

TROUBLING TRENDS IN ENERGETIC AND ECOLOGICAL INDICATORS IN PASSENGER TRANSPORT IN SELECTED OECD COUNTRIES

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Abstract

In this paper the relations between fuel prices and passenger travel activity, energy consumption in individual passenger transport, and the impact of fuel prices on fuel economy are analyzed for different OECD countries.

The major conclusions of this analysis are: Overall energy conservation and corresponding CO₂ reduction effects have not yet been strong or rapid enough to offset long-standing increases in overall travel activity. In Europe, however, technological improvements to new cars have occurred more rapidly than the increase in size and power of vehicles, resulting in a clearly discernible reduction in fuel use/km for new vehicles and the entire fleet since the late 1990s. Fuel prices have a modest impact on new vehicle fuel economy. However, as fuel prices increased, per capita car use leveled off or decreased. While car ownership and travel activity are strongly correlated with GDP, saturation of car ownership in the US and a slowdown in the increase in car ownership in Europe with increased GDP suggest slowing of overall per capita growth in vehicle use will contribute to slower growth in fuel use and emissions.

Introduction

Growth in passenger transport is the biggest contributor to the increase in world oil demand as well as air pollution and greenhouse gas emissions. Passenger cars contribute to a large share to these increases. Because of this the reduction of carbon dioxide emissions and energy use in passenger transport sector is an important goal in almost all countries. There are a lot of implemented governmental measures such as targets for CO₂-reduction, taxes and different fuel economy improvements programs.

Car ownership is still continuously increasing in all OECD countries as well as passenger travel activity. To derive solutions to problems caused by rising CO₂ emissions from cars, it is very important to know the impact of different economic parameters like income and fuel prices on energy consumption. Yet, energy consumption depends on two underlying categories of parameters: service in vehicle-km/capita and fuel intensity in energy use/vehicle-km.

Energy use in passenger transport is dominated by cars. Almost all fuel used for road passenger transport is from oil products, so that passenger transport cause significant amount of greenhouse gas emissions.

Fuel prices may have a significant impact on travel demand and fuel intensity. The development of the costs of the service mobility for cars¹ in road passenger transport (Fuel price/fuel economy, or the cost of fuel for 1 km of travel) in US\$ 2000 PPP/100 km is shown in Figure 1. The range of service prices varies widely across the analyzed countries. In 2006 the lowest service price was in the United States (\$ 0.05 per km) and highest in France and Italy (about \$ 0.20 per km). Between 1985 and 1998 fuel prices as well as service prices have been generally decreasing in real terms. After 1998 fuel prices increased significantly in many countries due to increases in world oil prices, as well as increases in fuel taxes mostly in European countries, as for example in Germany and United Kingdom. The relative increase has been largest in the US because taxes were lowest.

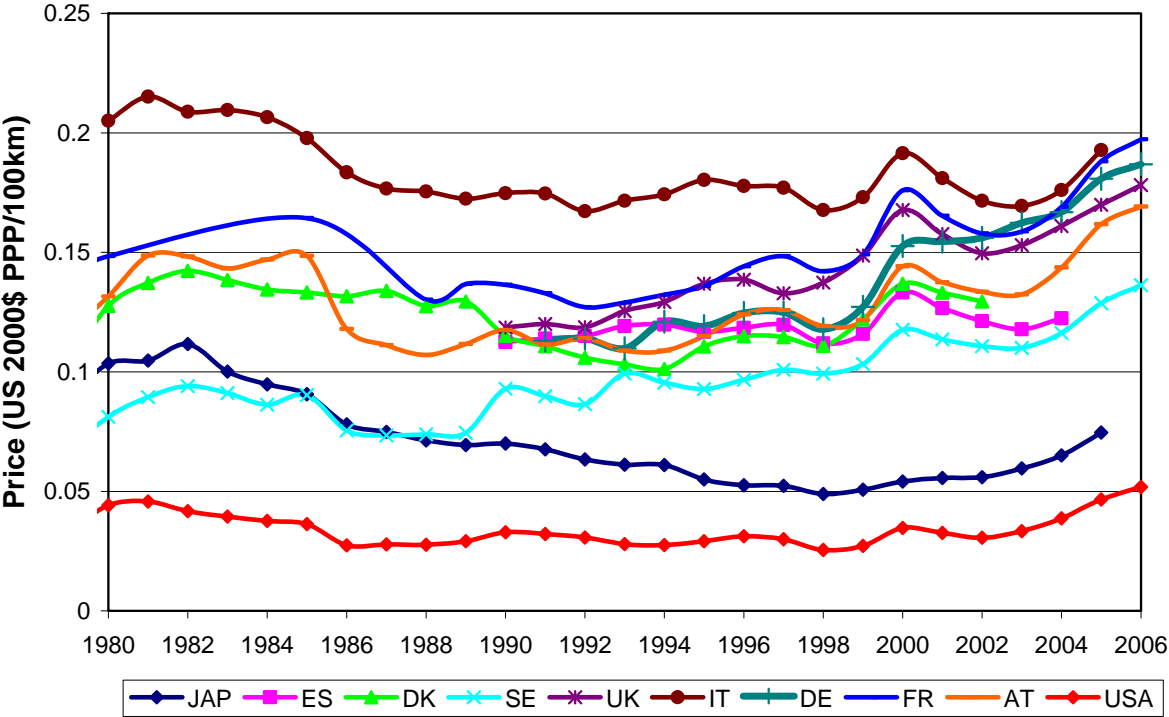


Figure 1. Price of service mobility for cars and household light trucks/SUV in road passenger transport (Fuel price/fuel economy) in US 2000\$ PPP/100 km (including all taxes)

