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Fuel taxes: An important instrument for climate policy ☆

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Abstract

This article shows that fuel taxes serve a very important role for the environment and that we risk a backlash of increased emissions if they are abolished. Fuel taxes have restrained growth in fuel demand and associated carbon emissions. Although fuel demand is large and growing, our analysis shows that it would have been much higher in the absence of domestic fuel taxes. People often assert that fuel demand is inelastic but there is strong research evidence showing the opposite. The price elasticity is in fact quite high but only in the long-run: in the short run it may be quite inelastic which has important implications for policy makers. Had Europe not followed a policy of high fuel taxation but had low US taxes, then fuel demand would have been twice as large. Hypothetical transport demand in the whole OECD area is calculated for various tax scenarios and the results show that fuel taxes are the single most powerful climate policy instrument implemented to date—yet this fact is not usually given due attention in the debate.

Keywords: Climate policy; Fuel tax; Demand elasticity

1. Introduction

Lately there has been some interest in including transport into carbon permit trading. This is natural since people now expect that permit trading implies generous allocation of free permits and if a firm needs to buy more they are inexpensive (at least compared to fuel tax levels)! Agents in the transport sector presumably hope that joining a trading scheme will act as an argument for abolished or lower taxation. We must however be very careful otherwise this will lead to a rapid escalation in transport fuel use.

Analyses by climate scientists show that since atmospheric carbon absorption is slow it acts virtually like a stock pollutant and we will need eventually to reduce emissions drastically. The exact reduction depends on what risks we are willing to take but for instance Azar (2005) shows that 50% reductions relative today's level would be needed this century in order to meet a target of 450 ppm. The Kyoto Protocol only aims for a reduction that was intentionally made very small in order to get all countries on board. However not even Kyoto was acceptable to all parties and one of the reasons for this is the belief that there are no acceptable and yet sufficiently effective policy instruments available. As evidence some observers point to the carbon tax that was tested politically in the EU during the 1990s and (prematurely) discarded as impossible. Relatively little is said about fuel taxes which have a long and reliable track record of reducing emissions in the countries that set them sufficiently high.

On both ends of the political spectrum, there are people who lack faith in fuel taxes as environmental instruments. There are some who do believe in market mechanisms but who do not fully grasp the importance of the environmental issues at stake and therefore dislike fuel taxes. On the other side, there are those who are concerned for the atmosphere but who believe capitalism cannot survive without satisfying a 'constantly growing thirst for oil'. They therefore think there is no point in arguing for economic instruments. But both are wrong! Economic instruments can and do work well! The evidence is already here because—by some irony—the policies have been

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tested for quite a long time but it seems no-one sees the forest for the trees: The instrument relatively few climate researchers write about already exists and has a very large effect: it is called a *fuel tax* and if it were not for the fuel taxes in some countries the atmospheric content of carbon would already be much higher!

Fuel taxes might not originally have been designed for environmental purposes but their effect is surely environmental.[1] 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. Since this is a very important policy with large effects, we need to be very cautious not to abandon it lightheartedly—for instance as part of any scheme to integrate transport into the European Trading Scheme for carbon rights (ETS).

We focus in this paper on fuel taxes because of the importance of motor fuels that account for over half of total oil-related carbon emissions in the OECD. Their importance is even somewhat greater than just the percentage share suggests since fuels are the ''high-end'' of the oil barrel—the most difficult to replace.[2] We will in Section 2 describe how fuel demand elasticities are calculated. In Section 3 we compare fuel taxes between countries and in Section 4 we look at the environmental effect of fuel taxes focusing first on gasoline and then complementing with diesel. In Section 5 we look at political obstacles to fuel taxation, and Section 6 concludes.

