THE IMPACT OF A RISING OIL PRICES ON TRANSPORT

Angelo Martino, Davide Fiorello

TRT Trasporti e Territorio srl, via Rutilia 10/8 20141 Milano (Italy)

Introduction

After more than a decade of cheap oil around 20 US$/barrel, prices have steeply risen during the recent years until mid-2008. If the economies as a whole have not suffered from the high oil prices (see Fiorello et. al., 2008, for some elements to explain this limited impact), specific sectors have experienced significant problems and the transport sector is one of these. Since the second half of 2008, the oil price has dramatically fallen below 40 US$/barrel, mainly as a consequence of the world financial crises and the economic stagnation in both United States and Europe, which pushed large consumers to reduce energy use. Then, the energy availability issue has receded back in the politicians' agenda, but its relevance remains high. Low oil prices may jeopardise many existing oil projects and lead to the cancellation or delay of others, with a medium-term supply shortage as a likely result. In addition, tight credit conditions may threaten new energy projects all over the world, whilst a future recovery of the world economy may put pressure on the limited capacity of oil reserves and cause price spike in the longer run. In the end the basic lesson to be retained from the top prices reached in 2008 is that oil and other fossil fuels are limited resources and their price will eventually increase. So, the transport sector (among others) has to confront its vulnerability to energy price despite the recent oil price decrease.

This paper investigates the relationships between oil prices and the transport sector, and provides an analysis of the impact of high oil prices on transport costs, by looking at the ways in which the transport of goods is influenced by significant fluctuations in oil prices, based also on the transport operators' responses. The impact of oil price is different across the transport modes and is dependent upon three main elements:

a) the relevance of oil prices to the cost of energy used for each transport mode;

b) to what extent variations in oil prices are transferred to transport fuel prices;

c) the relative weight of energy costs in total operating costs for each mode.

These aspects will be analysed according to the following structure of the paper.

- Chapter One illustrates the data on energy consumption in the transport sector by pointing out the incidence of oil consumption across transport modes and the efficiency achieved during the last years;

- in Chapter Two, the increase in the oil prices is analysed according to recent price trends in the main transport energy sources, and total consumption in the transport sector as well;

- Chapter Three presents an overview of the relevance of energy costs to the total transport costs for different freight transport modes;

- Chapter Four addresses the response of transport carriers to increasing costs resulting from oil prices, and also describes the actions taken by some European governments to mitigate such negative effects;

- lastly, Chapter Five draws some conclusions in order to allow a political debate on the influence of significant changes in oil prices and shortages of resources on the transport sectors.

1. Energy demand in transport sector

As illustrated in Table 1.1, which summarises the changes in final energy consumption in transport, industry, services and households between 1990 and 2006, the transport sector has significantly increased its energy consumption over the last 15 years. The share of transport (road, rail, inland navigation and aviation) in total final energy consumption has indeed increased steadily since 1990 to reach 370 million tons of oil equivalent (Mtoe) in 2006, i.e. (i) almost 31% of total final energy consumption, (ii) five percentage points more than its share in 1990 (26%), and finally (iii) three percentage points higher than industry's share (28%)[1]. It may also be noted, however, that more than one half of the total increase took place in the final years of twentieth century, while since 2001 energy consumption has grown more slowly (but still faster than in other sectors).

Tab. 1.1 Final energy consumption by sector in the EU-27 in Mtoe (1990-2006)

Sector	**1990**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**Change 1990/2006**
Transport	280	343	346	351	360	362	370	32%
Share % of total	*26.3%*	*30.1%*	*30.7%*	*30.3%*	*30.7%*	*30.9%*	*31.5%*	
Industry	366	331	326	332	332	326	324	-11%
Share % of total	*34.3%*	*29%*	*29%*	*28.7%*	*28.4%*	*27.8%*	*27.6%*	
Residential/Service/Other	422	466	454	475	479	484	482	14%
Share % of total	*39.5%*	*40.9%*	*40.3%*	*41%*	*40.9%*	*41.3%*	*40.9%*	
Total final consumption	**1,068**	**1,140**	**1,126**	**1,158**	**1,171**	**1,172**	**1,176**	**10%**
%	***100%***	***100%***	***100%***	***100%***	***100%***	***100%***	***100%***	

Source: TRT on EUROSTAT data

Note: Final energy consumption covers all energy delivered to the final consumer's door in the industry, transport, household and other sectors for all energy use.

Transport is not only a major consumer of energy; it is in particular a consumer of fossil fuels. Table 1.2 shows the evolution in mix of energy sources consumed in the transport sector for the period 1990-2006 and the share of the source consumed with respect to total consumption. The table clearly illustrates the predominance of oil in transport energy use, which represents almost 97% of the total energy consumption. This share has decreased by a percentage point

[1] This may be also explained by the changing characteristics of the manufacturing sectors: energy efficiency has increased in many manufacturing activities; at the same time many of these activities have gradually migrated to non-EU countries with lower cost bases.

between 1990 and 2006 and has been partially offset by an increase of renewable sources (e.g. biofuels), which showed an annual average increase of 58% from 2003 to 2006.

Tab. 1.2 Mix of energy sources in transport in the EU in Mtoe (1990-2006)

Energy Source	**1990**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Gas	216	361	504	454	457	461	506	584
Share % of total	0,08%	0,11%	0,15%	0,13%	0,13%	0,13%	0,14%	0,16%
Oil	274.552	332.295	335.636	338.355	343.291	351.042	352.380	358.108
Share % of total	97,96%	97,91%	97,84%	97,79%	97,71%	97,57%	97,24%	96,71%
Electricity	5.392	6.111	6.128	6.160	6.219	6.294	6.370	6.236
Share % of total	1,92%	1,80%	1,79%	1,78%	1,77%	1,75%	1,76%	1,68%
Renewable*	2	610	755	986	1.351	1.977	3.131	5.376
Share % of total	0,00%	0,18%	0,22%	0,28%	0,38%	0,55%	0,86%	1,45%
Solid fuels	107	13	33	31	6	5	5	0
Share % of total	0,04%	0,00%	0,01%	0,01%	0,00%	0,00%	0,00%	0,00%
TOTAL	**280.269**	**339.390**	**343.056**	**345.986**	**351.324**	**359.779**	**362.392**	**370.304**
%	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Source: TRT on EUROSTAT data
Note: Almost all the total of renewable in transport is made of biofuels

