

DIRECTORATE-GENERAL FOR INTERNAL POLICIES

POLICY DEPARTMENT
STRUCTURAL AND COHESION POLICIES **B**

Agriculture and Rural Development

Culture and Education

Fisheries

Regional Development

Transport and Tourism

**THE IMPACT OF OIL
PRICES FLUCTUATIONS
ON TRANSPORT AND
ITS RELATED SECTORS**

STUDY



DIRECTORATE GENERAL INTERNAL POLICIES OF THE UNION
POLICY DEPARTMENT STRUCTURAL AND COHESION POLICIES

TRANSPORT AND TOURISM

THE IMPACT OF OIL PRICES FLUCTUATIONS ON TRANSPORT AND ITS RELATED SECTORS

STUDY

Abstract

This study looks over the ways in which the transport of goods is influenced by significant variations in oil prices and focuses on carrier's responses in the different transport sectors. It investigates the relations between oil prices and the transport sector, by taking into account the evidence of the impact of recent price hikes on transport businesses and their response. Indeed, the spike in oil prices in the first half of 2008 has been taken as an opportunity to carry out an evidence-based analysis of the transport sectors' reactions.

This document was requested by the European Parliament's Committee on Transport and Tourism.

AUTHORS

Mr Angelo Martino
Mr Giuseppe Casamassima
Mr Davide Fiorello

RESPONSIBLE ADMINISTRATOR

Mr Piero SOAVE
Policy Department Structural and Cohesion Policies
European Parliament
B-1047 Brussels
E-mail: ipoldepb@europarl.europa.eu

LINGUISTIC VERSIONS

Original: EN
Translations: DE, FR, IT.

ABOUT THE EDITOR

To contact the Policy Department or to subscribe to its monthly newsletter please write to: ipoldepb@europarl.europa.eu

Manuscript completed in March 2009.
Brussels, © European Parliament, 2009.

This document is available on the Internet at:
<http://www.europarl.europa.eu/activities/expert/eStudies.do?language=N>

DISCLAIMER

The opinions expressed in this document are the sole responsibility of the author and do not necessarily represent the official position of the European Parliament.

Reproduction and translation for non-commercial purposes are authorized, provided the source is acknowledged and the publisher is given prior notice and sent a copy.

CONTENTS

INTRODUCTION	19
PART I RELATIONSHIPS BETWEEN THE PRICE OF CRUDE OIL AND ENERGY COSTS IN THE TRANSPORT SECTORS	21
CHAPTER 1 ENERGY DEMAND IN THE TRANSPORT SECTOR	21
1.1 Introduction	21
1.2 Evolution of final energy consumption in transport, industry, services and households	21
1.3 Energy consumption in transport	22
1.4 Energy efficiency	26
1.5 Modal shares in freight transport	28
1.6 Summary of key findings	28
CHAPTER 2 ANALYSIS ON FUEL PRICE TRENDS AND CORRELATION WITH CRUDE OIL PRICES	31
2.1 Introduction	31
2.2 Oil price trends	31
2.3 Relation between crude oil prices and fuel prices for road transport	32
2.4 Relation between the price of crude oil and the price of marine fuels	38
2.5 Relation between the price of crude oil and the price of jet fuel	39
2.6 Summary of key findings	41
CHAPTER 3 THE SHARE OF FUEL COSTS IN TOTAL TRANSPORT COSTS BY MODE	43
3.1 Introduction	43
3.2 Road	43
3.3 Rail	44
3.4 Aviation	45
3.5 Maritime shipping	46
3.6 Inland navigation	47
3.7 Summary of key findings	48
PART II THE IMPACTS OF THE PRICE OF OIL IN TRANSPORT SECTOR: REACTIONS OF TRANSPORT CARRIERS AND USERS, GOVERNMENT AND ECONOMIC ACTORS	49