2. The analysis of demand elasticities

Like all products we assume that the demand for fuel G, depends on income Y, and price P as in (1).[3]

$$G_{it} = cP_{it}^{\alpha} Y_{it}^{\beta} e^{\mu_{it}}. \quad (1)$$

However, it clearly takes a long time to adjust the stock of vehicles, not to speak of roads, urban architecture, public transport systems and forth. For this reason the quantity of fuel consumed in any particular year depends not only on current income and prices but also on a number of other variables such as the number and type of cars—which in turn depends on historic incomes and prices. For time-series data, it is common to use a so-called lagged endogenous model such as (2).

$$G_{it} = cP_{it}^{\alpha} Y_{it}^{\beta} G_{it-1}^{\lambda} e^{\mu_{it}}. \quad (2)$$

The lagged endogenous variable G_{it-1} can be seen as representing the inertia of the system and it is easy to show[4] that this equation is an alternative representation of a model in which fuel consumption depends on a large number of geometrically declining lags on the exogenous variables Y and P.

It is easy to show the short-run elasticity in (2) are α and β while the long-run values are $\alpha/(1-\lambda)$ and $\beta/(1-\lambda)$. With a λ of 0.7 the long-run elasticities are three times the short run values. There are many alternative models and the selection of model depends inter alia, on the type of data available. With cross-sectional data even the simplest static model will give reasonable long-run elasticities. With time series, such models do not perform well and the most commonly used, see Sterner and Dahl (1992) or Sterner et al. (1992). Already 1990 there were extensive surveys of the literature (for example, Drollas, 1984; Oum, 1989; Dahl and Sterner, 1991a, b; Goodwin, 1992) covering over a hundred different studies for different countries, time periods or methodologies. Since then there have been more studies, the some of which have focused on breaking down the mechanisms behind these estimates: number of vehicles, miles driven, efficiency etc, see for instance Johansson and Schipper (1997). Much of this later literature has been surveyed recently by Goodwin et al. (2004), Hanly et al. (2002), and Graham and Glaister (2002, 2004). The total number of individual estimates is now several hundred and we can only very briefly synthesize some of the main lessons of this large body of work here.

Graham and Glaister (2002) start their survey by summarising earlier surveys one of the first of which was Drollas (1984) which covers academic and non-academic studies including cross-sectional, time-series and pooled cross-section time-series models with a variety of lag structures. 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 slightly below unity. The author does not find big differences between the US and other countries. Dahl and Sterner (1991a, b) find long-run price elasticities in the interval −0.6 to −1 and for income between 0.6 and 1.4 depending primarily on methodology. Models with annual data appear to capture long run elasticities better than monthly or quarterly data which may be less reliable. Models which include vehicle numbers and characteristics give intermediate values.

Goodwin (1992) also explores the issues, updating previous surveys of gasoline price elasticities with work undertaken in the 1980s and 1990s. He shows that more recent work has generally revised the magnitude of

[1]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 and 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.

[2]Transport use of gasoline actually accounted for 29% of total oil use in the OECD in 2003 (authors calculations based on OECD data).

[3]The indices i and t are for country and year. It is common to assume a loglinear form as in (1) so that the parameters can be interpreted directly as elasticities.

[4]This is often shown using the Koyck transformation, see Sterner and Dahl (1992).

Table 1
Summary of price elasticities of gasoline consumption

	Short run	Long run
Time series data	−0.27 (0.18)	−0.71 (0.41)
Cross section data	−0.28 (0.13)	−0.84 (0.18)

Adapted from Graham and Glaister (2002) (standard deviations in brackets).

elasticity estimates upwards. Table 1 summarises his averages by type.

'Short-term' generally means up to a year. Long-term elasticities tend to be about three times higher than the short term. Having reviewed a wide range of studies, 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 Glaister (2004) find slightly lower values: price elasticities between −0.6 and −1 and income elasticities just above one.[5] Graham and Gleister conclude their survey of surveys and studies which build on many hundreds of studies, by saying that despite some variation in individual values, elasticities of fuel demand generally fall within a fairly narrow range. 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.