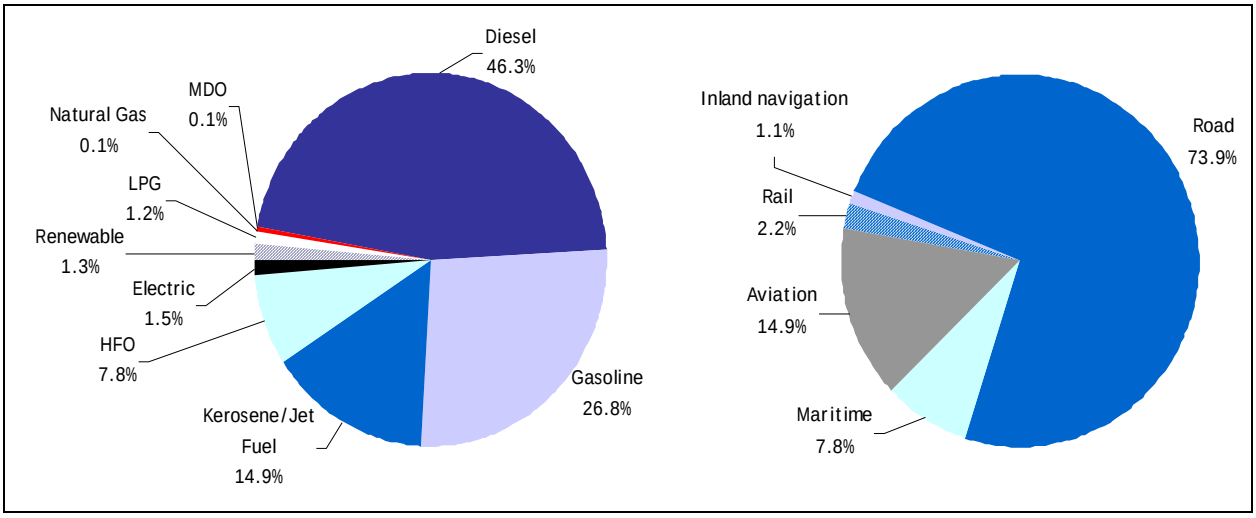
Most of the energy demanded by the transport sector is used in road transport, absorbing up 303 million of oil equivalent (Tab. 1.3), which is 74% of the total volume in 2006 (Fig. 1.1). This data should be compared to mode share of road transport. Cars and trucks are largely dominant on inland transportation, but if maritime and air transport are considered one find that in the freight sector, sea transport represents the largest modal share, being 76% of the total tkm transported (own estimation on Eurostat and Ex-TREMIS data).

Tab. 1.3 Final energy consumption by mode of transport in the EU-27 in 1,000toe (1990-2006)

Energy source	**Rail transport**			**Inland navigation**			**Road transport**			**Air transport**		
	1990	**2005**	**2006**	**1990**	**2005**	**2006**	**1990**	**2005**	**2006**	**1990**	**2005**	**2006**
LPG	2	-	-	-	-	-	2,724	4,520	4,733	-	-	-
Petrol	-	-	-	451	289	298	134,789	113,829	109,750	169	180	159
Diesel	4,058	3,048	2,951	5,200	4,079	4,380	96,825	175,757	182,870	-	-	-
Jet/kerosene	14	12	12	3	0	5	52	2	4	28,969	49,689	51,697
Natural Gas	-	-	-	-	-	-	216	506	584	-	-	-
Electric	5,392	6,370	6,236	-	-	-	-	-	-	-	-	-
Solid fuel	107	5	0	-	-	-	-	-	-	-	-	-
Renewable	-	-	-	-	-	-	2	3,131	5,376	-	-	-
TOTAL	**9,573**	**9,435**	**9,199**	**5,654**	**4,368**	**4,683**	**234,608**	**297,745**	**303,317**	**29,138**	**49,869**	**51,856**
% Share	3.4%	2.6%	2.5%	2 %	1.2%	1.3%	84.1%	82.4%	82.2%	10.4%	13.8%	14.1%
Year 1990=100	100.0	98.6	96.1	100.0	77.3	82.8	100.0	126.9	129.3	100.0	171.1	178.0

Source: TRT on EUROSTAT data
Note: Data do not include maritime transport, pipelines and intercontinental air traffic

Fig. 1.1 EU-27 share of transport energy demand by source and mode in 2006 (%)



Source: TRT based on Eurostat data and EX-TREMIS (Chiffi et. al. 2008)

Aviation is the second largest consumer with a 15% share, followed by maritime transport (7,8%); rail transport accounts only for 2.2% and finally inland navigation consumes only 1.1%. The electricity source is used almost exclusively in rail transport although a significant share of diesel locomotives and railcars are still operating in the EU (about 29% of total train-km performed in EU-27: see Chiffi et. al. 2008).

Transport energy consumption is driven by the size of transport activities, the market shares of transport modes and their energy efficiency. Since 1990, road transport has increased transport activity by 61% but in parallel energy consumption has only grown by 29% (Tab. 1.4). Consequently, burned fuel per single traffic unit passed from 0.145 kilograms of oil equivalent (kgoe) in 1990 to 0.116 kgoe. This means that road transport has improved efficiency by 20%, as a result of the technological development and the voluntary agreement within the car industry to reduce CO_2 emissions from new passenger cars. Only minor improvements may be attributed to road freight transport.

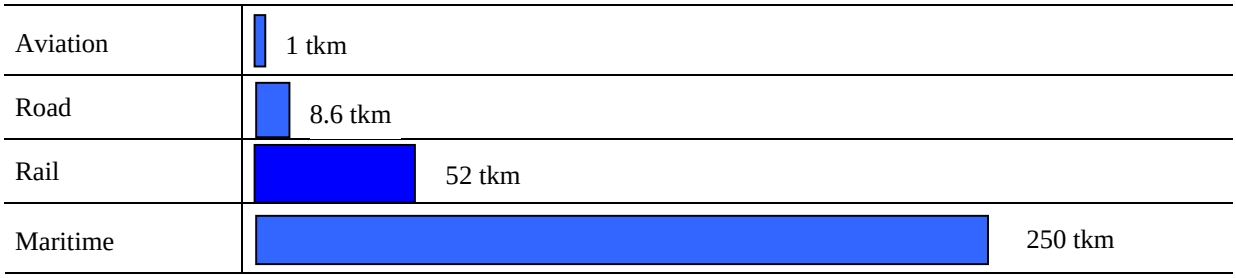
Comparable progress has been made by aviation, partially thanks to both the renewal of the fleet and higher occupancy factors, significantly influenced by the entrance of new carriers in the market. However, from Tab. 1.5, showing how many kilometres may be travelled by hauling one ton and using one ton of oil equivalent it is clear that maritime transport and rail are still the most energy-efficient transport modes per single traffic unit performed.

