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The taxation of diesel cars in Belgium – revisited

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ABSTRACT

This paper compares the current taxation of diesel and gasoline cars in Belgium with the guidelines for optimal taxation. We find that diesel cars are still taxed much less than gasoline cars, resulting in a dominant market share for diesel cars in the car stock. If the fuel tax is the main instrument to control for externalities and generate revenues, the diesel excise should be much higher than the excise on gasoline for two reasons: diesel is more polluting than gasoline and more importantly, through the better fuel efficiency, diesel cars contribute less fiscal revenues per mile.

1. Introduction

Many externalities in the transport sector need to be corrected for. The congestion, accident and environmental externalities are the most important ones. In principle, the environmental air pollution externalities are easiest to address. All one needs to do is to make sure that car users select the right vehicle and take into account the environmental costs when they decide on their vehicle use.

The choice of vehicle is the principal determinant of the level of air pollution by cars. Over time the OECD countries have seen a large reduction in conventional air pollution emissions thanks to the introduction of more performing catalytic converters and cleaner fuels. There has been a somewhat smaller progress for fuel efficiency and greenhouse gases (GHG). In the European Union the conventional pollution (non-GHG) of cars is regulated via standards. Standards for conventional pollutants are different for gasoline and for diesel cars. For greenhouse gases there are minimum fuel efficiency objectives to be met by each manufacturer for the average of all cars sold.

One of the few policy decisions left to the European member states are the registration taxes on cars, the excise taxes on fuels and the subsidies for cleaner vehicles. Among the EU member countries significant differences are observed in the market share of gasoline and diesel cars. Belgium is one of the countries where more new diesel cars are sold than new gasoline cars. In the Netherlands, another small EU country without a national car producer, diesel cars have a much smaller share in the sales of new cars.

In this paper we study in more detail the attitude to diesel cars in Belgium and the EU in general. As the differences in market shares are largely the result of a different tax treatment of gasoline and diesel cars we start with a discussion of the ideal tax system for gasoline and diesel cars. After presenting evidence on the environmental costs of gasoline and diesel cars, we then turn to the situation in Belgium. We describe the evolution of the car fleet and the tax system that underlies it. We find that recent changes in the Belgian tax and subsidy system have strengthened the position of diesel cars, leading to a reduction in CO_2 emissions. However, this has been realized at a very high social cost, mainly due to a lack of consideration of the tax revenue effects. This conclusion is likely to hold also for other countries with similar tax systems. The reason why some countries apply a tax system that is closer to the ideal tax system, and others do not remains an interesting political economy question.

2. How should diesel and gasoline cars ideally be taxed?

According to economic theory, taxes have two functions: first, to correct the market prices for external costs and second, to raise government revenue in an equitable and efficient way. The implications for the taxation of gasoline and diesel cars can be understood using Fig. 1. Fig. 1 represents schematically the full social costs of gasoline cars and diesel cars (the two left bars) and assesses the optimal taxation of both types of technologies (bars 3 and 4). The next two bars represent the ideal solution under the constraint that only fuel taxation is available. The approach we follow is highly simplified and mainly useful to get the intuition right. Fig. 1 is expressed in euro/vehicle km and represents a standard car in a standard situation. In theory one needs to discuss a whole set of prices and taxes because the social cost

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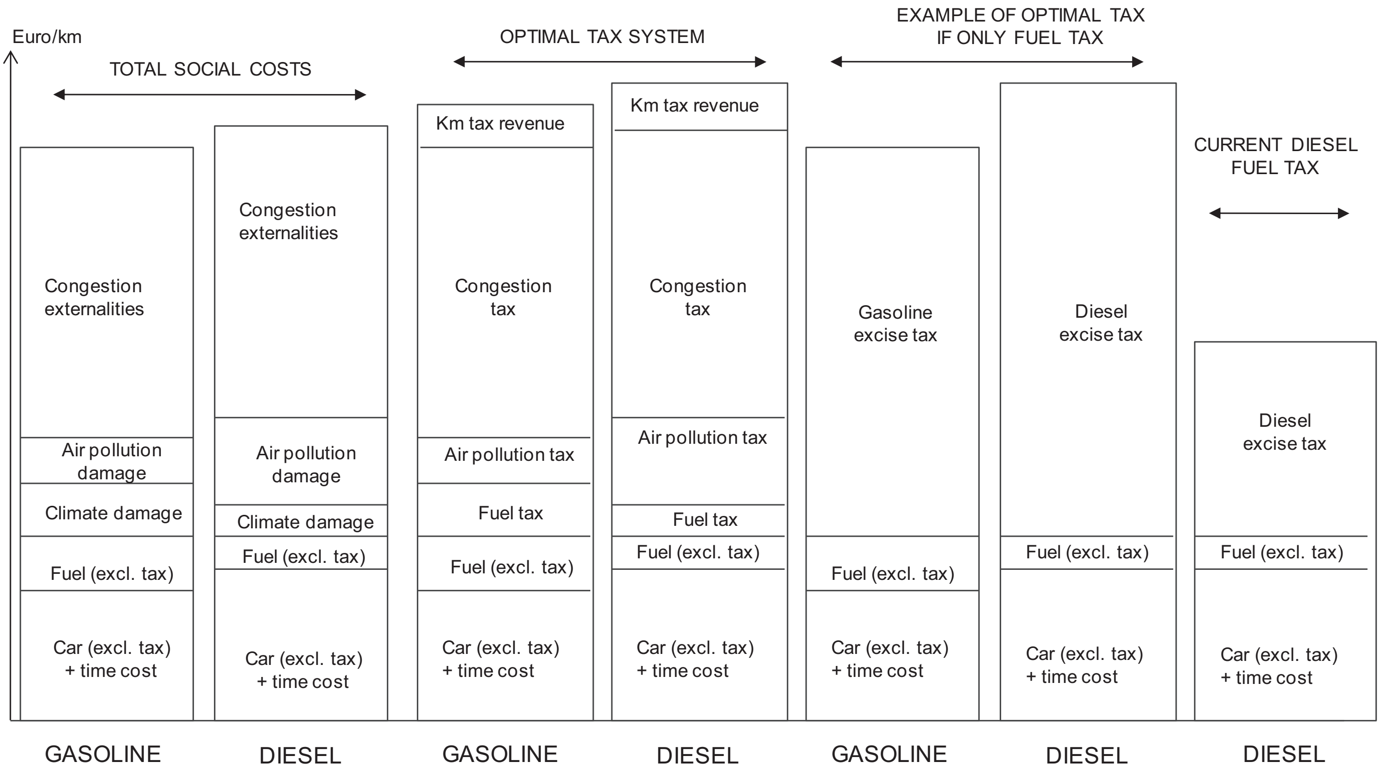