Beside fuel price an important driver of travel demand as well as of car ownership may be GDP. Since 1980 GDP per capita is continuously increasing in all countries, but the highest increase was in Spain, France and Japan followed by United Kingdom, United States and Sweden, see Figure 2.

The core objective of this paper is to analyze the impact of these economic parameters – income and fuel price – on service indicators – car ownership, overall travel activity, annual car use – and on car fuel economy in individual motorized transport in different OECD countries.

¹ “Car” here refers to automobiles and light trucks, SUV or vans owned by private households and driven as automobile

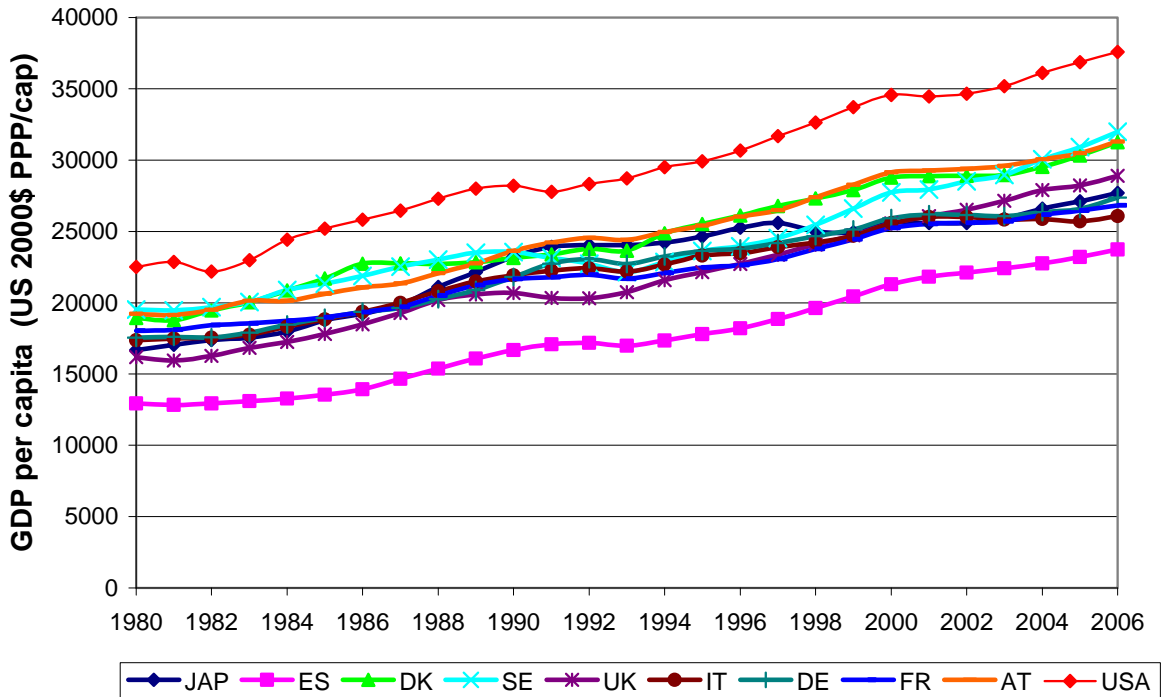


Figure 2. Development of GDP per capita (US 2000\$ PPP/capita)

The method of approach is based on the decomposition of energy consumption into service and intensity, see e.g. Howarth and Schipper (1991), Schipper and Haas (1997) and Haas and Schipper (1998). The analysis is based on work done by Schipper et al and by the IEA in the book “30 years of energy use in IEA countries” (IEA, 2004). Most of shown data in these references are for a period from 1973, 1980 to 1998, 2000. In this work these previous analysis will be updated and extended. The developments in individual road passenger transport in different OECD countries will be analyzed for the period from 1980 to 2006. In detail relations between fuel prices and passenger travel activity, energy consumption in individual passenger transport, and the impact of fuel prices on fuel economy are analyzed for different countries.

Energy consumption for cars and household light trucks/SUV in road passenger transport

Energy consumption for cars and household light trucks/SUV in passenger road transport per capita is continuously increasing, but the highest increase in period 1980 – 2006 was in Japan and Italy. United States have more than three times higher energy consumption per capita than most of the European countries, see Figure 3.

