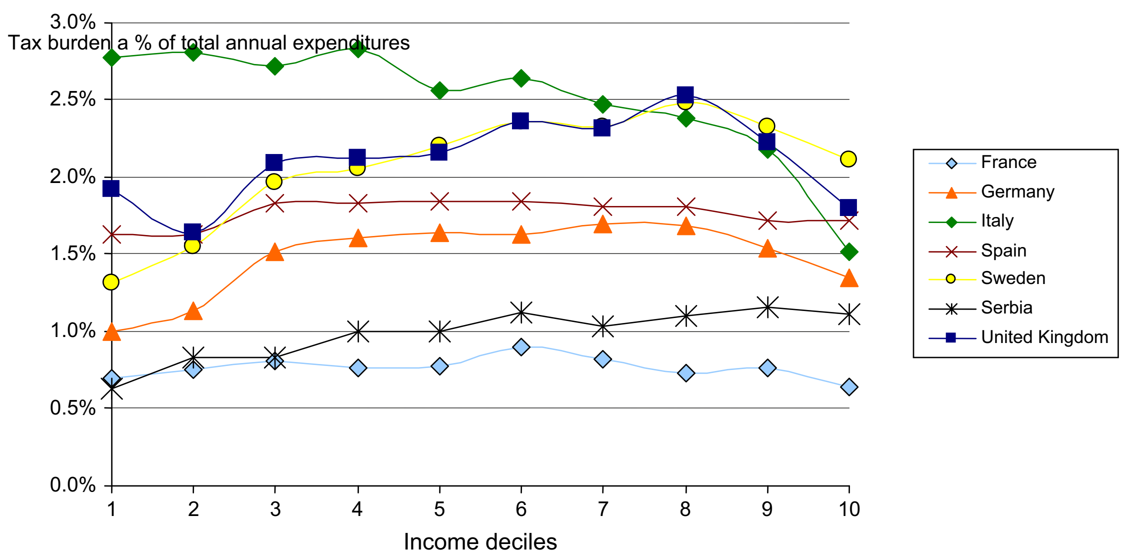


**Fig. 4.** Gasoline and diesel (direct+indirect) taxes as a % of annual total expenditures, per income deciles.

transportation and taxi companies. Table 5 summarizes the estimated shares used in our calculation.

## 5. Evidence on the distributional effect of fuel taxes

Starting with the annual income approach[8] (Fig. 3) an upward sloping line would suggest progressivity and a negatively sloping line would suggest regressivity. The results are quite mixed, but the first general impression is that effects are small and in many countries the tax appears reasonably close to proportionality. This applies in particular to the deciles 3–8. The richest two deciles have in several countries slightly lower shares but this does not apply to Serbia. It seems there is some overall regressivity for Sweden and United Kingdom, while Serbia shows progressivity. In Germany the middle income earners seem to bear the largest burden.

Visible in Fig. 3 is also a difference in the level of burden *across* countries. Households in France seems to bear a relatively low burden while the fuel tax in United Kingdom, Germany and Spain constitutes a larger share of each decile's average disposable income. Partly this reflects the level of taxation which is highest in the UK. Taking the national averages across all deciles, France has an average burden of 0.78% and the United Kingdom 2.20%.

We turn next, in Fig. 4 to exactly the same data but now as shares of total expenditure rather than income. This allows us to bring in Italy (not included in Fig. 3 due to missing income data)

[8] Burden is defined as the share of fuel (direct and indirect) in disposable income.

**Table 6**
.Suits' (1977) and West & Williams' (2004) coefficients for seven European countries
*Sources*: *Progressivity coefficients* - own calculations on data from seven national statistical authorities (see Table 2). *GDP/capita*–IMF (2009), *Gini-coefficients*: For all but Serbia, Eurostat (2009). For Serbia, CIA (2009). *Motor Gasoline Consumption*: WRI (2009a). *Population Density*: WRI (2009b). *Passenger Cars per 1000 People*: For all countries but Serbia, WRI (2009c). For Serbia, UNECE (2007b). *Urban Population as % of Total Population*: WRI (2009d).