Fig. 1. Taxation of gasoline and diesel cars.

of using a car depends strongly on place and time: congestion costs differ between the peak period and the off-peak period, air pollution damage depends on density of population etc. As most of the time we cannot differentiate taxes in this way, we present here average external costs.[1]

Take the first bar: this is the total cost to society of one km driven by a representative gasoline car. The cost consists of the vehicle production cost, the time costs for driving, the maintenance cost and the fuel costs, all before taxes.[2] To this we add the external costs: the climate change costs, the air pollution costs (related to the ambient concentration of particulates, tropospheric ozone, CO, etc.) and the external congestion costs. We do the same for an equivalent diesel car. An equivalent diesel car has the same size and performance as the representative gasoline car we selected. For the same power and size, an equivalent diesel car will have larger car production and maintenance costs (Delhaye et al., 2010), all before taxes. A diesel car is in general more fuel efficient and has therefore lower fuel costs (before taxes). As for the gasoline car, we add the different external costs. Because a diesel car is more fuel efficient it has lower climate change costs. The higher emissions of particulates cause diesel cars to generate more air pollution damage. The end result is that diesel cars are, for society as whole, slightly more costly than gasoline cars. Further on we will show that this result depends strongly on the precise emission standard (Euro 1 to 5) to which the car complies.

[1] In fact we use two simplifications: first, we discuss only averages and secondly, we neglect the reaction of some external costs to the volume of traffic. It is obvious that some external costs like the marginal congestion cost are endogenous: congestion pricing or higher prices for car use reduce the volume of car use and therefore the external marginal congestion cost.

[2] We left out all accident costs as these would require a more extensive discussion and are not really relevant for the gasoline versus diesel discussion.

2.1. *External cost considerations*

The ideal, but unrealistic, taxation scheme is represented in bars 3 and 4 of Fig. 1. In principle the car purchase costs, time costs, fuel costs before taxes and maintenance costs are paid by the user, whatever the level of external costs. When it comes to the first objective of taxation (the internalization of external costs), it is best to use a combination of taxes (Proost and Van Dender, 2001; Mayeres, 2003). For each external cost, the ideal tax base is the externality itself so that the externality tax is the correct incentive for each car user to select the car with the lowest social cost. This means that if there is a car that costs somewhat more to produce but has a smaller social cost, the car user will select that type of car. The ideal tax for climate change is a fuel tax, as there is a one to one relation between the type and quantity of fuel used and the emissions of CO_2 and so also with the climate damage. For air pollution, the emission level is mainly determined by the emission technology of the car. For external congestion costs one would ideally need a km tax that is differentiated by time of day and location.

2.2. *Revenue raising objectives*

As regards the second objective (to raise revenues), one obtains best results by taxing goods that are less price elastic and this implies taxing close substitutes in the same way. Fifty years ago, diesel cars used to be poor substitutes for gasoline cars, but recent diesel cars can offer the same quality of driving as gasoline cars. This means that both are now good substitutes. Therefore, they should generate more or less the same tax revenue per car km. The optimal tax on top of the external cost has been a topic of fierce debates among economists[3]; we keep it

[3] In the so-called double dividend debate, the claim was that taxing "dirty" goods would generate a second dividend (on top of the better environment) by

simple by stating that it is best to have a larger tax when the demand for the good is relatively inelastic. Demand for car use is indeed rather inelastic (Goodwin et al., 2004). In Fig. 1 we added a small revenue raising tax per vehicle km.

2.3. Restrictions on tax instruments

The correct taxation of gasoline and diesel cars is difficult because of several restrictions. First of all, in the short run, it is relatively difficult to tax car use directly. Therefore, the inputs of car use need to be taxed. One has to use taxes on car purchase and ownership and fuel taxes. Of these instruments, fuel taxes are probably most appropriate as a tax on the external costs. However, they suffer from a number of drawbacks. They cannot be differentiated according to location, time, and emission technology of the vehicle. The present taxation of vehicles is a mix of vehicle taxes (registration or annual fixed taxes), fuel excises, and of environmental regulations. The environmental regulations are imposed at the EU level for all new cars and have become more stringent over the years. When only registration or fuel taxes can be used, a second best could be to have the fuel taxes per km more or less in line with the average external cost per km and to add the same extra tax for both types of vehicles. In this way, the user price for both technologies still respects the absolute difference in social costs and generates revenues with a minimum of distortions. Bars 5 and 6 present a possible second best tax system. This result has far reaching implications. When diesel cars consume less fuel per km than gasoline cars and one wants both types of cars to generate the same tax revenue per car km, one needs to charge a higher tax per liter of diesel than per liter of gasoline. Moreover, it is likely that a diesel car has a higher social cost than a gasoline car. A diesel car generates less GHG and thus less climate damage but produces more conventional pollution costs via a higher emission of particulates. On balance, the difference in conventional pollution is more important so that a diesel car is in total more damaging for the environment than a gasoline car. The implication is that the excise on diesel fuel should be even higher, as the total user cost of a diesel car should be higher. This is a simple but important insight to which we return later.