One very important issue, somewhat glossed over so far is that there are several auto fuels: at least gasoline and diesel—in some countries also gas, alcohol and various other new fuels exist. Practically all demand sensitivity studies focus on gasoline as opposed to diesel and other fuels. It is unclear why but 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 than those used for private auto use. Furthermore diesel and light fuel oil (LFO) are similar and the latter is usually untaxed so it may be the case that LFO gets used "illegally" in the transport sector. This should however not be a problem in later data for industrialised countries. 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 tax and other instruments which tend to be complex and vary over time. Schipper et al. (1993) make an important point when they note that since the shares of the different fuels and their relative prices vary over time and between countries, this may well be a source of error in the estimation of fuel elasticities. 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. A recent survey of the field, see Basso and Oum (2006), identifies this as one of the more important methodological issues that is not normally dealt with. One of the very few studies which explicitly does deal with this and 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 fuel price elasticities of −0.7.

3. A comparison of gasoline tax rates

The fuel price elasticities just mentioned are important because there are big differences among the OECD countries in fuel taxation. It is these differences in fuel tax that determine the differences in final consumer price.[6] When we discuss fuel taxes we should bear in mind that motoring also bears a number of additional taxes and fees that are levied directly on vehicles (registration fees, yearly taxes, vehicle sales taxes) or on road use (tolls, congestion fees and so forth). 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 more complicated to compare.

Table 2 shows the average rate of taxation on gasoline. This indicator is a weighted average reflecting the varying composition of fuels with different octane (premium and regular) in the proportions actually used in each country. It is expressed in international cents converted by purchasing power parity. This is a useful way to provide an indicator of the *actual burden* the tax places on the representative motorist. This makes it attractive as an indicator of the intensity or strength of a policy instrument. The reader should be aware, however, that the comparisons would be different if we had used market exchange rates. The difference for most high-income countries is small but for some low-income countries it is more substantial. In our sample of countries, the US would have had a somewhat higher tax and the Eastern European countries considerably lower values.

As we can see in Table 2 the average for Western Europe is 80 cents per liter, which is high compared to the US and many other non-European countries. Countries such as Japan and Australia are intermediate. Within Western Europe variation is limited although it can still be quite significant considering that many are actually neighboring countries. Looking at gasoline prices and taxes in the 1970s

[5]Short-term elasticities tend to go from −0.2 to −0.3 for price and 0.35–0.55 for income.

[6]Other sources of difference such as the efficiency, profit margins and costs of the gas stations also exist but they are fairly small.

Table 2
Gasoline taxes in cents/liter in selected countries, 2005

	Gas tax
Western Europe	
Italy	90
UK	97
Netherlands	100
France	89
Belgium	94
Germany	90
Finland	85
Norway	74
Portugal	103
Sweden	80
Denmark	70
Spain	72
Austria	68
Ireland	62
Luxembourg	60
Switzerland	50
Average	80
Eastern Europe	
Hungary	125
Czech Re	117
Poland	118
Average	120
Non European	
Japan	46
Australia	35
New Zealand	42
Canada	26
Mexico	21
USA	10
Average	30

Source: IEA (2006). Leaded/unleaded and premium/regular weighted by consumption shares. All figures in purchasing power parity constant (2000) dollar cents.

and 1980s there was a wide divergence within Europe and several important countries such as Germany and the UK had low taxes and prices, Angelier and Sterner (1990). Looking at the figures today, all the major EU economies, Germany, France, Italy, UK, Belgium and Holland now have high taxes and are fairly well harmonized at a level of 90–100 cents/l. This reflects a fairly long and conscious effort in countries such as the UK where the "fuel tax escalator" has implied a pre-announced, long-run program of, at least moderate, fuel tax increases. Unfortunately these increases ceased around 2000 and the costs of public transport have actually risen while fuel prices have stagnated. In a global perspective the UK still has high taxes however. Some of the smaller and more peripheral economies now have somewhat lower values. This includes some of the countries that earlier had high taxes such as Denmark.