CHAPTER 4 EVIDENCE OF THE IMPACT OF HIGH OIL PRICES IN THE TRANSPORT SECTOR	49
4.1 Introduction	49
4.2 Road freight	50
4.2.1 Overview and impacts	50
4.2.2 Sector reactions	54
4.3 Aviation	57
4.3.1 Overview and impacts	57
4.3.2 Sector reactions	59
4.4 Rail	59
4.4.1 Overview and impacts	59
4.4.2 Sector reactions	59
4.5 Maritime	60
4.5.1 Overview and impacts	60
4.5.2 Sector reactions	60
4.6 Inland navigation	63
4.6.1 Overview and impacts	63
4.6.2 Sector reactions	63
4.7 The incidence of transport costs on industrial sectors	64
4.8 Summary of key findings	65
PART III THE IMPACTS OF FUTURE OIL PRICE INCREASES	67
CHAPTER 5 HIGH OIL PRICES SCENARIOS	67
5.1 Introduction	67
5.2 Differences with previous oil price shocks	67
5.3 Estimated future impacts of high oil prices	70
5.3.1 Overall impact on the economy	70
5.3.2 Impacts on the transport sector	72
5.4 Some transport policy impacts of high oil prices	78
5.5 Summary of key messages for future scenarios	79
CHAPTER 6 CONCLUSIONS	81
6.1 The impacts of oil price across the modes of transport	81
6.2 The reaction of the freight transport sector	82
6.3 Government measures	85
6.4 Future scenarios	85
6.5 Suggested measures	87
7. BIBLIOGRAPHY	89

GLOSSARY OF ABBREVIATIONS AND ACRONYMS

BAF	Bunker Adjustment Factor
CO2	Carbon Dioxide
COM	Commission Communication
CNG	Compressed Natural Gas
CNR	Comité National Routier
CSST	Centro Studi Sistemi di Trasporto
cSt	CentiStoke
DG ENV	Directorate–General Environment
DG TREN	Directorate–General Energy and Transport
DG ECFIN	Directorate–General Economic and Financial Affairs
EC	European Commission
ECMT	European Conference of Ministers of Transport
EEA	European Environment Agency
EIA	Energy Information Administration
EP	European Parliament
EREF	European Renewable Energies Federation
ETS	Emission Trading Scheme
EU-10	New Member States of the European Union since 2004
EU-12	New Member States of the European Union since 2004 and 2007
EU-15	The 15 Member States of the European Union since 1995
EU-25	The 25 Member States of the European Union since 2004
EU-27	The 27 Member States of the European Union since 2007
EU-28	EU-27 plus Turkey
EUROSTAT	Statistical Office of the European Communities
FEFC	Far Eastern Freight Conference
FNTR	Fédération Nationale des Transports Routiers
FTM	Freight Transport Management

GDP	Gross Domestic Product
GHG	Greenhouse Gas
GTL	Gas To Liquid
GW	Gigawatt
H₂	Hydrogen
HDV	Heavy-Duty Vehicle
HGVs	Heavy Goods Vehicles
HOP	EC DG RTD research project on “High Oil Prices”
HVF	Heavy Vehicles Fee
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
IEA	International Energy Agency
IFO	Intermediate Fuel Oil
IMF	International Monetary Fund
IMO	International Maritime Organisation
INFRAS-IWW	Institute for Economic Policy and Economic Research (D)
IPCC	Intergovernmental Panel on Climate Change
IPTS	Institute for Prospective Technological Studies
IRU	International Road Transport Union
ITS	Intelligent Transport System
IWW	Inland Water Ways
JRC	Joint Research Centre
LD	Landfill Directive
LDV	Light Duty Vehicles
LGVs	Light Goods Vehicles
LHVs	Long and Heavy Vehicles
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
LRT	Light Rail Transit
NEA	Transport Research Institute