Tab. 1.4 Transport activity, energy use and unitary consumption by mode in the EU, 1990-2006

Mode of transport	1990	2005	2006	Change 1990-2006
Total demand in equivalent tkm (1 tkm = 10 pkm, billion)				
Rail	487	459	482	-1%
Inland navigation	114	138	138	22%
Road	1,619	2,503	2,608	61%
Aviation	28	56	58	110%
Maritime	5,309	8,638	8,850	67%
Energy use in 1,000toe				
Rail	9,573	9,435	9,199	-4%
Inland navigation	5,654	4,368	4,683	-17%
Road	234,608	297,745	303,317	29%
Aviation	29,138	49,869	51,856	78%
Maritime	20,478	32,188	32,220	57%
Energy consumption in 1,000 toe per unit of traffic				
Rail	0.020	0.021	0.019	-3%
Inland navigation	n.a.	n.a.	n.a.	-
Road	0.145	0.119	0.116	-20%
Aviation	1.058	0.899	0.899	-15%
Maritime	0.004	0.004	0.004	-6%

Source: TRT based on Eurostat, INFRAS-IWW and EX-TREMIS data

Tab. 1.5 Tkm hauled per one ton of oil equivalent

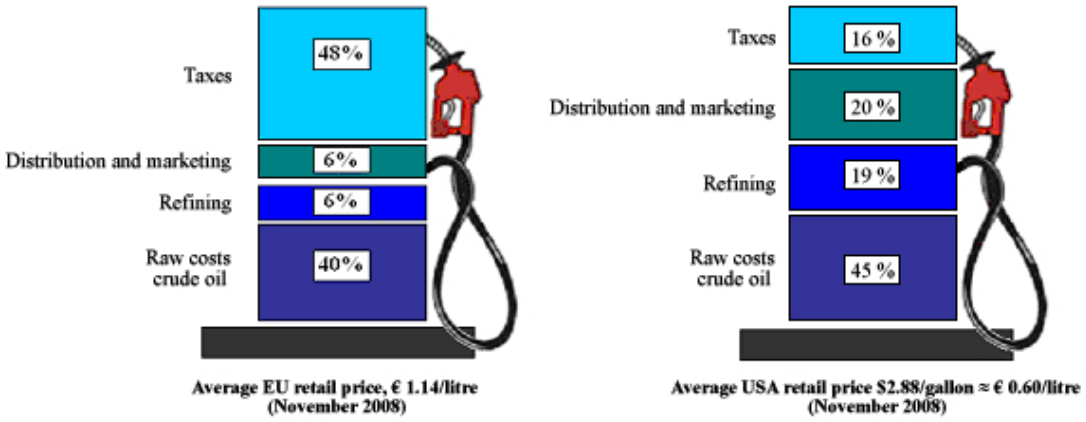


2 Analysis on fuel price trends and correlation with crude oil prices

The dependence of the transport sector on oil has been clearly demonstrated in the analysis of Chapter one, though some progress has lately been made in improving efficiency and in introducing alternative fuels. This Chapter evaluates the linkages between oil prices and transport fuel prices.

The rapidly increasing prices of crude oil affect the final wholesale and retail prices of a number of key petroleum products such as petrol, kerosene and fuel oil. Especially in the road sector, oil prices constitute only a part of the total fuel price, which reflects the interaction of many other factors such as the scarcity of specific fuels, market forces, processing and distribution costs, and the intensity of competition in individual countries. Each time either increase or reduction of crude oil price take place, these changes affect only the part of the final pump price related to the industrial production of fuel (primarily raw material costs). This share is depicted in figure 2.1 for United States and Europe, along with the other main components being taxes, distribution, marketing and refining, for an average November 2008 diesel price. A large difference emerges for the share paid in taxes, which is substantially lower in the United States (16%), with an average tax of ~46 cents/gallon (~0.10 €/litre), whilst in Europe the share is higher (48%) and corresponds to ~0.54 €/litre. This has contributed to mitigate the effects of the sharp increase of oil prices occurred in the last four-year period on the total road fuel price.

Fig. 2.1 Cost components of one litre of diesel in EU and USA in November 2008



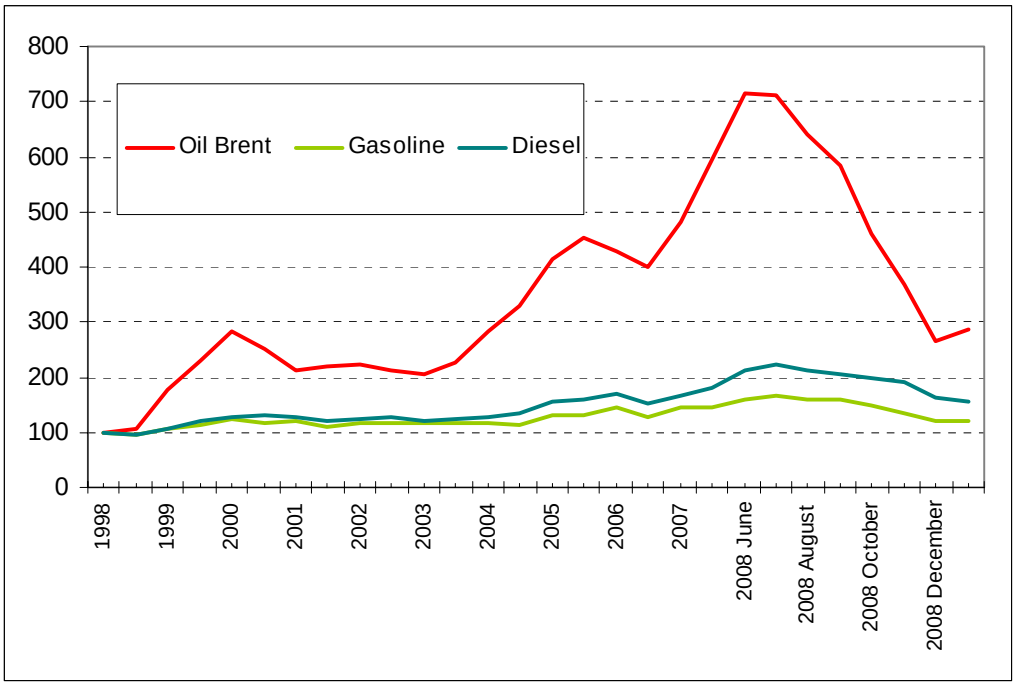
Source: EIA 2008, Eurostat 2008

Figure 2.2 reports the average variation of unleaded gasoline and diesel prices at the pump occurred in the EU-25[2] between 1998 and 2008 and compared to the growth in the price of Brent oil in Euro terms for the same period. The level of magnitude in the oil price variation and the variation of fuel price differs significantly. Indeed, looking at the period of increase until July 2008, the price of crude oil encompasses a larger variation (increase by 600 in index terms), while the price variation for the fuel at the pump rises by 60 for petrol and 110 for diesel in index terms.

The relatively limited correlation between oil prices and fuel user prices for the most important market partly explains why the sharp increase of the former has not led to a reduction of fuel consumption in the transport sector (see figure 2.3). Another part of the explanation lies in the share of fuel prices in total transport costs (see Chapter Three).