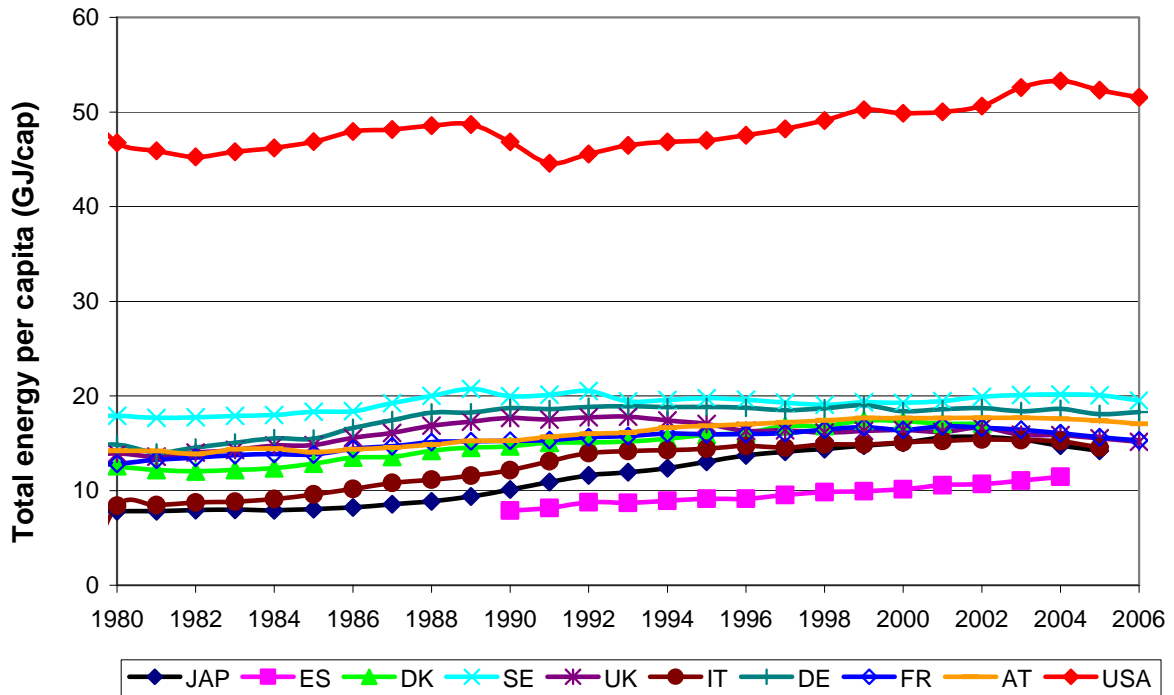


Figure 3. Development of energy use per capita for cars and household light trucks/SUV in road passenger transport

From the analyzed European countries the highest energy use per capita for cars is in Sweden and the lowest in Spain.

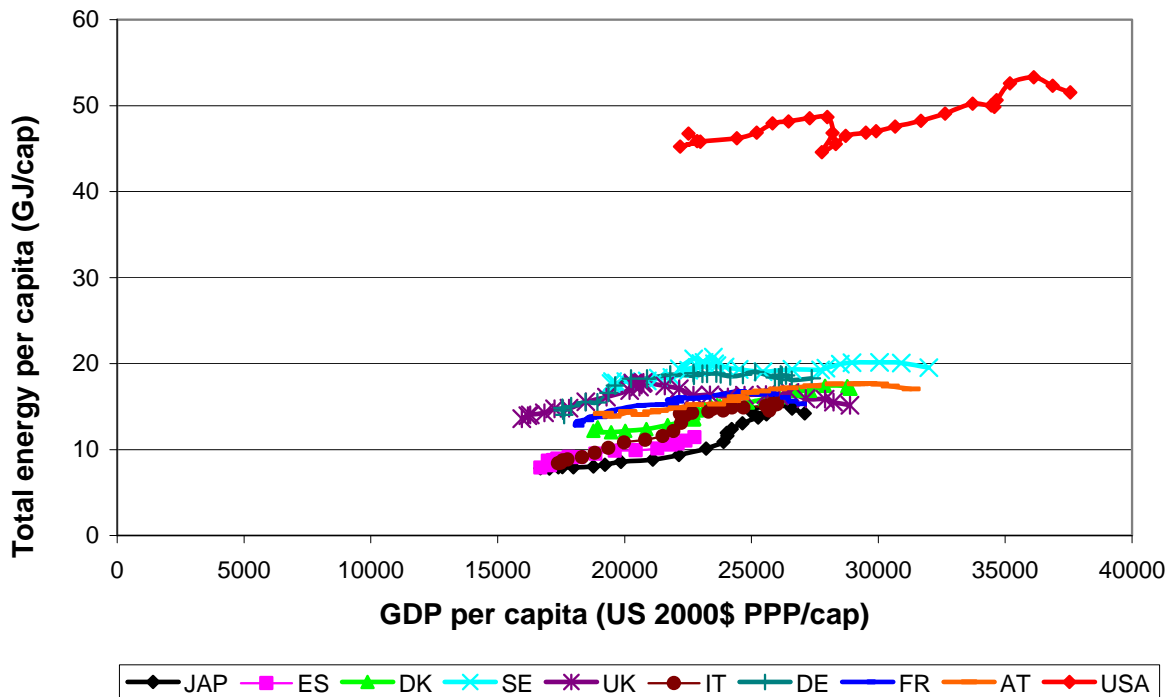


Figure 4. Energy use per capita for cars and household light trucks/SUV in road passenger transport versus GDP per capita