The lowest taxes in Western Europe are in Luxemburg and Switzerland. Luxemburg is a special case which appears to be consciously attracting motorists from neighboring countries to fuel their cars thereby giving Luxemburg high tax revenues through a low tax rate which can hardly be seen as a serious European environmental or transport policy. The case of Switzerland is quite distinct. It uses regulations and advanced road pricing to deter transit traffic that is a considerable local environmental problem as well as causing big costs to road maintenance in mountainous areas. Other countries such as Austria and Ireland with low to moderate tax rates appear to compensate with sizeable road or vehicle taxes.

Outside the OECD, it is not uncommon for oilexporting countries to subsidize local consumption heavily. Oil-importing countries are split: some (but far from all) do tax petroleum products heavily keeping consumption (and expensive imports) down, see Sterner (1989a, b). Brazil is an important example that has attempted to tax imported petroleum products and cross-subsidize domestic alcohol as an alternative.

4. The environmental effect of fuel taxes

Politically, 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: Let us start with the case of gasoline; In the US annual gasoline consumption per capita is at 1300 l. Most European countries use less than a third (Germany 360, France 240, UK 360, Italy 300), see Figs. 1 and 2 (all data from IEA, 2006).

If the EU had followed a similar tax policy to that in the US, aggregate carbon emissions would have been substantially higher. It is, in some sense, impossible to calculate such a counterfactual path[7] for the whole transport sector in such a large group of countries 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. Consider a given country, i whose consumption G_{it} is a response to income and prices Y_{it} and P_{it}. If the country instead had different taxes and thus prices ρ—not only today but sufficiently long for the demanded quantity to be in equilibrium, then that country's hypothetical demand G_H would be given by (3)[8]:

$$G_H = G_{it}\left(\frac{\rho}{P_{it}}\right)^{\alpha}. \tag{3}$$

[7]Counterfactuals are never easy, particularly not for large changes. Had the whole of Europe and Japan not taxed fuels, then aggregate demand would have been higher creating an upward pressure on world crude prices with unforeseeable effects—particularly in a cartel market but we simply focus on the first order effect.

[8]This follows from the models of demand presented earlier. We chose the highest gasoline price in Europe which 2003 was in the Netherlands. We assume the only factor leading to differences in gas prices is the tax level. In reality there are other minor factors such as labour costs or market structure that vary between countries.

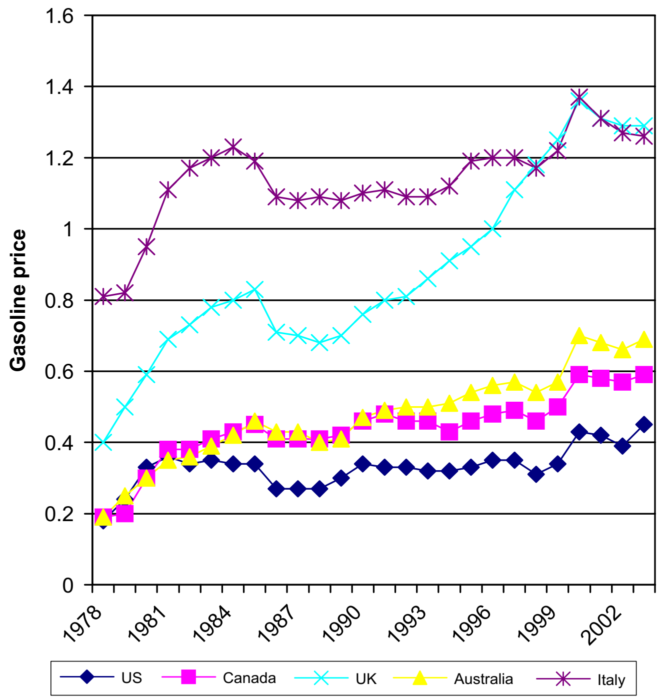

Fig. 1. Price of gasoline in selected countries. This diagram shows the nominal price paid by consumers in the five countries. Gasoline is much cheaper in the US, Canada or Australia than in the UK or Italy with the main reason for these differences being the differences in tax in each country.