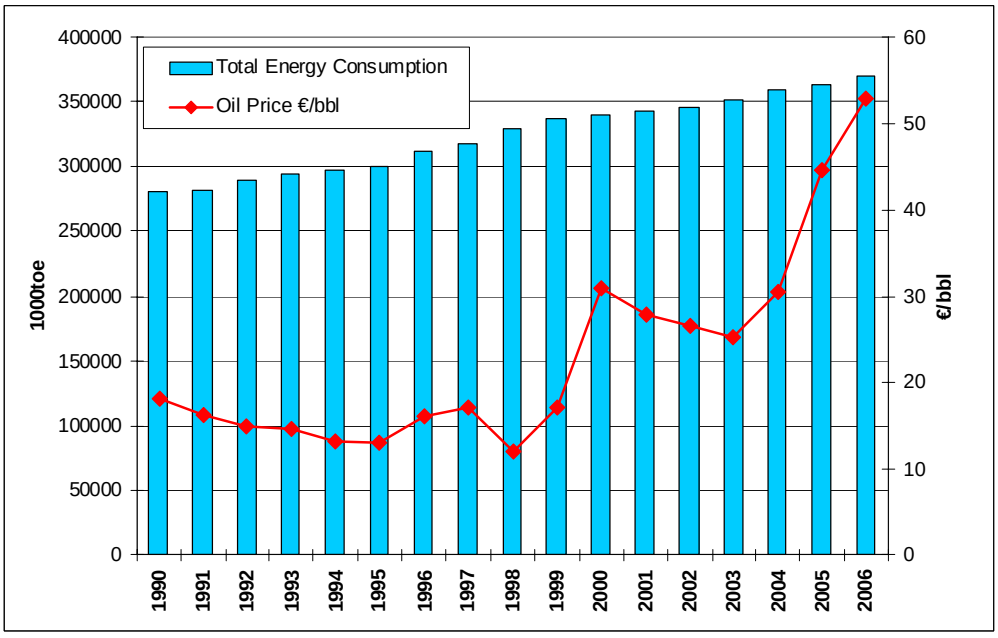
[2] Data for Romania and Bulgaria is not available from Eurostat

Fig. 2.2 Increases in the pump price of unleaded petrol in the EU (1998 –2008) Index100=1998



Source: TRT on European Central Bank and Eurostat.

Fig. 2.3 Evolution of EU-25 total fuel consumption in transport (1,000 toe) and oil price (€/bbl)



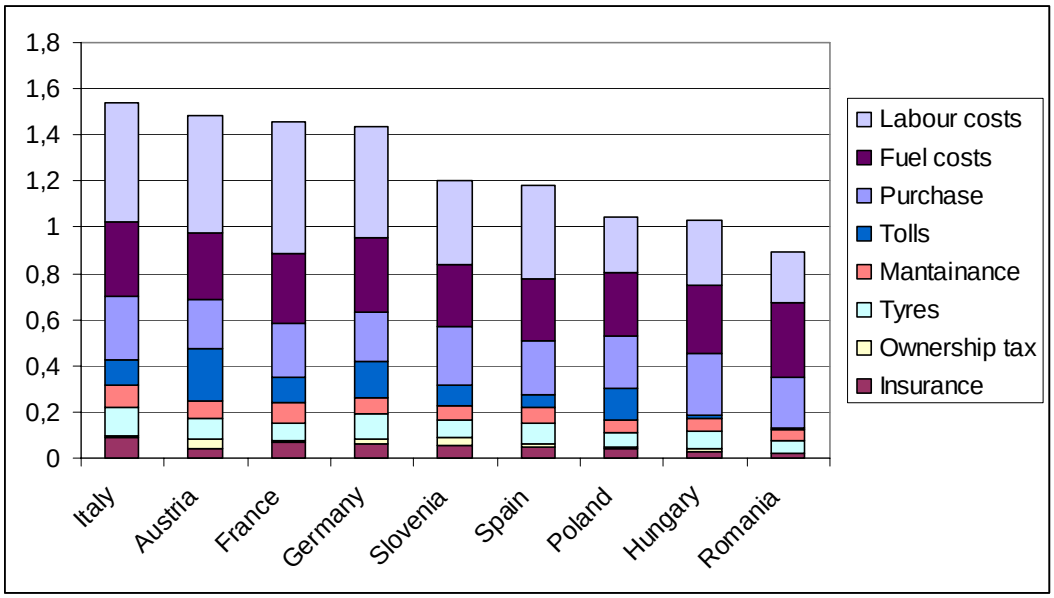
Source: TRT elaboration on data Eurostat, data for years 2005 and 2006 are provisional.

When non-road fuels are considered, the picture is quite different. Since marine and aviation fuels are exempted by government taxation, price raises of crude oil have a direct effect on the level of marine bunker prices and jet fuels.

3 Share of fuel costs in total transport costs

The fuel cost has a different relevance on total transport costs for different modes. This chapter provides an overview. Figure 3.1 illustrates the breakdown of road freight transport costs in a sample of EU countries for the year 2008. The fuel costs (VAT excluded) represent between 19% (Austria) to 36% (Romania) of total costs, and respectively between 24% and 49% of total operating costs. For the selected countries, fuel taxes account for between 9% and 11% of the total costs of a road haulage business (CSST, 2008).

Fig. 3.1 Breakdown of transport costs (in €/km) for selected EU countries (2008)



Note: The costs refer to a representative 5 axle 44 tons truck.
Source: CSST 2008

For rail only very aggregate and hardly comparable estimations are available on the importance of energy costs since commercial rail freight operators are very reluctant to provide an insight into their operating costs. The cost calculation models developed by NEA and Transcare (NEA, 2004) estimates the share of energy costs in rail freight transport ranging between 12% and 27% of the total operating costs of a train, depending upon the distance and type of traction. Higher shares are found for diesel traction, while costs of electric traction are substantially lower. Calculations made in the TRIAS project (Schade et. al., 2008) and based on various sources, even though especially on data for the Italian railways, have come up with lower figures, since the share of energy would amount at about 10% of variable costs and about 5% of total costs.

As reported by IATA for system-wide global commercial aviation, the fuel costs share of total operating costs jumped from 13% in 2001 to 29% in 2007 and exceeded 30% in 2008 (September 2008). According to the Association of European Airlines (AEA, 2008), which brings together 35 major network or full-service airlines, fuel in Europe has risen from about 15% of total operating costs in 2004 to 23% in 2006. In 2008, having assumed an average oil price of 109.53 US$/barrel (EIA, 2008), AEA estimates this single cost item to reach 33% of total operating costs for the major European network carriers. The relative importance of fuel costs on total operating expenses increases further on long-haul flights for all the airlines without exceptions, whereas budget carriers also register a consistent increase of this item on

the medium and short-haul, with fuel representing – in the mid of the year 2008 – nearly 50% of their total operating costs compared to 36% in 2007 and beginning of 2008. This figure is taken from the Ryanair's Financial Report 1st Quarter Results 2008 and is assumed to be similar for other budget Airlines, as declared by Brian Pearce, chief economist of IATA, interviewed by the International Herald Tribune last June the 3rd. The European Low Fares Airlines Association (ELFAA), does not publish any aggregated cost analysis for its members. This lack of official data is also reflected in the DG TREN's quarterly report Air Transport Vademecum, mostly based on AEA statistics.

The share of bunker costs in the daily running costs of a ship is substantial. According to recent analyses, during the recent high oil price periods energy costs may have amounted up to three quarters of variable costs for delivering a Twenty-Foot Equivalent Unit (TEU); this share is clearly lower if total operating costs are considered. Calculations carried out in the European project REALISE on short sea shipping and intermodality indicate that for a representative corridor the share of fuel costs is between 15% and 20% of total transport costs. In another study from NEA (NEA, 2004) the share of energy costs in the total transport costs of short sea movements has been estimated around 30%. The same data updated at 2008 values for oil price (representative 100 US$/barrel) brings figures to over 50%. Data for deep sea are generally lower, but this data may be considered as representative.