Figure 4 shows energy use per capita for cars and household light trucks/SUV in passenger road transport per capita versus GDP per capita. It is obvious that with higher GDP per capita

energy consumption is growing in all countries. However, United States has by the highest energy consumption per capita, more than twice as high than European countries and Japan.

Vehicle stock

The most important driver behind increased energy consumption in passenger transport is car ownership, whose rates are continuously increasing over time. In the period from 1980 – 2006 car ownership rates have increased in the range from 23% to 119%. The highest increase was in Japan and lowest in the United States (starting at an already very high level). 35 years ago car ownership rate in the United States was already relatively high, about one car for every other person, so that United States is closer to a saturation point.

Car ownership level for EU countries in 2006 ranges from 400 to 600 per 1000 people, see Figure 5. Many European countries have currently same car ownership level as United States 30 years ago, but none have had as many cars relative to GDP as the United States.

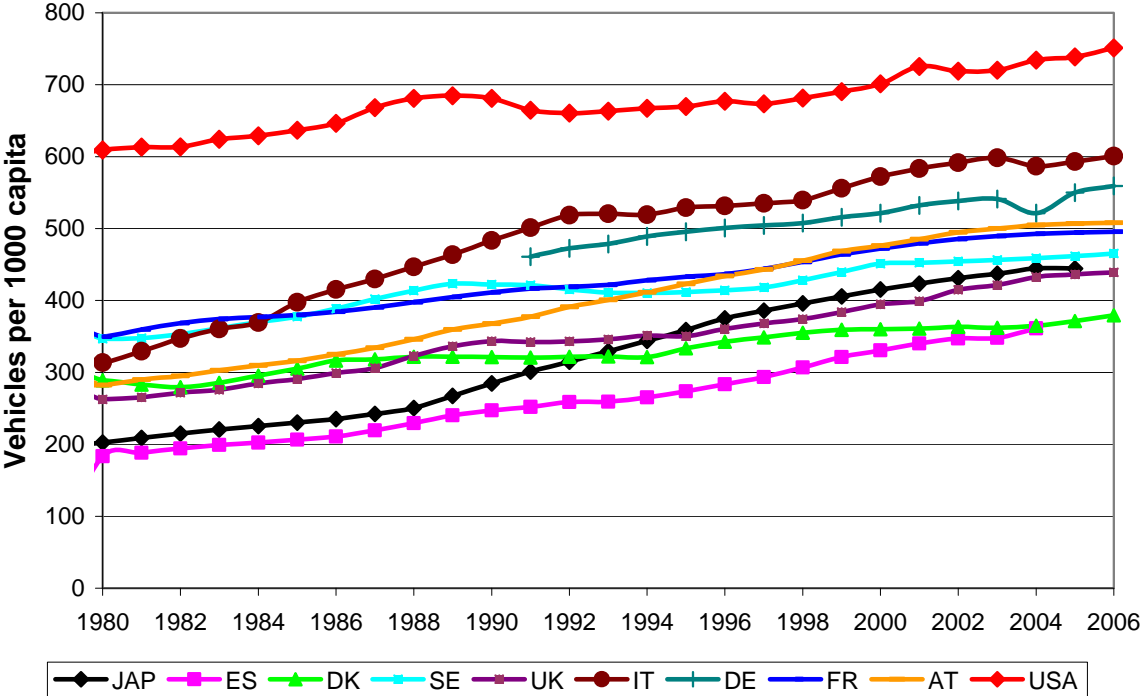


Figure 5. Car ownership: Vehicles per thousand inhabitants

The relation between number of vehicles per capita and GDP per capita is shown in Figure 6. It is obvious that these both factors are increasing over time.

Denmark has a relatively high GDP per capita and low car ownership level. This can be explained with the high vehicle taxes in Denmark. The highest car ownership in EU has Italy and it is rapidly increasing with GDP increase.