| Index | Methodology | | Coefficient for country | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | *Type of income* | *Type of Effect* | *France* | *Germany* | *Italy* | *Serbia* | *Spain* | *Sweden* | *United Kingdom* |
| Suits (1977) | Temporary | Direct and indirect | −0.157 | −0,067 | | 0.172 | −0.086 | −0.178 | −0.125 |
| | Temporary | Direct only | −0.155 | −0.066 | | 0.187 | −0.086 | −0.171 | −0,123 |
| | Lifetime | Direct and indirect | −0.024 | 0.008 | −0.110 | 0.051 | −0.002 | 0.064 | −0.004 |
| | Lifetime | Direct only | −0.021 | 0.009 | −0,110 | 0.066 | −0.002 | 0.072 | −0.003 |
| *Various statistics for comparison* | | *Details* | *France* | *Germany* | *Italy* | *Serbia* | *Spain* | *Sweden* | *United Kingdom* |
| GDP/capita (2006) | | PPP adjusted, current international $US | 30150 | 31571 | 29406 | 5713 | 27542 | 31264 | 31585 |
| Gini-coefficient (year) | | | 27 (2006) | 27 (2006) | 32 (2006) | 30 (2003) | 31 (2006) | 24 (2006) | 32 (2006) |
| Motor gasoline consumption (2005) | | Liters per capita and year | 223.8 | 353.9 | 292.4 | 132.1 | 213.3 | 544.8 | 396.3 |
| Population density (2005) | | Number of people per square kilometer | 110.6 | 231.5 | 194.6 | 111.6 | 85.8 | 20.1 | 248 |
| Passenger cars per 1000 people (year) | | | 494.6 (2003) | 545.5 (2003) | 194.6 (2003) | 161 (1999) | 454.7 (2003) | 455 (2003) | 439.2 (2003) |
| Urban population as a % of total population (2005) | | | 76.7 | 75.2 | 67.6 | 52.2 | 76.7 | 84.2 | 89.7 |

where, as in the UK, the total fuel taxes are high and hence incidence on average also. Otherwise figures are fairly similar but the overall impression is one of greater progressivity in these figures. This is also confirmed when we look at the overall Suits measures as given in Table 6 as well as Figs. 5 and 6. The Suits coefficients are all negative—i.e. they find regressivity when we use a traditional income measure. All with the exception of Serbia which being a lower income country with a smaller share of the population having access to cars (see Table 6), may be it is not surprising that fuels have more of a "luxury" character and hence fuel taxes are more progressive. This hypothesis is also strengthened by the finding of strong progressivity in India by Datta (2008) already mentioned. When however expenditures are used as a proxy for lifetime income, we find that the picture is much more mixed. Both Germany and Sweden actually find the fuel taxes now to be progressive instead of regressive. However all the values—for practically all the countries (except Italy) are very small and perhaps the tax should now be best characterized as proportional on average.

Table 6 also allows us to study the difference between direct and total effects which are however in all cases very small. The addition of indirect effects thus does not turn out to make a very big difference in these countries (it can do in countries in very low income countries).

Table 6 also provides some additional comparative data on the countries, income, inequality as measured by Gini, population density, vehicle density and degree of urbanization. There is however not much variation in income (with the exception of Serbia). Sweden is an outlier when it comes to low population density but still has a high degree of urbanization and high gasoline demand per capita. These factors might contribute to making a fuel tax somewhat more regressive—although the regressivity in Sweden still only applies to the case when yearly income and not lifetime income (expenditures) are used.

## 6. Conclusion and discussion

Fuel taxation is an effective and potentially important instrument in dealing with climate change. Those who disfavor fuel taxes often claim they are strongly regressive. Earlier studies have shown that this depends on the country studied and on the details of the methods used, for instance if lifetime or temporary income is used, if substitution or other reactions are allowed for in the analysis. There is a tendency to progressivity in low income countries but regressivity in high income countries. We use fairly simple methods in order to study a larger selection of European countries. We find that when using traditional income as a measure, there is indeed technically some regressivity in most of the European countries studies. It is however so small that the tax can for practical purposes be considered broadly proportional or neutral. In the lowest income country, Serbia, the tax is instead progressive. The inclusion of indirect consumption through public transport has little or no effect on results. The use of lifetime income (as proxied by total expenditures) does however more or less reverse results and the tax is now found to be neutral or proportional (or weakly progressive in some countries and weakly regressive in others). As shown by West and Williams (2004) inclusion of adaptive mechanisms such as elasticies and in particular individual elasticities for each decile and the use of theoretically preferable measures such as equivalent variation instead of ordinary consumer surplus measures tend to weaken regressivity and or make results even more progressive.

