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 are offset to a large extent by increases in overall travel activity and a trend to larger vehicles. Fuel prices have a significant impact on fuel economy. In recent years when fuel price increased travel activity also decreased or at least stagnated moderately by capita. Car ownership and travel activity are strongly correlated with GDP.

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 these problems, 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 and fuel intensity.

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. Development of fuel prices are shown in Figure 1. The range of fuel prices vary wide across analyzed countries. In 2006 the lowest fuel price was in United States $ 0.59 per liter and highest in Germany, $ 1.51 per liter. Between 1980 and 1998 oil 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.
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.

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 in road passenger transport**

Energy consumption 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. From the analyzed European countries the highest energy consumption per capita is in Sweden and the lowest in Spain.

![Figure 3. Development of total energy consumption in road passenger transport](image-url)
Figure 4 shows energy consumption 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 the highest energy consumption per capita even in comparison to the countries with similar GDP per capita.

**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 0.4 to 0.6 cars per capita, see Figure 5. Many European countries have currently same car ownership level as United States 30 years ago.
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 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.
Fuel economy

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

![Figure 7. Average fuel economy of stock of cars](image)

Between 1980 and 1990 fuel economy 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 analyzed European countries have had fuel economy in the range of 6.8- 8.3 liter per 100 kilometer, and analyzed non-European countries, Japan and United States, in the range of 10.5-11.4 liter per 100 kilometer.

The fuel economy improvement in Europe between 1980 and 2006 was in range of 18% - 30%. These improvements were mainly due to the voluntary agreements to improve fuel economy, but currently agreements don’t have same political force that those of the late 1990s did (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 was in Japan, only 4%. This was mainly due to a significant switch to larger vehicles.

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 economy. For example, the United States and Japan have highest fuel economy and lowest fuel prices. Italy has high fuel prices and relative low fuel economy.
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.

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 increase in travel activity was in Italy, 127% and Japan, 101%.
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%.
Conclusions

The major conclusions of this analysis are:

- Overall energy conservation and corresponding CO2 reduction effects are offset to a large extent by increases in overall travel activity and a trend to larger vehicles.
- Fuel prices have a significant impact on fuel economy. Only if fuel prices are high or increasing reduction in fuel consumption per km can be observed.
- In recent years when fuel price increased travel activity also decreased or at least stagnated moderately by capita.
- Car ownership and travel activity are strongly correlated with GDP.

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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