Using only fuel taxes to correct for externalities and to raise government revenues has been the dominant mode of taxation but generates some extra problems. We discuss in more depth two of these problems: The excessive incentive to save fuel and the tax competition on gasoline and diesel.

Fuel taxation would be an ideal tax base if all external costs would be proportional to the fuel consumed. This is only the case for climate damage, as this is directly proportional to fuel consumption. When only fuel is taxed, there is a disproportionate incentive to save fuel. Each liter of fuel saved reduces climate damage but it will in general be cheaper to reduce climate damage in other sectors where the tax on fuel does either not exist or is much lower (Proost et al., 2009). So ideally, the fuel tax is combined first with standards to address conventional air pollution and second with a higher registration tax on cars in order to raise revenue and to reduce car use in general.

The second specific problem of high fuel taxation is fuel tourism. Particularly small countries (say Luxemburg) may find it attractive to decrease their fuel taxes below the level in neighboring countries (see Kanbur and Keen, 1993). This will generate more revenue for the country that reduces the fuel tax, while this country will escape largely the air pollution and congestion associated to the use of this fuel. There are solutions to this type of tax competition. First, one can agree on minimum tax rates at the level of the federation (EU). Second, one can reduce fuel taxes and increase the vehicle taxes. The latter are more difficult to avoid by car buyers.

2.4. Results from previous studies

A number of studies have looked in more detail at the possible reforms of taxes on gasoline and diesel in Belgium taking on board all the reactions of the car users. Mayeres and Proost (2001) analyze a number of budgetary neutral reforms of car taxes and show that diesel is under-taxed. With constant fixed taxes on gasoline and diesel cars, an increase in the fuel tax on diesel cars financed by a reduction in the tax on gasoline is shown to be welfare improving, taking into account the impacts on households, firms, and the government. Similarly, at constant fuel taxes an increase in the fixed annual tax on diesel cars financed by a reduction in the tax on gasoline car ownership gives rise to a welfare improvement.

A second study (De Borger and Mayeres, 2007) simultaneously looks at the optimal tax structure on car ownership and use in Belgium in a number of scenarios. The economic model that is used makes a distinction between different car types, it takes into account the welfare of people that do not own a car and it assumes that everyone may use public transport for part of his trips. The ideal tax structure, namely the one where the government can set perfectly both the fixed and variable taxes, drastically changes the current tax structure. First of all, the tax on car use in the peak period is much higher than in the reference case and is also much higher than in the off-peak period. The reason is of course the existence of congestion costs. Second, the variable tax on diesel km is higher than that on gasoline km (and so even higher per liter) due to the higher environmental costs of diesel cars. Third, fixed taxes are approximately equal for both car types and they are lower than in the reference situation. The optimal tax structure, which would also lead to substantial increases in tax revenue, is very different from actual government policy.

If one does not wish to increase transport tax revenues, the study shows that higher variable taxes are compensated by a large fall in fixed taxes. In practical terms one could abolish fixed taxes.

If one assumes that perfect correction for external costs is infeasible and one has to limit oneself to reforming currently existing policy instruments (fixed taxes such as annual traffic tax, registration tax and fuel taxes), then no distinction can be made between the peak and the off-peak. The optimal set up of these taxes would imply a small increase of the gasoline tax and a substantial increase for diesel (almost doubling). The fixed tax on diesel would fall.

If one does not wish to touch the variable taxes either, then the fixed taxes can be used as a very rough instrument to take into account the congestion costs and especially the relative environmental costs of diesel and gasoline km. This results in much higher fixed taxes on cars, especially of diesel cars.

3. What are the air pollution and climate change costs of the gasoline and diesel technologies?

Fig. 2 reports the marginal air pollution and climate damage of different generations of gasoline and diesel cars in 2010. We distinguish between 5 generations of standards.[4] The underlying damages per ton of pollutant are based on Maibach et al. (2008).

(*footnote continued*)
using the revenues of the externality tax to reduce distortionary labor taxes. Giving this second benefit, one would be tempted to increase the externality tax beyond the external cost. The strong double dividend does not hold in general (Goulder, 1995).

[4] The Euro 1 standard was the first and was an obligation for new type approvals as from 1992. The Euro 5 standard is binding since 2009 for new type approvals and since January 2011 for all new cars.