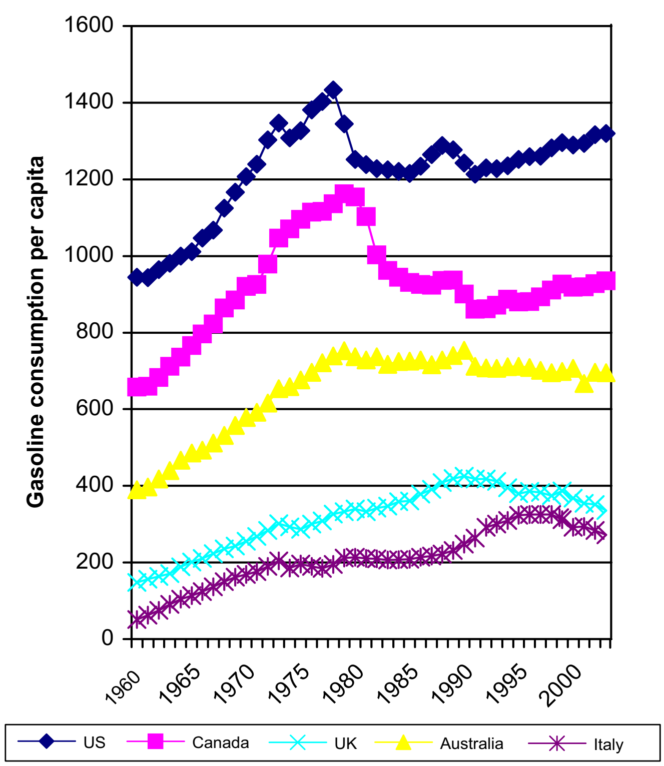

Fig. 2. Demand for gasoline in selected countries. This diagram shows the corresponding consumption of gasoline per capita in the five countries. We see that the ranking order is preserved and consumption is higher in those countries where price is lower.

In (3) the crucial parameter is the price elasticity α. We use a value of -0.8 following the survey above but we also show results for lower values.

Table 3 shows the considerable environmental importance that European gasoline tax policy has had. It shows the hypothetical effect on the OECD if all countries in the OECD had applied (for a long period) the price (tax) policy pursued by the European countries with the highest tax level (such as notably Italy, UK and the Netherlands). Not all individual countries are shown but the calculation has been done individually for each country, assuming a price elasticity of -0.8 and the results then summed to the OECD level. It shows that the whole OECD emissions of carbon from transport would have been 44% lower. Had we used a price elasticity of -0.7 we would instead had found differences of 40% (and 36% with a long run elasticity of only -0.6).

The difference in consumption is around 270 million tons of fuel per year. If we consider a decade of such differences this amounts to emissions of roughly 8.5 billion tons of CO_2 which is enough to imply that the atmospheric carbon content would have been 1 ppm higher than it is today if gasoline taxes had not been used the way they have in Europe.

Similarly, we can calculate the effect if all OECD countries had had as low taxes as the OECD country with the lowest taxes (the US). Total OECD fuel use would then have been 30% higher, see Table 4. This again, illustrates just how much gasoline taxes have achieved. I have often heard the counterargument that gasoline taxes were not created for environmental but for fiscal or other reasons such as to finance roads. It may be true that the intent behind these taxes was not necessarily environmental 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 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[9] in Europe, see Table 5, which shows the estimated volume shares of diesel in total fuel in different countries.

Note that Table 5 includes all the diesel and gasoline that is classified as transport related. It thus includes notably a high share for trucks and busses. We know however that a large part of the increase observed in many countries is due to the increased popularity of private diesel cars. According to Schipper et al. (2002) the share of diesels among new cars had reached 50% in many European countries by 2000 and even the share in the whole fleet was on average 8–15% in a selection of European countries—with a record of 25%

[9] *Data source*: IEA (2006). Table 4 shows volume shares without regard for differences in energy content or efficiency. In some countries fuels such as CNG or alcohol could play a role but as far as we have been able to ascertain, this is generally a very minor role.