According to a recent issue of "*Market observation for inland navigation in Europe*", a report compiled by the Central Commission for Navigation in the Rhine and the European Commission (CNR and DG TREN, 2007, Volume 2), the development in the breakdown of transport costs has been influenced by a visible increase of those cost items related to the vessel acquisition (e.g. interests and insurance), which is partly the result of strong demand for new constructions and the high price of steel. Since 2004, fuel costs increased by 48%, whereas investment, insurance and maintenance costs registered an increase of over 70%. The share of fuel costs accounts for a stable 21% of total transport costs for a new self-propelled vessel with a capacity of 2.500 tonnes. Depending from type, size and age of the vessel, fuel costs ranges between 10 and 25% of the total annual operating costs.

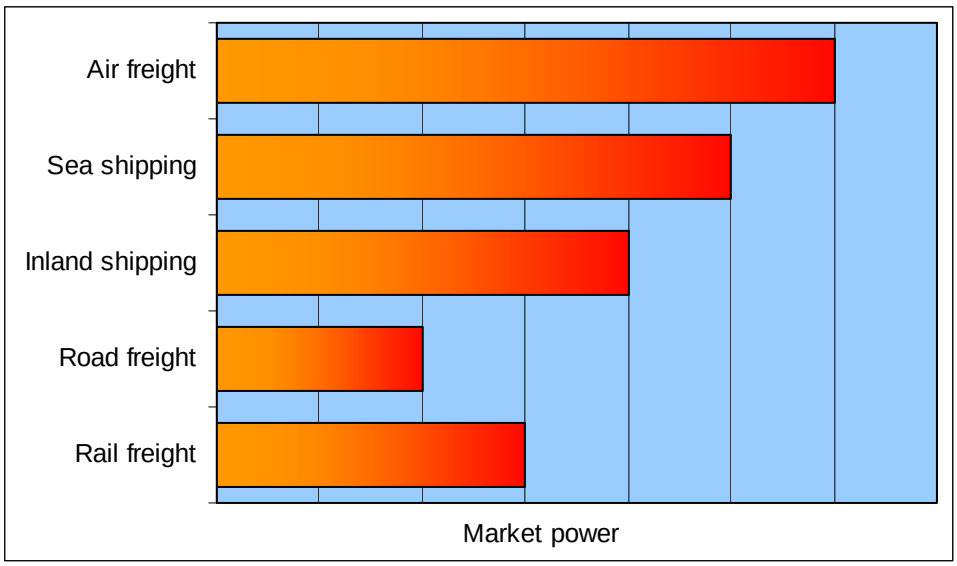
4 Evidence of impacts of high oil prices in the transport sectors

This chapter focuses on the impacts and reactions of providers of freight transport services to the oil price increases which occurred during on 2007 and the first half of 2008. The analysis stems from evidence of impacts and reactions collected mainly from newspapers, surveys and recent studies. It is worth mentioning that collecting systematic evidences of sector reactions has been problematic due to: (i) fragmentary information, (ii) lack of comparable data by official sources, and (iii) the economic crisis in the sector whose effects overlap those of the oil price increase.

The first reactions by transport operators to oil prices increases are governed by costs increases or tariff changes. However, also the increased uncertainty of oil prices (due for example to sudden fall in oil prices as it is occurring today) may have effect on suppliers. The ability for the transport operators to change the tariffs and thus pass on the higher costs of fuel to their customers differs considerably by market segment and mode (e.g. the practice of fuel surcharges is widely used in both cargo and passenger aviation, whereas it is quite unusual in road transport) and depends on their market power. Indeed, small transport companies have substantially lower market power than large companies and rising fuel costs are then absorbed

by temporarily reducing margins. Figure 4.1 summarises the market power positions of the different transport modes and sets them in relation to their sensitivity to the oil prices, as it resulted from the analysis made in the previous chapters.

Fig. 4.1 Market power by mode of transport



4.1 Road freight

Considering the incidence of the fuel price in the road freight transport it is interesting to note the changed composition of the "long distance index" in France in the period 2003-2007[3]. The changing incidence of the cost items reflects soaring diesel prices and in 2007, for the first time since 2000, the incidence of the diesel cost becomes as dominant as the incidence of personnel cost (see table 4.1). According to the European Transport Barometer[4], a pan-European annual survey on road freight transport trends, almost one out of three European operators has seen an increase in costs of more than 20%, and the key factor forcing higher costs is definitely fuel.

[3] The "long distance index", elaborated by the Comité National Routier (CNR) (www.cnr.fr), aims at observing the evolution of the costs of the professional road transport.

[4] The European Transport Barometer is carried out by the industry magazine TruckEurope and the business intelligence Analytiqa. The 2008 survey has been conducted between December 2007 and February 2008, involving over 2,800 respondents from 18 countries and covering both large companies and small transporters.

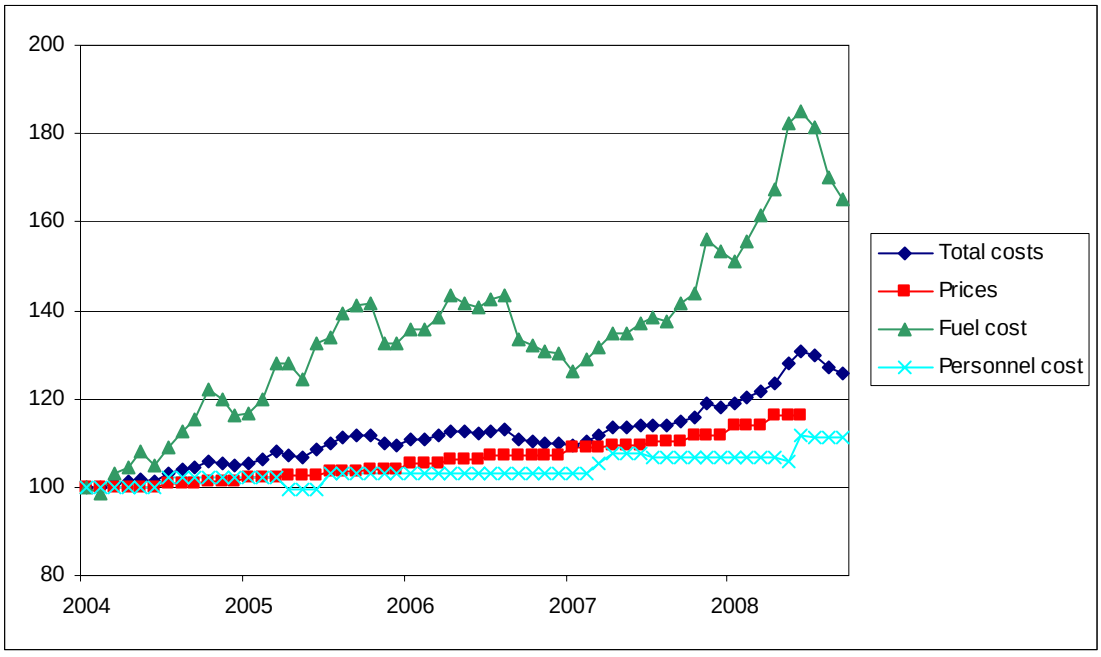
Tab. 4.1 The evolution of the composition of the "long distance index" (France)