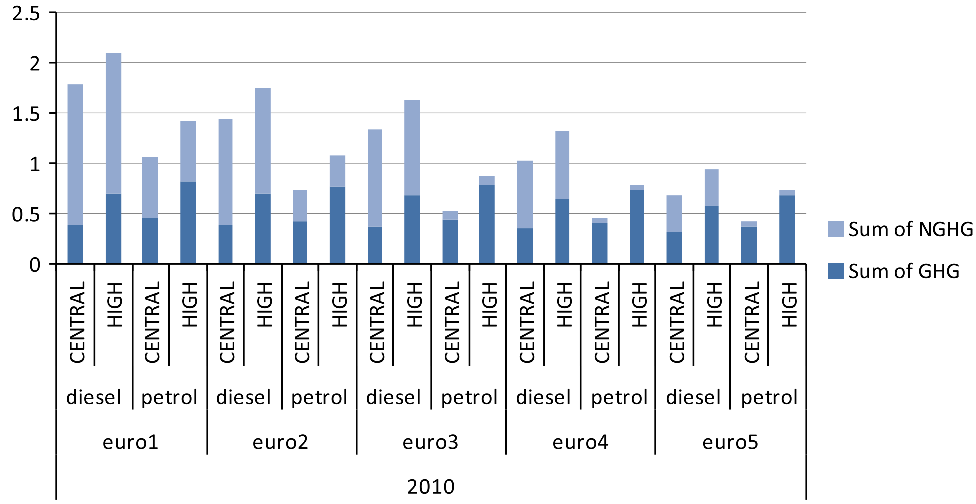

Fig. 2. Marginal air pollution and climate change costs of diesel and gasoline cars in Belgium in 2010 – different euro standards (eurocent 2009/vehicle km). *Source*: own calculations based on the E-Motion model (Vankerkom et al., 2009) and Maibach et al. (2008). GHG = greenhouse gases, NGHG = non greenhouse gases.

Table 1
Environmental damage costs of emissions in Belgium (euro 2009/ton).
Source: own calculations based on Maibach et al. (2008).

	Central	High
CO_2e	25	45
NO_x	6640	
PM	135,475	
NMVOC	3192	
SO_2	14,046	

Note: For PM we assumed the following shares of the areas in which they are emitted: 1.7% for urban metropolitan areas, 21.1% for other urban areas and 77.2% for non-urban areas.

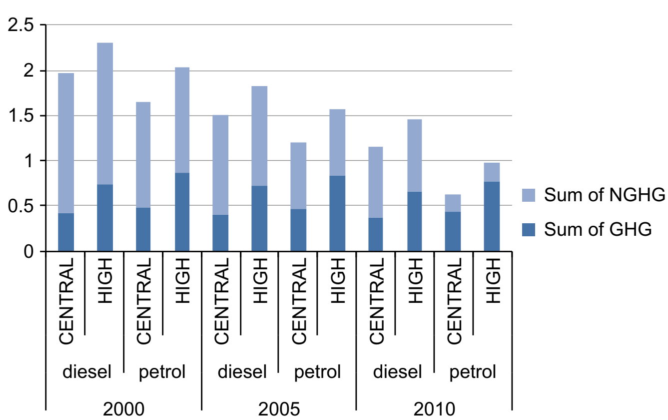

Fig. 3. Evolution over time of the marginal air pollution and climate costs of an average diesel and gasoline car (eurocent 2009/vehicle km) - Belgium. *Source*: own calculations based on the E-Motion model (Vankerkom et al., 2009) and Maibach et al. (2008). GHG = greenhouse gases, NGHG = non greenhouse gases.

They are reported in Table 1. We present calculations for the central and high value of CO_2 equivalents (CO_2e).

The emission factors on which Fig. 2 is based, are taken from the E-Motion model (Vankerkom et al., 2009). This is an average speed macroscopic emission model that uses COPERT4 energy consumption and emission functions, combined with other sources.

For diesel cars, the air pollution and climate change costs (in eurocents per vehicle km) decrease strongly in the different rounds of standards but remain in general higher than for gasoline cars. For

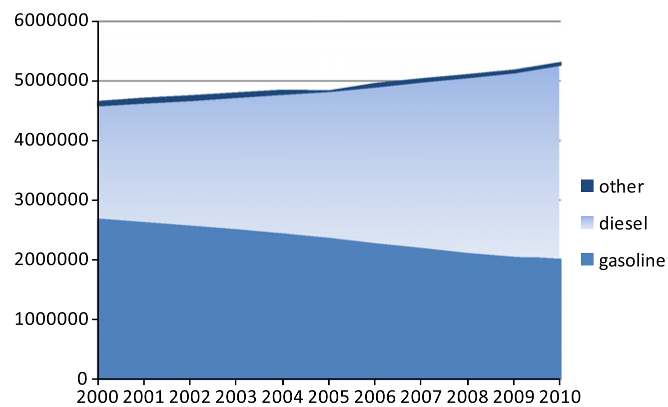

Fig. 4. The composition of the Belgian car fleet (2000–2010).
Source: Federal Planning Bureau.

the future the environmental cost of a euro 6 diesel car (using the same methodology as in Fig. 2) is projected to be 4% to 20% higher than that of a euro 6 gasoline car, depending on whether we use a high or central value for the climate change damages. A diesel car is especially damaging in areas with a high population density. From an environmental point of view a gasoline car is less damaging to health in an urban area.

Fig. 3 reports the evolution of the environmental costs of an average diesel and gasoline car over time in Belgium. These costs have fallen considerably over time. As expected, they are higher for diesel than for gasoline cars.

4. Diesel and gasoline car taxation in Belgium

4.1. The evolution of the Belgian car fleet

When we compare the structure of the car fleet in Belgium with that in other European countries, the first observation is that the share of diesel cars in Belgium is very high. In addition, this share is still growing (Fig. 4). Between 2000 and 2010 the share of diesel cars increased from 40% to appr. 61%.

In the period 2000–2009 the share of diesel cars in the registration of new cars in Belgium increased from 56% to 75% (Fig. 5). In the case of company cars (owned by "legal persons") appr. 90% of newly registered cars were diesel cars in 2009.