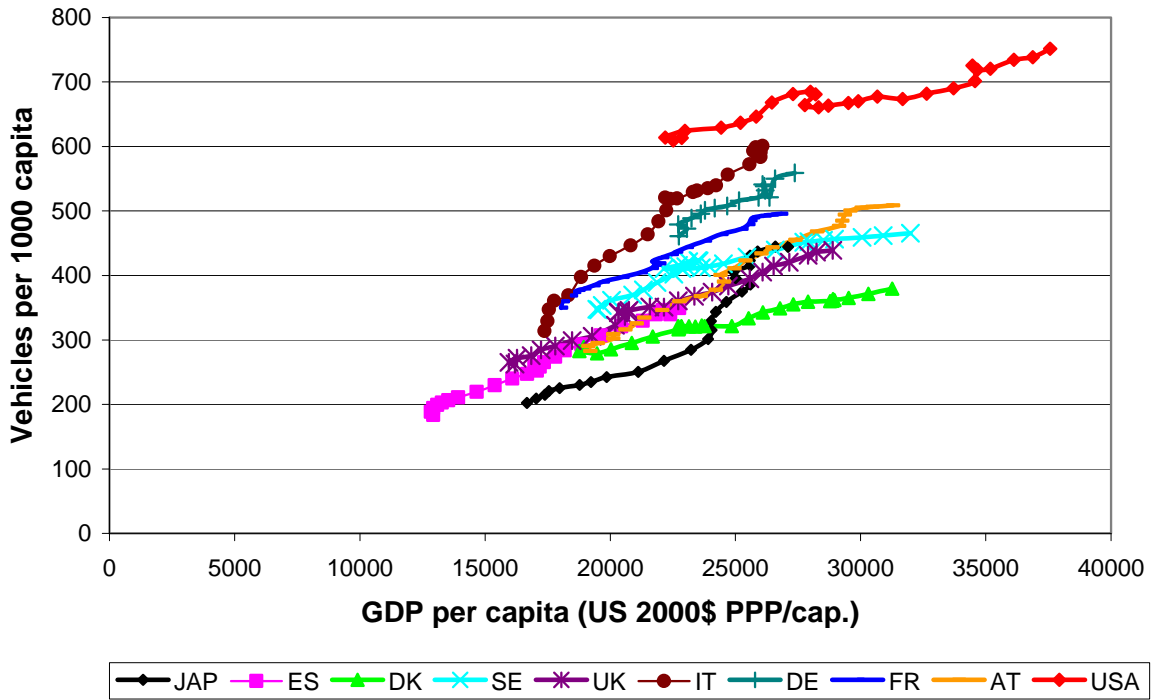


Figure 6. Car ownership versus GDP

Fuel intensity

As shown in Figure 7, since 1980 the average fuel intensity of stock of cars decreased in all countries.

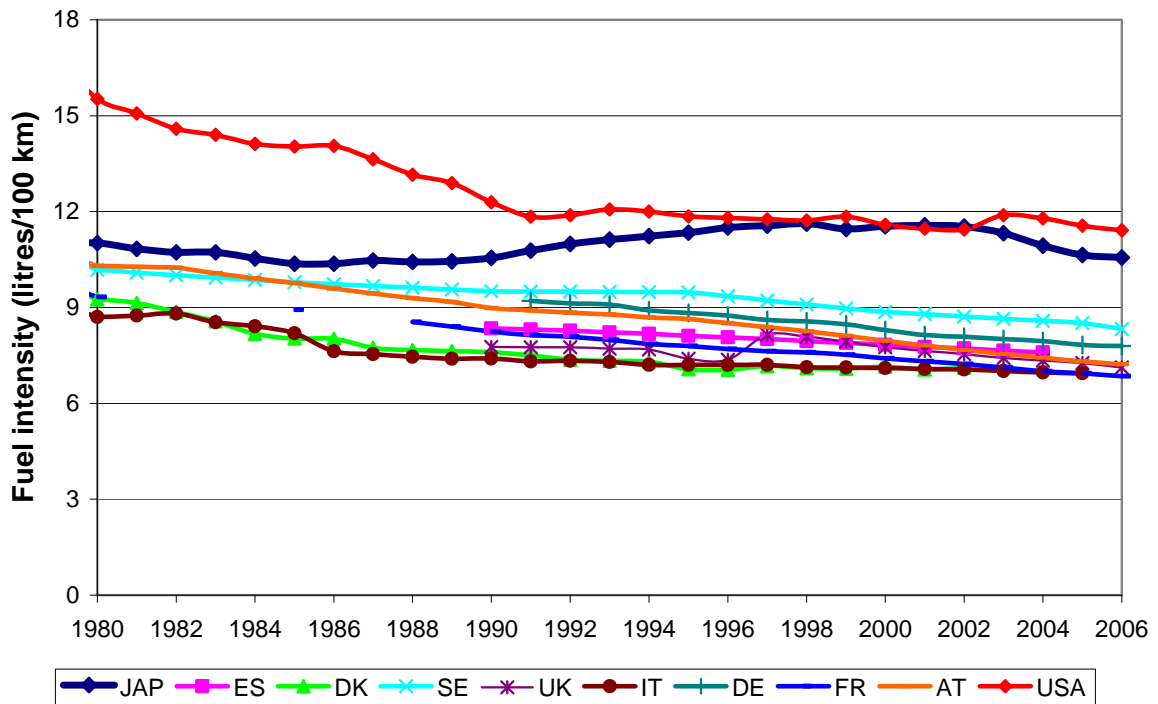


Figure 7. Average on road fuel intensity of stock of cars and household light truck fleet, gasoline equivalent (Diesel and LPG are converted to liters of gasoline at their energy content. 1 litre diesel = 1.12 litre gasoline)

Between 1980 and 1990 fuel intensity was rapidly decreasing, especially in United States, mostly due to the different fuel economy improvements programs. But after 1986 oil price fell and by 1990, the rate of improvement in many countries had slowed (IEA, 2004).