Table 3
Effect of higher gasoline tax in the OECD

Country	Gas use (Ktons)	Price ($/L)	Hypoth. gas use with the highest EU price level	% change
Australia	13,900	0.68	8315	−40.2
Canada	29,568	0.63	16,717	−43.5
France	12,116	1.16	11,193	−7.6
Germany	25,850	1.16	23,815	−7.9
Italy	15,829	1.26	15,562	−1.7
Japan	44,566	0.77	29,499	−33.8
Mexico	25,122	0.89	18,716	−25.5
Nethlands	4185	1.28	4185	0.0
Spain	8040	1.14	7299	−9.2
Sweden	4105	1.03	3449	−16.0
UK	19,918	1.26	19,657	−1.3
USA	384,175	0.45	164,678	−57.1
OECD (24)[a]	612,487		342,447	−44.1

[a]Some newer OECD countries (Hungary, Czeck republic, Poland, Korea, Slovakia and Turkey are not included. These countries have very high gasoline prices using PPP exchange rates. Thus their hypothetical gas consumption appears higher when using Dutch prices but this seems somewhat misleading. Including these countries only changes the overall reduction from 44% to 42% so it is not vital for the conclusions.

Table 4
Summary of hypothetical and actual gasoline use in the OECD

Region	Actual fuel use (Ktons)	Hypothetical fuel use with high/low taxes (Ktons)				Difference between high and low price scenarios
		High tax	%	Low tax	%	
USA	384,175	164,680	−57	384,175	0	
Aus, NZ, Can, Mex	70,916	45,240	−36	105,540	49	
Europe	111,406	103,030	−8	240,356	116	
Japan	44,566	29,500	−34	68,820	54	
OECD	611,063	342,450	−44	798,892	31	+133%

in France. Considering that their average driving distance was much higher than for gasoline powered cars (40–110% higher in five major European countries) it is clear that the diesel shares in automobile use are quite sizeable. The last column of Table 5 has the relative price of diesel in relation to gasoline (averaged over the last decade 1994–2003). It is quite clear that there is a strong negative relationship between these average relative prices and the diesel share in 2003. The correlation coefficient is actually a striking −0.88 showing that relatively inexpensive diesel does actually appear to have been a strong mechanism in driving the expansion of diesel at the expense of gasoline. There is however a definite although very slow tendency to reduced price differentials. The simple average for 21 OECD countries of the relative diesel price rose from 0.65 in 1978 to 0.77 in 2003. Still 0.77 implies a very considerable relative subsidy to diesel and this is something that is totally unwarranted from the viewpoint of climate and generally speaking of local environmental emissions too.

An increased share of diesel is in itself often thought of as a mechanism of adaptation to higher fossil fuel prices since the efficiency of diesel engines is significantly higher. As shown by Schipper et al. (2002) and Schipper and Lilliu (1999), this effect is actually not worth much in practice. Although diesel engines are more efficient, they are heavier and this tends to entail that the diesel cars driven are (even) heavier. Thus for identical cars Schipper et al show that fuel efficiency of diesels is on average 26% higher and can be over 30% for new diesels (with TDI: turbocharged direct injection technology), but this is when efficiency is measured in litres. When correcting for the higher energy content of diesel and for the fact that fleet averages (the diesels and gasoline cars actually chosen on the market as opposed to comparing identical vehicles with different motors) the differences in efficiency drop to between 0% and 12% for 5 European countries. Furthermore the diesel fuel causes slightly more carbon emissions per unit of energy (it has more carbon atoms in relation to hydrogen atoms) when compared to gasoline. Thus the overall benefits of diesels to date are quite limited.