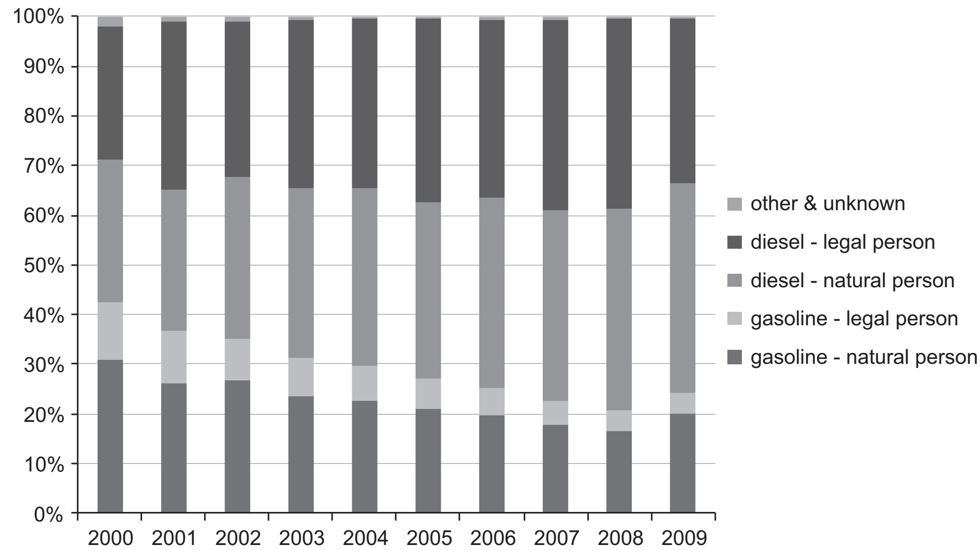

Fig. 5. New vehicle registrations in Belgium: share of fuel type and owner type (2000–2009).
Source: Federal Planning Bureau.

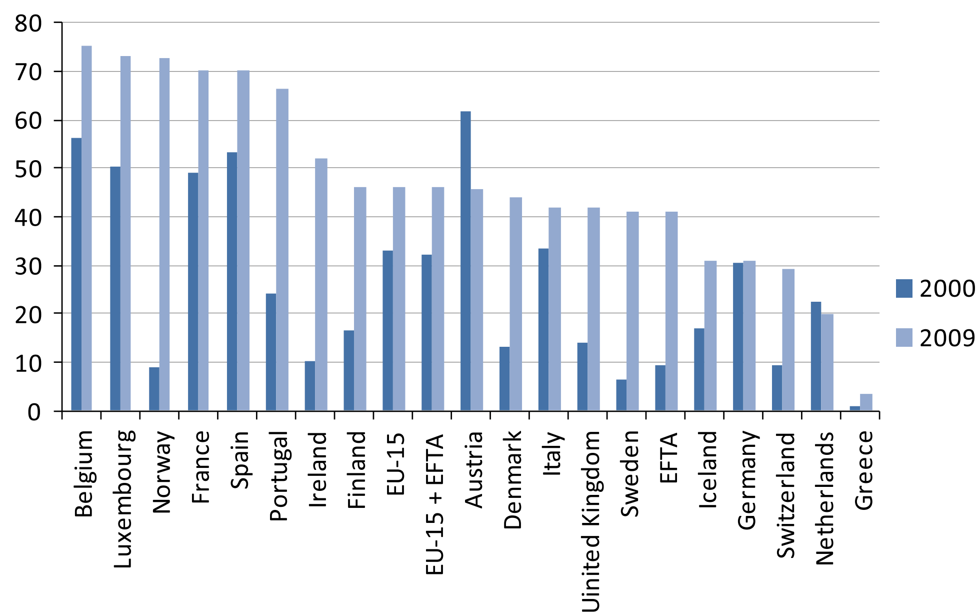

Fig. 6. Share of diesel in new passenger car registrations (%) (2000 and 2009).
Source: ACEA.

Between 2000 and 2010 the CO_2 emissions per km (test-cycle) of newly registered cars dropped by 20% (FEBIAC). Between 2000 and 2005 the reduction slowed down, but since then it picked up again. Although other factors are also playing (e.g., the larger range of diesel vehicles offered by manufacturers, the economic slowdown in recent years), the evolution is certainly strengthened by the tax system, which is described below.

In an international perspective Belgium belongs to the group of EU countries with the highest diesel share, together with France, Austria, and Luxemburg. The average share of diesel cars in the EU-15 (minus Portugal) was 22% in 2001 and rose to 33% in 2007 (ACEA).

Fig. 6 presents the evolution of the share of diesel cars in new passenger car registrations in the EU-15 and EFTA countries between 2000 and 2009. For the EU-15 the share increased from 33% in 2000 to 46% in 2009.

As is shown by Kalinowska et al. (2009) the tax systems on car purchase, registration, ownership, and use are very diverse in Europe. The authors find that generally taxes are lower for diesel than for gasoline cars. In most cases fixed taxes are higher for diesel cars, but this is compensated for by the lower fuel taxes. However, the relative tax differences vary across the countries.[5] We have been following the tax treatment of diesel cars since 2001 (Mayeres and Proost, 2001) and must admit we fail to see the rationale for a more advantageous treatment of diesel cars. Some countries avoid the high penetration of diesel cars (the Netherlands, Greece, but also US) but there is no reason why Belgium and other EU countries cannot adopt the same policy.

In the rest of this paper we focus on the Belgian case.

4.2. *The evolution of CO_2 emissions by the Belgian car fleet*

What are the resulting changes in CO_2 emissions by cars in Belgium? The line in and the numbers at the bottom of Fig. 7 give

[5] See the paper by Lee Shipper in this special issue.