Cost item	2003	2004	2005	2006	2007
Diesel	20.8%	23.3%	25.5 %	25.2 %	27.6 %
Maintenance	8.7%	8.8%	8.7 %	9.1 %	8.2 %
Vehicle and insurance	13.6%	12.6%	12.0 %	12.1 %	11.7 %
Tolls and taxation	4.8%	4.9%	5.0 %	5.1 %	5.5 %
Personnel	30.7%	29.3%	28.9 %	28.4 %	27.6 %
Board and lodging	6.7%	6.6%	6.5 %	6.5 %	6.3 %
Structure and indirect costs	14.7%	14.5%	13.4 %	13.6 %	13.1 %
Total	***100%***	***100%***	***100%***	***100%***	***100%***

Source: CNR, 2008

Across Europe, road haulage companies are generally unable to pass on increasing costs to their customers simply by rising their prices. A study carried out by the Bank of Italy (TRT, 2008) pointed out that the road freight rates from 2006 to 2007, with the exception of some specific areas, have shown a very small increase (and sometimes a decrease)[5]. Further evidence comes from a detailed analysis of the French market (CNR, 2008). In this respect, figure 4.2 highlights the difficulties in relation to the last two years, when fuel costs rose dramatically risen while prices only showed a low increase.

Fig. 4.2 France-Total costs, fuel costs, personnel costs and prices in road freight transport (January 2004 = 100)

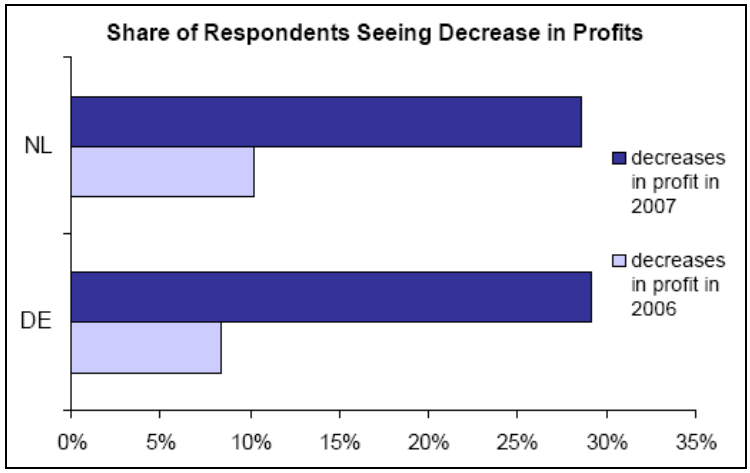


Source: TRT on CNR data

5 The study was implemented through an extensive survey to the transport operators: the outcome from the interviews was used to derive cost functions on the basis of an accurate identification of relevant variables such as distance, duration of the trip and its origin/destination.

Difficulties in passing higher energy price to customers is also reflected in the pricing policies. Even when requests for tariff adjustment occur in the normal process of annual review of trade agreements, customers often return on the market to evaluate competing offers. The phenomenon also covers big operators, so confirming a trend to saving on the cost of transportation also by customers traditionally searching quality services. Consequently, the largest part of the manufacturing cost has been absorbed by the compression of profit margins and a lower overall profitability of the sector. Particularly, small and medium-sized firms have been suffering. A significant example of decreasing profitability is provided in figure 4.5, showing that a relevant percentage of German and Dutch operators experienced decrease in profits (about 30% in 2007 as against less than 10% in 2006).

Fig. 4. 3 Decrease in profitability according German and Dutch operators



Source: European Transport Barometer, 2008

Sector associations advice their members to apply fuel adjustment to their contracts, and technical organizations give the haulers tools to help estimating extra fuel costs; in this respect, relevant examples are the United Kingdom Road Haulage Association and the Comité National Routier in France [6]. Big logistics companies and express couriers have introduced a flexible surcharge for diesel on the basis of the diesel price trend as resulting from official sources[7]. However, since most of road haulage companies are not able to pass on higher transport costs completely several initiatives have been undertaken to reduce other costs. Such initiatives include: fleet cost management (e.g. a careful choice should be made between "invest" or/and "lease"), fuel cost management (e.g. application of economic driving techniques, such as reducing vehicles speed, using in-board devices, monitoring tyres pressure etc..), staff cost management (e.g. leased temporary workforce), insurance cost management (e.g. fix franchise at an appropriate level). Also, the price of diesel fuel has encouraged trucking companies to invest in diesel tanks to reduce their supply cost. In fact, there are real

---

6 RHA Fuel Adjustment Guide (www.rha.net) and *Evolution du prix du gazole et incidence sur le prix de revient, situation au 30 septembre 2008*. For more information see: www.cnr.fr.

7 DHL Freight, for example, in Austria refers to the Austrian sales price of diesel, published by the Federal Ministry for Economic Affairs, while in Italy refers to the Oil Bulletin published by the European Commission, Dg Energy and Transport.

opportunities to install own diesel tanks and buy diesel from oil companies or large retailers with effective savings (between six and nine eurocent per litre).

Furthermore, with fuel prices rising, there is more scope for collaboration between shippers. Many costs imposed on a freight transport company may be attenuated through economies of scale. All experimentation that has been run has turned out to be very successful. For instance, a group of about forty of the British leading food and consumer goods companies started to share vehicles on certain routes for their delivery operations, aiming at reducing delivering with part-filled trucks or returning empty ("Sustainable Distribution Initiative").

4.2 Aviation

Jet fuel expenditure for the major network carriers that are members of the Association of European Airlines (AEA) has doubled between 2004 and 2007, reaching 18 billion €, and a further increase is predicted for 2008 (AEA, 2008). This is mostly due to the record fuel costs suffered by the air transport industry during the first half of 2008 (e.g. the budget airline leader Ryanair declared that for the first quarter of 2008 its fuel bill was over 367 million €, i.e. 93% higher compared to the same period of 2007). Besides its absolute value the main problem was indeed the speed at which fuel prices increased, since a large proportion of airlines' revenue is pre-sold and the recovery of higher costs either through over surcharges or just higher fares has only a limited positive effect on current levels of expenditures. Moreover, the most important airlines' strategy of hedging jet fuel prices was undoubtedly re-targeted too late to the higher shares of the fuel needed for spring and summer 2008.