Furthermore there are some complex differences in health effects which hinge on the different emission profiles for Diesel and Otto engines with different fuels. In the latest decade or so the considerable toxicity of fine and

Table 5
Percentage shares and relative price of diesel

	1960 Share[a]	1980 Share[a]	2003 Share[a]	Pd/Pg last 10 years
Australia	35	36	45	0.95
Canada	50	46	45	0.88
Italy	52	66	64	0.72
UK	43	47	55	0.89
US	35	32	32	0.91
France	62	69	80	0.68
Germany	68	69	68	0.79
Spain	62	66	79	0.74
Belgium	66	74	84	0.66
Austria	48	52	78	0.72
Sweden	72	69	55	0.75

Note that the US has very few cars run on diesel so the data reflect mainly use by trucks and busses, etc. Some countries like Canada actually have a share of LNG and CNG gas too but this is not included here. The last column shows the relative price of diesel compared to gasoline.

[a]Share of diesel in the sum of diesel and gasoline. Source IEA (2006). Fuel shares by weight. (Shares by carbon emissions or useful energy would be slightly higher).

Table 6
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 had the prices that correspond to the lowest or highest in the OECD area, respectively.

ultrafine particles from diesel has been in focus. However, in the future, with new technology that could virtually eliminate particles and reap the full potential of diesel efficiency, it would be an environmental improvement to use diesel fuels.

The inclusion of the high (and increasing) diesel use means that the comparison made for total fuel consumption per capita between the US and Europe is somewhat less dramatic than it seems in Figs. 1 and 2. The difference is however still big: If we calculate the total (gasoline+-diesel) fuel per capita instead the US still has considerably more than twice the consumption of the UK or Italy and 60–70% more than France or Germany. This shows that part of the adaptation to higher fuel prices is fuel choice and this shows how detrimental reduced taxes on diesel can be. The effect of these considerations on our main conclusion is however quite limited. 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 the −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[10] of the effects on total fuel we can do an analysis using formula (3)—like the one in Tables 3 and 4—but for *total* automobile fuel using the weighted average price (average price of diesel and gasoline weighted by consumption shares) see Table 6. The conclusion is similar as earlier: if the whole OECD had harmonized prices to coincide with the countries that today have the highest (average) fuel price—which is now the UK—then 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. The difference between the low and high tax scenarios for the whole of the OECD for total fuel actually makes a difference of around 10% of total global fossil carbon emissions from all sources.[11]

All in all, this shows that the fuel tax policies should be seen, alongside the Kyoto agreement, as a policy of considerable importance even for overall carbon emissions. Therefore we believe the policy maker needs to be very careful to follow up on this lesson and not to loose track of its implications. Currently there are discussions of including the transport sector into the ETS.[12] Naturally this could in the long run have a number of potential benefits such as cost savings through equalization of marginal abatement costs. However there are also some considerable risks—particularly if the design is badly done—that the transport demand for permits drives up the price of permits causing industries to question the system. There is also the opposite risk that the transport sector manages to argue that carbon and gasoline taxes should be phased out in return for their joining the ETS. This could easily have the perverse effect that the effective price of gasoline goes down instead of up- thus causing transport fuel demand to explode.

5. Political economy type of obstacles

If fuel taxes are such a good instrument, we must address the question why they are not used more universally—also in the USA and in low-income oil exporting countries that regularly sell fuel at very low prices on the domestic market?[13] One reason may of course be that their decision

[10]This is still a rough estimate since we have not included alcohol, gases, bio-diesel and other fuels. Nor have we in detail analyzed the cross-price elasticities between all the fuels.

[11]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.

[12]See for instance CE Delft (2006), SOU (2005) or Egenhofer et al. (2006).

[13]In the case of the developing, country oil producers it appears to be a mechanism to share the rent, see Sterner (1989a, b) and Hammar et al. (2004).

makers do not believe in or rate climate change as a serious problem. Another important factor appears to be the prevalence of political lobbying. Policies are not necessarily adopted because they maximize welfare—in fact some would discard this as a very naïve idea. Instead policies are shaped by economic interests and the higher the dependence on motoring among the (electorate) population the more difficult it is politically to raise fuel taxes, see Sterner (2002) or Hammar et al. (2004).