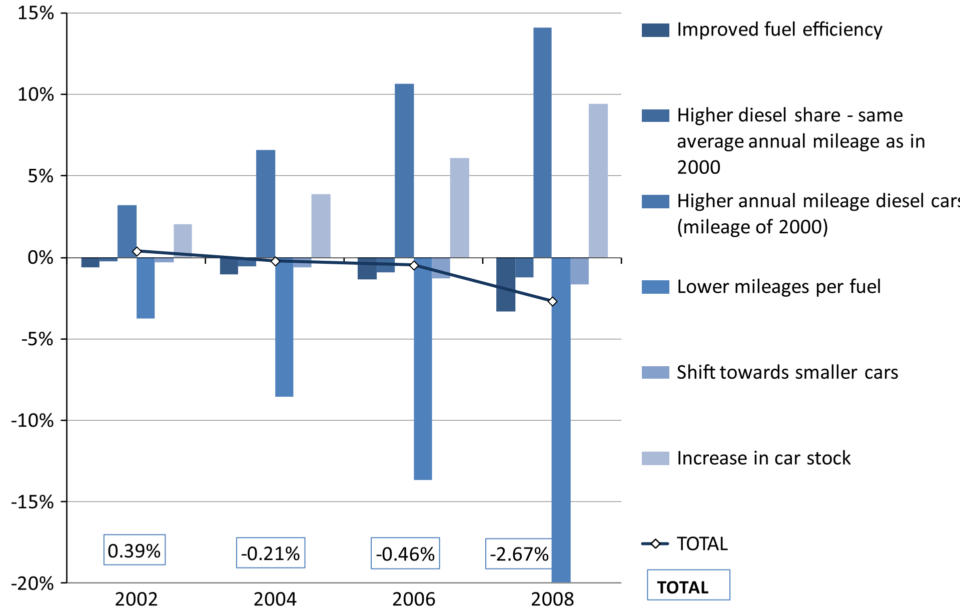

Fig. 7. Decomposing the evolution of CO_2 emissions by the Belgian car fleet between 2000 and 2008. *Source*: own calculations based on the E-Motion model (Vankerkom et al., 2009).

the percentage change in CO_2 emissions in the period 2002–2008 w.r.t. the emission levels in 2000, in steps of 2 years. By 2008 these emissions have fallen by 2.7% w.r.t. 2000, with the largest reduction taking place after 2006. The evolution is the result of changes in the total number of cars, in the share of different car sizes and fuel types, in the annual mileage of cars and in the fuel efficiency. For each year, Fig. 7 gives the contribution of the different elements to the evolution of the CO_2 emissions. Each bar gives the additional impact as the different determinants of the CO_2 emissions are changed one by one from their 2000 level to their level in the year that is considered.

- The first bar gives the impact of the increase in fuel efficiency w.r.t. 2000, keeping all other determinants of the emissions constant at their 2000 level. As can be expected, this leads to a reduction in CO_2 emissions w.r.t. 2000, ranging from −0.6% in 2002 to −3.3% in 2008.
- The second bar gives the additional reduction w.r.t. 2000 that has taken place due to the higher share of diesel cars, keeping the average annual mileage constant at the level of 2000. It ranges from −0.3% in 2002 to −1.2% in 2008.
- Next, we take into account that the average diesel car drives more than the average gasoline car, using the annual mileages by fuel type as observed in 2000. This implies an increase in the average annual mileage (by appr. 15% in 2008). The result is an increase in emissions w.r.t. 2000 (by +3.2% in 2002 to +14.1% in 2008) which is higher than the two previous effects taken together.
- The fourth bar accounts for the fall in the average annual mileage per fuel type between 2000 and 2008, leading to lower CO_2 emissions w.r.t. 2000 (ranging from −3.7% in 2002 to −20% in 2008). The reduction in the average annual mileage between 2000 and 2008 is observed both for diesel and gasoline cars, but it has been somewhat larger for the former, and differs according to vehicle size.
- Between 2000 and 2008 the average size of the cars has also fallen, thereby reducing CO_2 emissions, as represented by the fifth bar (between −0.3% in 2002 and −1.7% in 2008 w.r.t. 2000).
- Finally, the total number of cars has risen, causing higher CO_2 emissions (ranging from +2% in 2002 to +9.4% in 2008).

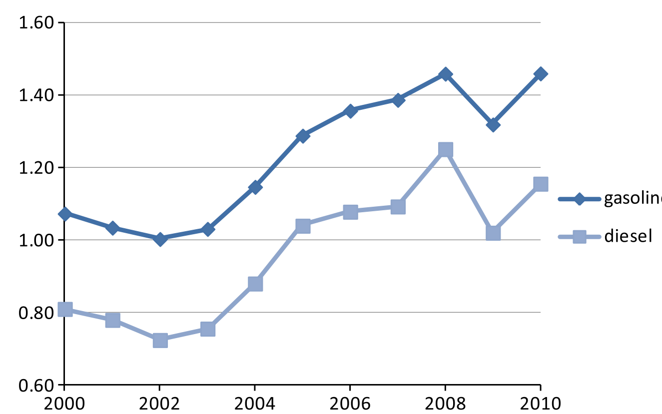

Fig. 8. Price at the pump in euro/liter (Belgium) (nominal prices). *Source*: IEA and Belgische Petroleumfederatie.

The aggregation of the impact of all these changes, gives the total impact that is represented by the line in Fig. 7 (see also the numbers at the bottom of the figure). The impact of the dieselization of the car fleet is given by the sum of the second to fourth bar. For 2002 and 2008 these three elements taken together give rise to a fall in the CO_2 emissions by resp. 0.8% and 7.1% w.r.t. 2000, which is reinforced by the rise in fuel efficiency and the higher share of smaller cars, and counteracted by the increase in the total number of cars. Of course, even if the higher share for diesel reduced CO_2 emissions, this may have come at a very high cost in terms of resources and foregone tax revenue, as we will show in the next section.