The reader should note that we have only investigated one of several possible effects of fuel taxation. There are also distributive effects of changes in pollution, transitional effects on various

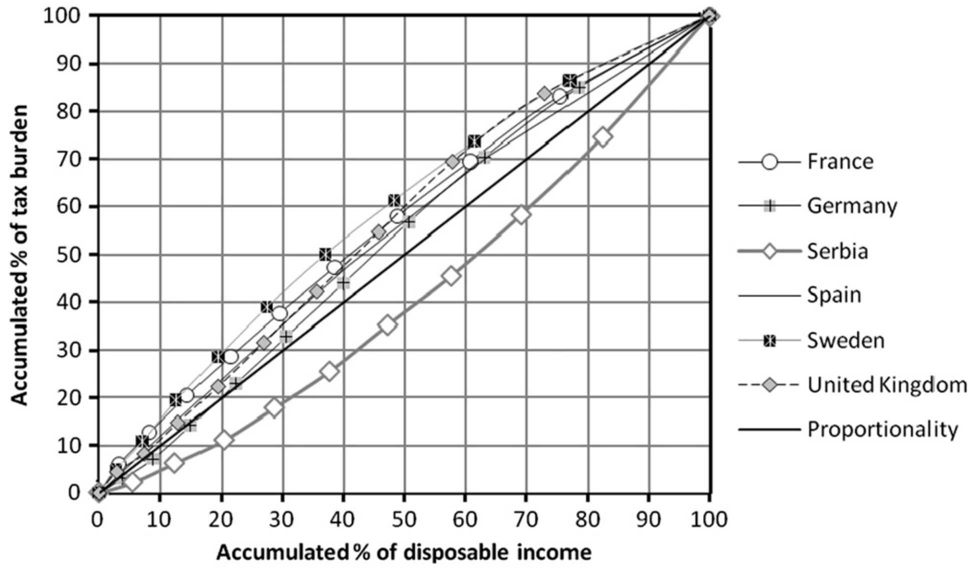


**Fig. 5.** Concentration curves for seven European countries: direct and indirect tax burden plotted against annual disposable income.

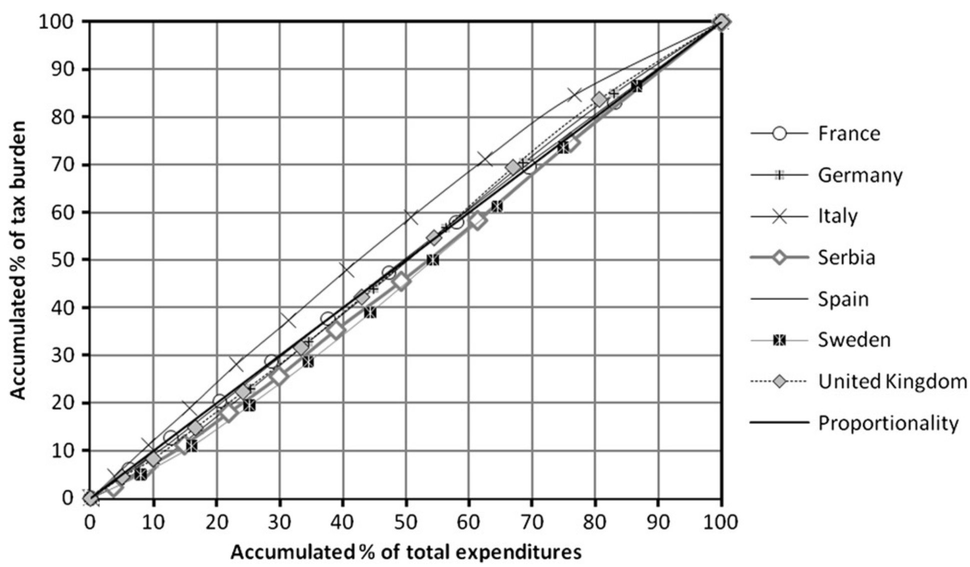


**Fig. 6.** Concentration curves for seven European countries: direct and indirect tax burden plotted against total expenditures.

markets, changing property prices etc, see Fullerton et al. (2008). As an example Bento et al. (2009) study effects through the used car market but this is outside the scope of this particular study. Most importantly however, there is the possibility of using proceeds of a gasoline tax in some way. Either the budget will be strengthened or public expenditures increased or finally other taxes may be lowered. Depending on which combination of policies is chosen, small distributional effects could quite easily be corrected if the policy maker so desires.

There is considerable opposition to fuel taxation. Part of this can be explained by the self-interest of polluters. In the case of fuel taxation however, the intensity of the acrimony has been unusually intense and has also to a large extent been focused around the argument that the taxes are said to hurt the poor. Naturally this would be a potent argument, perhaps in particular when used against the environmentalists who are often thought to be soft-hearted and left-leaning. As it turns out, there is little foundation for this argument.

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