The industry's continuing expansion is now under the pressure of concomitant negative elements: global recession, resurgence of inflation, tightening of disposable income, the inclusion of aviation in the EU Emission Trading Scheme and, in the end, the proliferation of national taxes on passenger air transport. Since there are structural limits to further fuel and non-fuel efficiency improvements, several airlines decided to increase ticket prices and adapt capacity to this emerging competitive scenario of rising operating costs. Fuel surcharges were largely adopted to transfer most of the fuel increase to the final air cargo users. During the last oil shock, these charges have been extremely high and in some cases even exceeded the net transport fare, similarly to the maritime transport tariff structure

Nonetheless, the strong price competition already induced EU airlines to pursue several cost reductions in the recent years both for fuel and non-fuel items. AEA carriers have improved cost efficiency especially by acting on tickets, sales and promotional expenditures (-9.2% change in unit costs, 2006 *vs*. 2005), stations and ground (-1.8%) maintenance (-0.8%) and depreciation (-7.5%). Excluding fuel, easyJet has registered a strong cost per seat reduction of 13% over the past three years, whereas Ryanair has declared that its unit costs reduced by 6% in its last financial reporting of 2008. Network adjustments were addressed by all carriers, whereas pricing strategies seemed to range from generalised increases of tickets prices (e.g. fuel surcharges), to maintained low fares accompanied by further personnel cost cuts (i.e. by eliminating some call-centre jobs and freezing salaries), and induced changes in air travel behaviour of price sensitive flyers (i.e. by increasing baggage charges and encouraging to more web check-in procedures).

4.3 Rail freight

The rail freight sector has evolved greatly during the last ten years, also due to the full opening of the market to competition, resulting in 701 freight operators having today an active license in Europe. This new landscape has also accelerated cost reductions and efficiency improvements, so that the impact of rising energy costs has been partially limited in recent years.

Rail transport operators are constantly integrating combined transport and logistic services in their traditional activity. The impact of the oil price peak on the sector as a whole is therefore very difficult to summarise, also because of the effect of simultaneous advantage over the "full road" transport mode. However, most of the negative consequences of high oil prices were concentrated in those rail activities focused more on diesel traction.

Railway operators, who have strong market positions due to specific market or geographic conditions (i.e. in the Alpine region), transfer cost increases to their customers and quite often adapt their tariffs to the prices of road transport and inland shipping. When road freight taxes were introduced in Germany (Maut), the tariffs for some rail freight services through Germany and Austria were increased as well. So, so far as road transport became more expensive, rail operators, in principle, adapted their tariffs.

During early 2008, in order to compensate for the very high prices of diesel oil, some operators (e.g. the Dutch operator European Rail Shuttle) applied an indexed fuel surcharge, calculated as a percentage of the freight rate. However, as in road transport, not all the operators are able to pass on all cost increases and therefore many seek other cost reduction measures. It is worth mentioning that, in the short term, many operators have very limited options available with which to react: rail freight production models are relatively inflexible, and an increase in load factors or a combination of clients and cargo may not be realised as easily as in road transport or inland shipping.

4.4 Maritime

Looking at the earning rates in the bulk markets, it is not easy to understand how fuel costs have impacted on overall transport costs. For example, in 2007 and 2008, the rates paid for oil (liquid bulk) transport with tankers showed a very volatile trend.

The containerised transport offers more elements for the analysis. The speed factor is the most important driver of the fuel consumption: in global shipping, the increase in ship speed over the last fifteen years has doubled fuel consumption per unit of freight.

In the quotation of freight rates, the additional cost due to higher oil prices is levied through the Bunker Adjustment Factor (BAF), which is directly translated from shipping companies to shippers. Once corrected for the BAF, container shipping rates would show quite a flat trend. The application of the BAF occurred very frequently starting from the first rises of bunker prices in 2001-2002 and is an interesting case of how oil price changes are translated into higher freight rates. The regular application of the BAF has shown a strong correlation to oil price. Over the last three years, every one dollar rise in world oil prices has fed directly into a 1% rise in transport costs. Table 4.4, based on the results of a direct survey about the relationships between Mediterranean ports and Far Eastern countries, demonstrates the growing role of BAF.

Tab. 4. 2 Mediterranean-Far East: freight rates and BAF surcharge (2002-2008)

Year	Freight rate ($/TEU)		BAF ($/TEU)	BAF incidence	
	Eastbound	Westbound		Eastbound	Westbound
2002	580	900	40	7%	4%
2005	500	1365	187	37%	14%
2008	750	1750	520	69%	30%

Source: Elaboration TRT on Bank of Italy, FEFC

Over the last years the application of BAF not only reflected a fair sharing of vessel fuel costs, but also that large part of bunker surcharges are in fact a form of rate increase. In the context of high fuel prices, the shipping sector was only slightly impacted. In practice the main trade flows were not slowed down by the increased oil price for several reasons:

- freight rates are not amongst the main drivers of the maritime sector, which is often characterised by highly fluctuating rates;
- the growth of traffic flows has been led by strong world demand in the bulk sector and by production and distribution patterns that have brought to strong increase in trade flows (in particular for the containerised sector);
- freight rates (at least in the container sector) have shown a declining trend in real terms despite BAF.

Nevertheless, oil price represents a consistent share of the operating costs, and shipping companies have adopted some strategies to control their pattern of consumption, thus lowering their overall costs. A first improvement was obtained through the use of bigger vessels, which have a lower energy intensity (energy consumption per unit of transport tkm). Furthermore, since fuel consumption rises dramatically as speed increases (fuel consumption relates to the cubic of speed), reducing speed was one of the first reactions[8]. However, to maintain the same level of service on a given route, the shipping line would need to add a ship, thus increasing their full cost[9].

Other strategies adopted by the companies include vessel sharing agreements, by which shipping companies optimise the load factor of vessels and reduce their costs and risks. Two or more companies share their ships on a given route according to their availability of ships and characteristics of flows. The importance of these types of agreement is confirmed by the involvement of the world's largest carriers.

[8] News reports indicated that Hapag-Lloyd has instructed ships to reduce average speeds from 23 knots to 20 knots. The same happened for NYK line which estimates a 20% fuel savings slowing the large vessels to a speed of 23 miles per hour from almost 29 miles per hour..

[9] However, to maintain the same level of service on a given route, the shipping line could need to add a ship, thus rising their full cost.

5 Conclusions

The increase of oil price affects the transport sector much more than the rest of the economy. Almost 97% of the total energy consumption derives from oil-based fuel with road transport being the largest energy consumer. There is almost no oil substitute in the transport sector, and this makes it extremely dependent to oil price dynamics. While some alternative use of oil such as CNG, biofuels and electric are currently viable for passenger road modes, in freight modes the uptake of oil-based fuel is still necessary. In terms of efficiency, maritime transport and rail are felt as the most energy-efficient transport modes per single traffic unit performed.