4.3. *The current tax system in Belgium*

The excise taxes on fuel are an important tax component. Fig. 8 reports the end user price of gasoline and diesel for the last 10 years. In the period 2000–2010 the price at the pump of gasoline is 17% to 39% higher than that of diesel. As the ex-refinery cost of both products is more or less equal, we observe that the price is always some 20–30 eurocents lower per liter for diesel. If one adds that a diesel car consumes some 20% to 30% less liters for the

Table 2
Difference in costs of diesel versions with respect to gasoline version (euro2009/year).
Source: own calculations based on Autogids, Ecoscore and Maibach et al. (2008).

		VW Golf (77 kW)		BMW 320 (120 kW)	
		Diesel	Fuel efficient diesel	Diesel	Fuel efficient diesel
Resource costs (excl. taxes and subsidies)	$a=a1+a2+a3$	65	141	168	94
Purchase costs	$a1$	144	272	361	361
Fuel costs	$a2$	−80	−132	−193	−267
Other resource costs	$a3$	0	0	0	0
Net taxes	b	−278	−753	−672	−865
Resource costs (incl. taxes and subsidies)	$c=a+b$	−213	−612	−504	−771
Total external costs					
Low damage costs CO_2e	$=d+e1+f$	23	6	15	8
Central damage costs CO_2e	$=d+e2+f$	19	−4	5	−10
High damage costs CO_2e	$=d+e3+f$	14	−14	−7	−29
External air pollution costs	d	24	9	19	14
Climate change costs					
Low damage costs CO_2e	$e1$	−2	−4	−4	−7
Central damage costs CO_2e	$e2$	−6	−13	−14	−24
High damage costs CO_2e	$e3$	−10	−24	−26	−44
Other external costs (congestion, accidents)	f	0	0	0	0

same distance, a diesel car pays some 50% less fuel taxes per km than a gasoline car.

Up to 2008 this difference in excises was partly compensated by a higher ownership tax on diesel cars, but for all the cars aiming at a high mileage, this higher fixed charge was compensated by the savings of the excise taxes. The excise compensating tax was gradually reduced as from 2004 and completely abolished in 2008. All of this stimulated the growth of the diesel share as described above.

4.4. *Comparing car taxes and external costs for gasoline and diesel cars*

It is useful to discuss in more detail the current tax treatment of gasoline and diesel cars. We do this for two types of cars: a VW golf (77 kW) and a BMW320 (120 kW).

For these two car types, we compare the taxation of 3 variants: a regular gasoline car, a regular diesel variant and finally a very fuel efficient diesel variant. The latter variant has become important because the Belgian government has installed a special subsidy regime for more fuel efficient cars bought by natural persons. Cars that emit between 105 and 115 g of CO_2/ km receive a subsidy of 3% on the purchase price. Cars that emit less than 105 g of CO_2/ km receive a subsidy equal to 15% of the purchase price. Both subsidies cannot exceed an annually indexed ceiling. From 2007 to 2010 there was an additional federal subsidy for new diesel cars with a particulate filter emitting less than 130 g CO_2/ km. All of this on the basis of test cycle emissions.[6,7]

The main assumptions used are a lifetime of 9 years, a real interest rate of 4%, fuel prices of 2009, a marginal cost of public funds (MCPF) of 1.5 and emission factors that are based on test cycles. The latter may be different from real emission factors. The MCPF represents the real cost of raising revenue via labor taxes. Raising one more euro via labor taxes costs in general more than one euro in terms of resources because the increase of labor taxes creates an additional efficiency loss on the labor market.[8]

For the two car types we compare the gasoline version with the two diesel versions. The comparisons are on an annual basis and include each of the cost components used in Fig. 1. The annual distance driven is taken to be 15 000 km for the VW Golf and 23 000 km for the BMW 320. It is assumed that the diesel variants cause the same congestion and accident externalities as the gasoline version. The results are summarized in Table 2. In our discussion we focus on the VW Golf. However, in general the same conclusions can be drawn in the case of the BMW 320.

We start with car and fuel costs before taxes, summarized in the first line. In the case of the VW Golf a regular diesel car costs 65 euro more per year before taxes and subsidies than a gasoline car; a very efficient diesel car costs 140 euro more.

In order to know the total user costs we need to add the taxes. For the VW Golf a regular diesel car pays 278 euro less in taxes than a gasoline car and a super efficient diesel car pays 753 euro less in taxes per year. Combining this with the difference in costs before taxes, we find that a diesel car is 213 euro cheaper to use than a gasoline car and a super efficient diesel car is 612 euro cheaper to use than a gasoline car. The user cost advantage of the fuel efficient diesel and the regular diesel car is entirely due to the lower tax regime.

This tax advantage would be justified if the diesel cars had significant lower external costs. Using the environmental damage valuation of Table 1, we find that the regular diesel VW Golf generates higher conventional air pollution costs (+24 euro per year) and somewhat less climate change costs (−2 to −10 euro per year, depending on the costs per ton of CO_2e). The net result is a higher external cost of 14–23 euro per year for the regular diesel car compared to a gasoline car and an external cost difference of −14 to 6 euro per year for the fuel efficient diesel compared with the gasoline version.

[6] The share of newly registered cars with CO_2 emissions $<=115$ g CO_2/ km (based on test-cycle emissions) increased from 6% in 2005 to 31% in 2010 (FEBIAC). In 2010 69% of these cars were bought by natural persons and could therefore benefit from the federal subsidy. The total budget spent on federal CO_2 subsidies in 2010 was close to 213 million euro (Minister of Finance, 2011), , corresponding to ±2600 euro per car for those receiving a subsidy of 15% and ±450 euro per car for those receiving a subsidy of 3%).