In 2006 the fleets in the European countries analyzed have had on-road fuel intensity in the range of 6.8- 8.3 liter per 100 kilometer, and non-European countries, Japan and United States, in the range of 10.5-11.4 liter per 100 kilometer.

The fuel economy improvement in new cars in Europe between 1980 and 2006 according to tests, was in range of 18% - 30%. These improvements were mainly due to the voluntary agreements to improve fuel economy, but currently agreements in Japan and Europe are expected to be both tighter and mandatory. The US passed new standards in late 2007 that would bring its fleet to an on road average of about 7.5 l/100 km by 2030-2035, about where Europe lay in 2006 (Schipper, 2008).

The EU proposes to strengthen their “Voluntary Agreement” to become a mandatory target with goal of 120 g/km CO₂ emissions from tests of new cars, which corresponds to roughly 5.5 l/100 km (Major, 2008)

The lowest fuel economy improvement took place in Japan, only 4%. On road and new vehicle test fuel intensity of cars rose in the 1990s as more larger cars entered the stock. A boom in mini cars after 1998 led to improvements in new vehicle fuel economy and by 2002 the stock begin to improve significantly as well.

Note, that for a harmonized comparison the average test new car fuel economy in the US to on road values requires multiplying the sales weighted test averages about 1.2-1.25, Japan by 1.33, and Europe by 1.12 (Schipper 2009 from various sources).

Summing up, the major fact is that important technical improvements have been made to engine and other cars components, but these have been mostly outweighed by heavier, larger and more powerful cars.

Figure 8 shows a relatively clear correlation between higher fuel prices and lower fuel intensity. For example, the United States and Japan have highest fuel intensity and lowest fuel prices. Italy has high fuel prices and relative low fuel intensity.

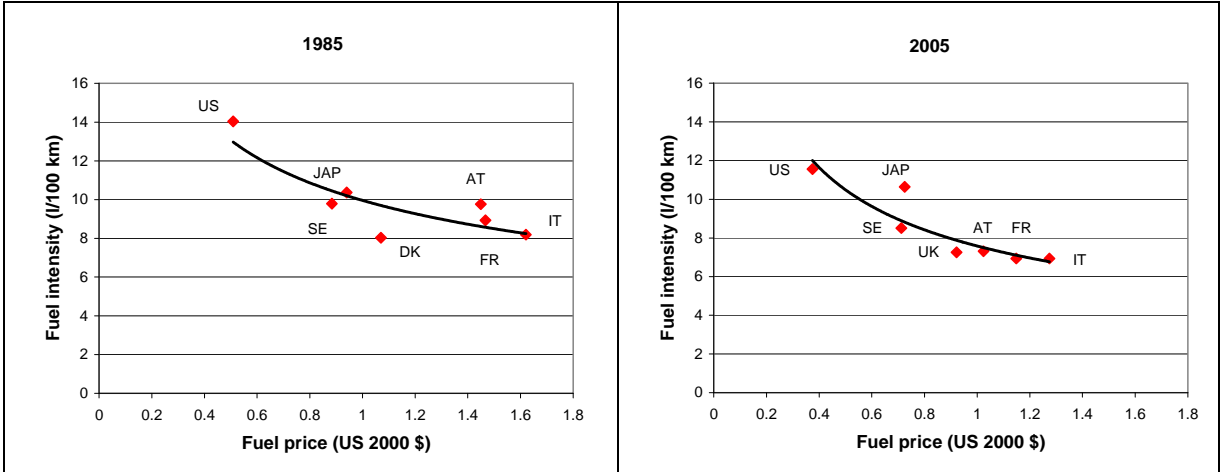


Figure 8. Car fuel intensity versus average fuel price, 1985 and 2005

The cost of diesel is included in the average price according to its proportion of total fuel used in the year shown

Travel activity

Overall travel activity is continuously increasing in all countries, but the range of vehicle kilometer per capita is very wide, between 4.500 and 13.500 vehicle kilometers per capita, see Figure 9.