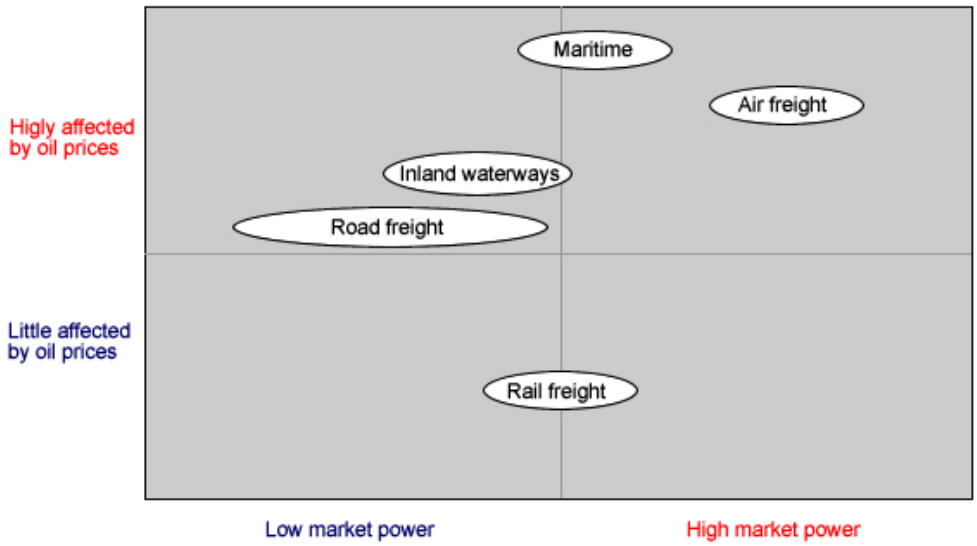
The price of crude oil affects the fuel costs of the majority of transport operators. However, the relation between oil and fuel costs is influenced by other elements, such as production and distribution costs, taxes, excise duties and VAT. Due to the absence of taxation and lower distribution and refining costs, the variation in the price of crude oil affects directly the fuel of kerosene (i.e. jet fuel) used in aviation and marine bunker used in sea shipping. The following table summarises the elements discussed above and sets up the relations between oil price and its effect on transport costs. In the last column, the estimated effect of a doubling of the price of crude oil on costs of moving freight is presented.

Table 5.1 Average share of fuel costs in freight transport costs

	Sensitivity of fuel costs to crude oil price	**Share energy costs in total transport costs**	**Effect of doubling of crude oil price on transport costs**
Road Freight	40%	25%	10%
Rail - diesel	40%	27	10%
Rail - electric	15%	12%	2%
Inland waterways	100%	25%	25%
Maritime	100%	50%	50%
Aviation	100%	33%	33%

At the same time, transport markets also differ in the capacity of transferring higher operating costs to customers. In general, small transport companies in road (driver/owner) and inland shipping have substantially lower market power than large companies (third-party logistics providers). Impacts and reactions are provided for different modes below.

Figure 5.1 Sensitivity to oil prices and market power



Source: Ecorys, 2006

The most critical situations concern road and air. In the road sector, despite the cushioning effect of taxation on diesel that makes the fuel costs less vulnerable to oil price increases, the surge of oil price occurred in last years has damaged many operators. Indeed, almost one out of three European operators has seen an increase in costs of more than 20% and across Europe road haulage companies are generally unable to transfer increasing costs to their customers simply by rising their prices. As results the largest part of the higher cost has been absorbed by the compression of profit margins and a lower overall profitability of the sector. However, given the very high level of fragmentation of this market in several countries, profit margins are already very low. When oil price should rise again and steadily remain on high values for a long period, the sustainability of road freight transport would be seriously threatened. Given the relevance of this sector, which supply about three quarters of the total inland freight transport in Europe, this scenario should not be underestimated. The economy as a whole can live through high oil prices much better than in the 1970's, nonetheless big difficulties could arise if one single sector – road freight transport – should be stopped.

The air sector is the other weak transport market when oil price becomes high. Fuel costs are a significant part of the air transport costs (33%) and the jet fuel is highly depending on the crude oil as no cushioning effect of taxation exists. Due to strong price competition in the context of the air industry's continuing expansion, the rise in fuel prices between 2001 and 2006 has mostly been absorbed by efficiency measures rather than by increases in flight prices but again here a limit exists. During the peak oil period, a number of airlines announced some structural capacity cuts, in particular from the winter timetable, and imminently grounding their aircrafts on unprofitable or marginally profitable routes. The huge increase of the air demand in the last years, and the consequent economic activity and employment generated, have been almost totally due to the significant reduction of fares achieved with the entrance in the market of budget companies selling low cost tickets. Basically, they generated additional air demand rather than attracting demand from competing modes. When low air tariffs should became unsustainable for carriers because of high energy

prices, but also because of environmental taxation, which is under study of the Commission, the risk that a large share of demand would disappear is high.

In conclusion, the recent peak oil price period experienced until mid 2008 has demonstrated that the global economy is today less vulnerable to high energy costs than it was a the time of the first oil crises in the 1970's. However, in the transport sector there are some markets that are particularly endangered by elevated energy price. Since these markets play a strategic role for the whole economy, their weakness could give rise to big problems even if industry can afford high oil price. For that reason, despite the recent fall of oil price, designing a strategy to limit oil dependency of the transport sector remains a urgent need.

6. Bibliography

AEA (Association of European Airlines), *State of the Industry, Emissions Trading Scheme and Single European Sky*, 17.9.2008

Chiffi, Fiorello, Schrooten, De Vlieger, *EX-TREMIS - Exploring non road Transport Emissions in Europe – Final Report*, IPTS - Institute for Prospective Technological Studies, DG-JRC, Seville, 2008

CNR (Comité National Routier), *Enquete long distance 2007*, 2008

CNR (Comité National Routier), *Evolution du prix du gazole et incidence sur le prix de revient, situation au 30 septembre 2008*, 2008

CSST (Centro Studi Sistemi di Trasporto), *Indagine e monitoraggio sui costi e fiscalità*, 2006 and 2008

ECORYS Transport, *Analysis of the impact of oil prices on the socioeconomic situation in the transport sector*, Rotterdam, 2006

EIA (Energy Information Administration), *Official Energy Statistics from the U.S. Government*, 2008

European Central Bank, Statistical Data Warehouse.

European Commission, *EU Energy and transport in figures 2007/2008*, Luxembourg, 2008

European Transport Barometer, 2008

EUROSTAT, *Panorama of Energy*, Luxembourg, 2007

EUROSTAT, *Panorama of Transport*, Luxembourg, 2007

Fiorello D., Martino A., Schade W., Walz R., Schade B., Wiesenthal T., *High Oil Prices: Quantification of direct and indirect impacts for the EU, Final report*. Funded by European Commission 6th RTD Programme, Milano, 2008 (www.hop-project.eu)

INFRAS-IWW, *External costs of transport: update study*, Karlsruhe/Zürich/Paris, 2004

IATA (International Air Transport Association), *Medium Term Outlook for Oil and Jet Fuel Prices*, October 2008

IATA (International Air Transport Association), *Industry Financial Forecast*, September 2008

NEA, Transcare, *Factorkosten van het goederenvervoer: een analyse van de ontwikkeling in de tijd*, 2004

Schade W., Fiorello D., Köhler J., Krail M., Martino A., Schade B., Wiesenthal T., *Final Report of the TRIAS Project: SIA of Strategies Integrating Transport, Technology and Energy Scenarios*. Funded by European Commission 6th RTD Programme, Karlsruhe, Germany, 2008

TRT Trasporti e Territorio for Italian Central Bank, Sample survey on the international transport for the period 2005-2007, Milano, 2008.