[7] In addition, in the Walloon region an ecobonus/ecomalus system, based on CO_2 emissions, exists for cars bought by natural persons. However, this system does not apply for the cars considered in our example, either because their CO_2 emissions are too high or because they are too expensive.

[8] see Dahlby (2008) for the concept of MCPF and Kleven and Kreiner (2006) for estimates.

Table 3
Implicit cost per ton of CO_2 emission reduction (euro/ton).
Source: own calculations based on Autogids, Ecoscore and Maibach et al. (2008).

	Units	VW Golf (77 kW)		BMW 320 (120 kW)	
		Diesel	Fuel efficient diesel	Diesel	Fuel efficient diesel
Difference w.r.t. gasoline version					
Resource costs (excl. taxes and subsidies)	euro/year	65	141	168	94
External air pollution costs	euro/year	24	9	19	14
External costs due to mileage	euro/year	0	0	0	0
Social costs of raising public funds[a]	euro/year	139	376	336	433
Net social cost	euro/year	228	526	523	541
CO_2 emissions	ton/year	0.225	0.525	0.575	0.975
Cost per ton of CO_2 savings	euro/ton	1013	1002	910	555

[a] The social cost of raising public funds is obtained by multiplying the reduction in tax revenue (compared to the gasoline version) by the MCPF − 1.

Compared to the gasoline version, the regular diesel VW Golf therefore receives a tax advantage of 278 euro per year to create 14 to 23 euro more pollution damage per year. The more fuel efficient diesel VW Golf receives a tax advantage of 753 euro per year to save 14 euro in pollution damage, in the case of the high costs per ton of CO_2e.

Using some conventions (like the MCPF), we can express this as a cost per ton of CO_2 emissions saved. The calculations are presented in Table 3. The tax advantages for the diesel versions of the VW Golf are equivalent to a subsidy of around 1000 euro per ton of CO_2 saved, which is well above the estimates of climate change damage in Maibach et al. (2008) and also well above the cost of saving CO_2 on the EU permit market (10–30 euro/ton).

Redoing the same computation for the BMW 320 in the gasoline, diesel, and fuel efficient diesel version, we find the same type of results. Compared to the gasoline version, the diesel versions pay less taxes and generate either somewhat more external air pollution costs (regular and fuel efficient diesel with low CO_2e damage and regular diesel with central CO_2e damage) or save some air pollution costs (other cases). This can be seen as a very costly way (555 to 910 euro per ton of CO_2) to save CO_2 emissions.

In the case of company cars, the tax system also favors cars with low CO_2 emissions. The income in kind corresponding with the availability of a company car, the social contributions on the income in kind and the tax deductibility of the company car in the corporate taxation are all based on the CO_2 emissions per km, with a further differentiation between fuel types. The conventional air pollution costs of the vehicles do not enter the equation.

In this section we showed that the overemphasis on CO_2 emission reduction in the transport sector via the use of subsidy schemes for cars with low CO_2 emissions favors even more the penetration of diesel cars. This proves to be a very costly way to reduce CO_2 emissions as CO_2 is saved at a cost that may be fifty times higher than the cost in other sectors. It is probable that all EU countries with favorable diesel car taxation that follow similar subsidy schemes end up with cost in-efficient CO_2 reduction schemes in the transport sector.

5. Concluding remarks

In the past, the fuel taxes on diesel were held relatively low, because diesel is used both by cars and trucks and it is difficult for the government to observe the purpose for which diesel is used. The low diesel taxes were accompanied by the excise compensating tax on diesel cars. However, the resulting overall taxation per km was lower for diesel than gasoline cars. This situation has partly arisen because the tax authorities did not take into account the technological developments for diesel cars. Nor did they consider new scientific evidence that point to the health damage caused by particulate matter. To make matters worse, some years ago the excise compensating tax was abolished.

There can be no doubt on the correct tax treatment of gasoline and diesel cars. As long as there are no better instruments to internalize congestion and traffic accident externalities, gasoline, and diesel cars should pay the same excises per mile. The high taxes per mile serve to limit the overall volume of car use and raise enough tax revenues. As for air pollution, the total damage of diesel cars remains higher than for gasoline cars because the carbon emission advantage is generally compensated by a disadvantage in terms of conventional pollutants. The correct tax treatment requires therefore excise taxes on diesel used for passenger cars that are much higher than for gasoline cars and when this is difficult an additional fixed charge per year to discourage diesel cars.

In this paper we found that some EU countries succeed in limiting the penetration of diesel cars. Other countries failed to do so and made things worse. Belgium in particular installed a subsidy scheme for low carbon emitting cars and this means increasing even more the share and use of diesel cars. Replacing a gasoline car by a more efficient diesel car boils down to a small reduction of carbon emissions at a very high social cost, mainly because the substitution of a gasoline by a diesel car means halving the tax contribution per mile. Overall, carbon emissions are reduced but in a very cost-inefficient way, as the social cost of the substitution is of the order of 500–1000 euro per ton of CO_2 to be compared to costs of CO_2 permits in European industry of some 20 euro per ton. The argument that in a cost effective reduction scenario the share of the transport sector in reducing the CO_2 emissions may be much smaller than its share in CO_2 emissions might suggest (see e.g. Proost et al., 2009), is apparently not understood by the policy makers.

It is difficult to see the reason why some EU countries got it right and others got it wrong. This remains an interesting political economy question. As the major social cost of favoring diesel cars is a lack of consideration for the tax revenue effects, the current budgetary crisis may put policy makers on the right track again.

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