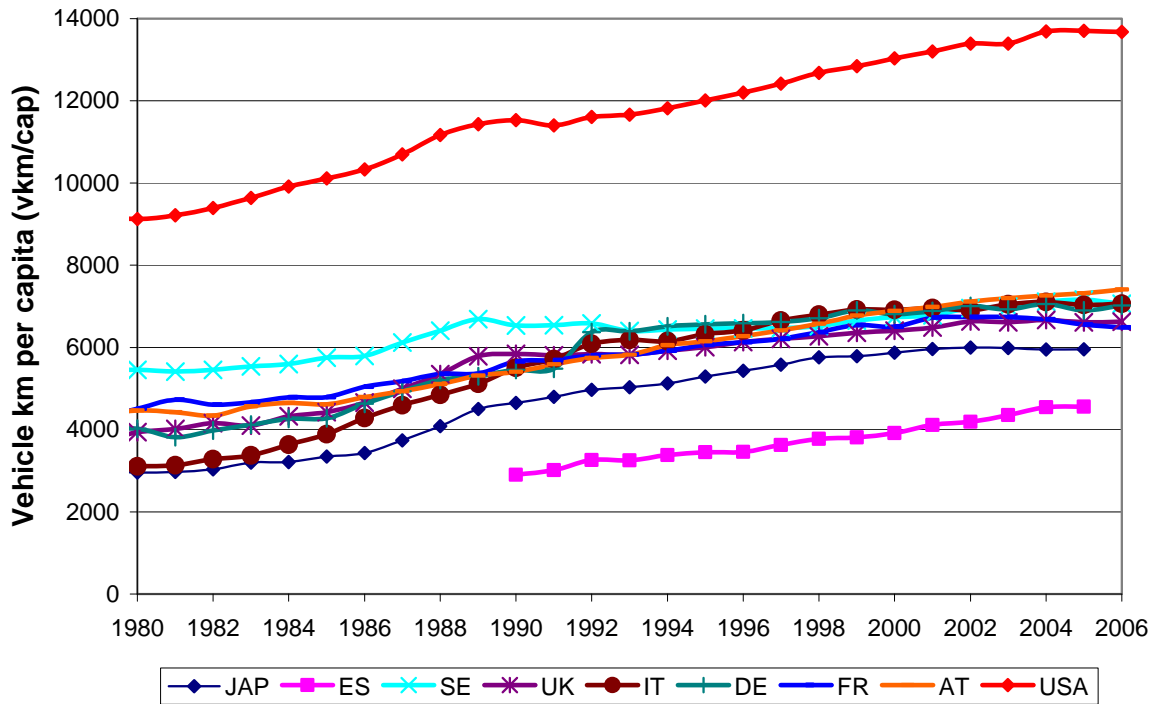


Figure 9. Development of vehicle kilometer per capita

Obviously, the United States is well above all other analyzed countries. So high travel activity per capita reflects high car ownership and utilization rates in United States. In the period 1980-2006 the largest increases in travel activity were in Italy, 127% and Japan, 101%. These increases are closely parallel to the increases in vehicle ownership shown earlier.

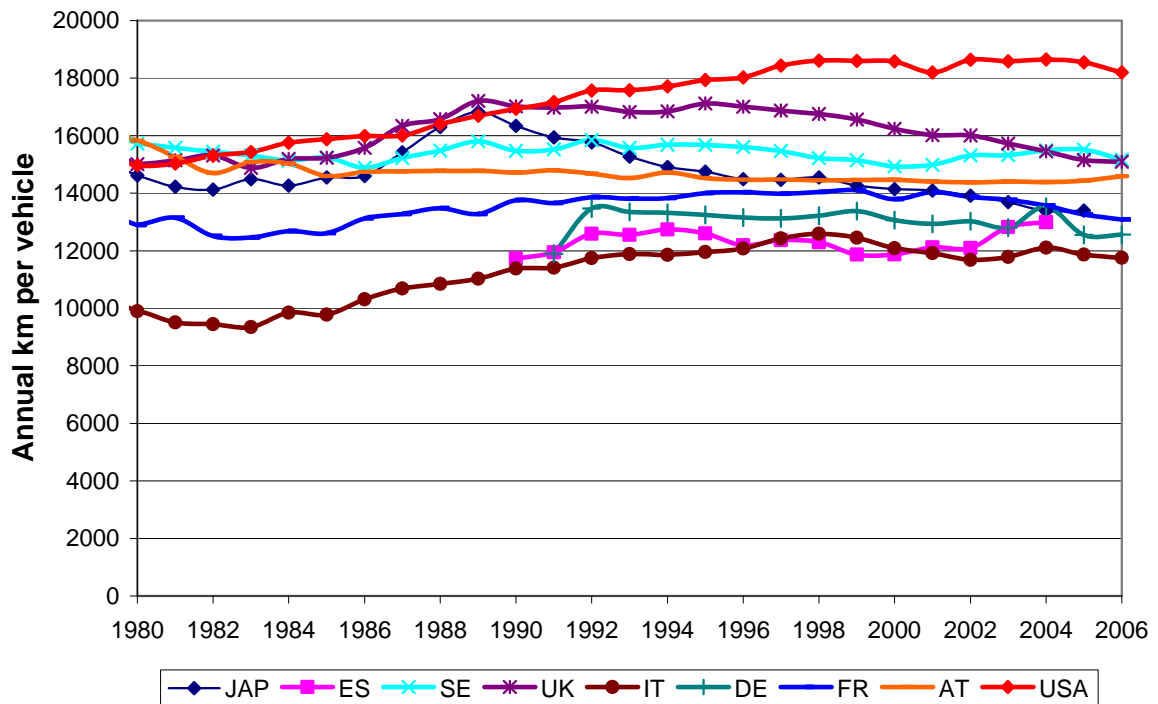


Figure 10. Annual kilometers per vehicle

While passenger travel and car ownership levels have continuously increased since 1980 (see Figure 5 and 9) the average use of each vehicle has not. In some countries, such as United States and Italy, average use of vehicle has increased since 1980 in the range of 2000 to 3000 km per vehicle. But this effect is offset largely by the increase in total car ownership (secondary cars per household) and increase in total km driven, see Figure 9.