The difference between short and long-run elasticities is an important factor in this context: In the short run, there is little environmental effect but a big resistance that makes politicians hesitate. The important environmental effects come in the long-run but that is a limited consolation to politicians trying to get reelected and therefore looking for visible progress in the short run. It is for these reasons that this particular policy experiment (high fuel taxes) is a valuable lesson. Whatever the reason for these taxes, their effect has been to lower fuel use and thus environmental damage.

One of the motivations for the suggestions of integrating transport into the EU trading directive is that the use of oil products is still growing fast in the transport sector which has been "managed" by fuel taxes, while consumption growth is lower (or negative) for the industrial sectors within the trading sector. This might create the impression that permit trade is more effective than fuel taxes. Nothing could be more wrong! The difference is due to the fairly high income elasticity for motoring while industrial fuel demand in the rich countries of the OECD is more sluggish. The differences in principle between the operation of taxes and permits trading are several and complex but in this case they are completely dominated by the magnitude of the implied carbon price. In the trading sector, the marginal cost of emitting carbon is the permit price which is in the region of 20 $/ton which is not much compared to the highest gasoline taxes which are of another order of magnitude (1 dollar per litre or 300 $/ton CO_2). Motoring is currently taxed at a very much higher rate than heating or industrial use of fossil fuels in Europe. If we are to reduce fossil carbon emissions it is vital to keep up the pressure on transport fuels and at the same time raise the price or increase the stringency of the instruments used for the other sectors.

6. Conclusion and further reflections

This article seeks to show just how much has been achieved by transport fuel taxation in European countries (and others with high fuel taxes): the effect of gasoline taxes on global carbon emissions makes it a significant instrument of climate policy. The bottom line is that carbon emissions are essentially cut by more than half by introducing a long run policy of high taxes that raises the consumer price by a factor of around 3. This is basically the difference between the USA and Europe. These policies in the high tax countries, mainly in Europe, have already had an effect on the carbon content of the atmosphere of the order of more than 1 ppm. Had they followed the USA and other low tax countries the carbon content of the atmosphere would (other things equal) have been even higher today. Conversely if the USA and others had had high taxes it would be less high. Policy makers should be careful not to loose this environmental effect by lowering fuel taxes in Europe—and this policy applies to both gasoline and diesel.

There is also an important message here for rapidly growing countries such as the giants of Asia, China and India concerning the role of sensible institutions and policies. We are dealing with a long run problem and now is the time to think of what (urban, technological and transport) structure these societies will have in a decade or two since it will determine energy and fossil fuel intensities for many years to come. One would therefore hope that building, infrastructure and vehicle technologies as well as urban architecture be adjusted to expectations of a high and rising fuel price for all fuels, in proportion to the environmental damage they cause, both at the local and global levels[14].

It is also very important to discuss the spread of sensible policies to other sectors, notably industry. It is likely that carbon taxes[15] would be the most effective policy instrument but for the power of lobbyists who will always use the argument of threats to competitivity. Including transport in the current ETS could in fact lead to a harmonization between sectors. However it risks being a harmonization that will lead to a lowering of the effective price for transport while raising the carbon price so much for industry that the reaction would threaten the intergity of the whole system.

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[14]The ideal policies for the transport sector might actually be a combination of taxes (or rights) for carbon to deal with global climate change, differentiated kilometer based taxes for wear and tear of roads and differentiated environmental/congestion charges (that take into account local air pollution where both diesel in old engines and gasoline use in two stroke engines may be particularly important in some developing countries such as India). This is however also outside the scope of this paper.

[15]There are at present really no countries that have true broad-based carbon taxes. Sweden and Norway have sizeable carbon taxes for some sectors (Denmark, Finland, Italy and the Netherlands also have some form of carbon taxes, see Stavins (2002)). The Swedish tax level is over 300 USD/ton of carbon which is high compared to the levels that have been discussed internationally. There are however numerous exceptions to the tax (particularly for industry). In spite of this they have had significant effect for instance on biomass use for district heating and for carbon sequestration in the Norwegian gas field Sleipner Vest.

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