On the other hand, in some countries such as Sweden and Austria, utilization level is declining over time. France and United Kingdom have had in 2006 almost the same level of travel per vehicle as in 1980. On average, in 2006 vehicles were driven between 11.000 and 18.500 kilometers per year, depending on the country, see Figure 10.

Development of vehicle kilometers per GDP is shown in Figure 11. In the period from 1980 to 1993 the vehicle kilometers per GDP in Italy was rapidly increasing, but after 1994 its travel activity per GDP was relatively stable. Comparing to 1980 in 2006 vehicle kilometers per GDP in Italy was about 50% higher. This can be explained by the steep increase in car ownership in Italy in the period 1980 -1993, see Figure 5.

In most of the analyzed countries vehicle kilometers per GDP has slowly decreased, for example in United States by 10%, in Sweden by 23%, and in France by 17%.

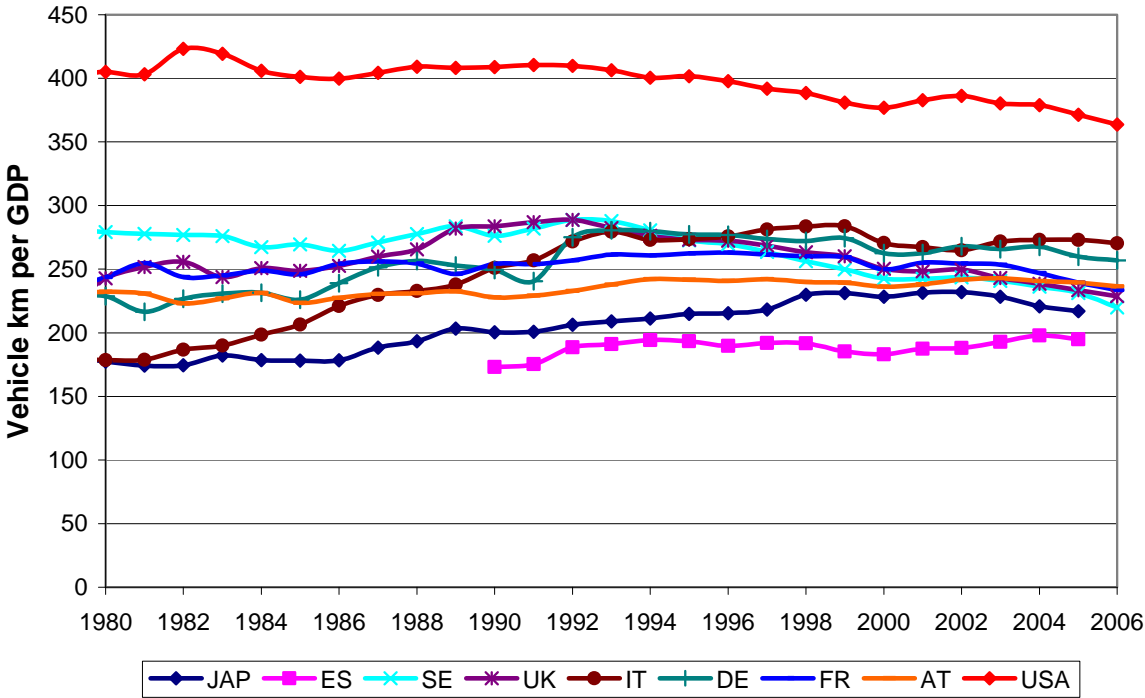


Figure 11. Vehicle kilometre per GDP

Conclusions

The major conclusions of this analysis are:

- Overall energy conservation and corresponding CO₂ reduction have not been large enough yet to offset long-term trends increasing overall travel activity in cars.
- Fuel prices have a significant impact on fuel economy. Voluntary agreements in Japan and EU had some impact on fuel economy when fuel prices were low (1998-2002) but the pace of improvement increased as fuel prices started upward in 2002, even in the US after 2004.

- In recent years when fuel price increased, per capita travel activity in cars decreased or stagnated moderately.
- Car ownership and travel activity are strongly correlated with GDP but saturation of ownership appears to be passed in the US and approaching in Europe.

With respect to the future development of individual passenger mobility the perception is that only a broad portfolio of policy instruments – consisting mainly of tax policies for fuels as well as car investment and standards – will bring about significant reductions in fuel intensity and energy consumption as well as related CO₂ emissions.

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