NMS	New Member States (the 10 countries joining the EU in 2004)
NOx	Generic term for mono-nitrogen oxides (NO and NO ₂) which are produced during combustion
OECD	Organization for Economic Co-operation and Development
p.a.	Per Annum/Per Year
PM	Particulate Matter
RPK	Revenues per flown passenger-km
SECAs	Sulphur Emissions Control Areas
SO₂	Sulphur dioxide generated by the combustion of coal and petroleum products
TEU	Twenty-foot Equivalent Unit
TREMOVE	Transport Model
TRIAS	EC DG RTD research project on “Sustainability Impact Assessment of Strategies Integrating Transport, Technology and Energy Scenarios”
UIC	International Union of Railways
UNECE	United Nations Economic Commission for Europe
UNFCCC	United Nations Framework Convention on Climate Change
VAT	Value Added Tax
VLCC	Very large Crude Carrier
VTPI	Victoria Transport Policy Institute - Canada
WEO	World Energy Outlook
WTI	West Texas Intermediate (type of crude oil)

UNITS OF MEASUREMENT

€	Euro
Mt	Million tons
Mtoe	Million tons of oil equivalent
1000toe	Thousands tons of oil equivalent
Pkm	Passenger kilometre
Ppm	Parts Per Million
TEU	Twenty-Foot Equivalent Unit
Tg	Teragrams
Tkm	Tons kilometre
Vkm	Vehicle kilometre

LIST OF TABLES

Tab. 1. 1	Final energy consumption by sector in the EU in Mtoe (1990-2006)	22
Tab. 1. 2	Mix of energy sources in transport in the EU in 1000toe (1990-2006)	23
Tab. 1. 3	Final energy consumption by mode of transport in the EU in 1000toe (1990-2006)	24
Tab. 1. 4	Energy consumption for national and international maritime and air transport in the EU in 1000toe (1990-2006)	25
Tab. 1. 5	Transport activity, energy use and unit consumption by mode in the EU, 1990-2006	27
Tab. 1. 6	Tkm hauled per one ton of oil equivalent	27
Tab. 2. 1	Sensitivity of fuel costs to crude oil prices	42
Tab. 3. 2	Overview of cost breakdown in rail freight transport using the VKM model calculations	45
Tab. 3. 3	Structure of costs for new self-propelled inland navigation vessels	47
Tab. 3. 4	Indicative share of energy costs in total transport costs for different modes	48
Tab. 4. 1	The evolution of the composition of the “long distance index” (France)	51
Tab. 4. 2	Road freight prices between Italy and the main European regional areas in 2006 and 2007 (€/vehicle)	52
Tab. 4. 3	From costs to prices: an increasing gap	53
Tab. 4. 4	Mediterranean-Far East: freight rates and BAF surcharge (2002-2008)	62
Tab. 5. 1	Major differences between oil price crises over time	69
Tab. 6. 1	Sensitivity of transport costs to crude oil price	81
Tab. 6. 2	Overview of measures to respond to the effects of increasing oil prices	84
Tab. 6. 3	Recommended measures to improve energy efficiency	87

LIST OF FIGURES

Fig. 1. 1	EUshare of transport energy demand by source and mode in 2006 (%)	26
Fig. 1. 2	Modal shares of performed freight tkm in EU, in 2006	28
Fig. 2. 1	Development of crude oil nominal prices (monthly averages 1987-2008)	32
Fig. 2. 2	Cost components of one litre of diesel in EU and USA in November 2008	33
Fig. 2. 3	Level of excise duties on diesel (€/litre) by country in the EU	34
Fig. 2. 5	Increases in the pump price of unleaded petrol in the EU (1998–2008) Index100=1998	35
Fig. 2. 6	Percentage increases in the pump price of diesel for EU-25 countries (first half of 2008 compared to second half of 2004)	36
Fig. 2. 7	Components of average EU diesel price (€/litre)	37
Fig. 2. 8	Evolution of EU total fuel consumption in transport (1,000 toe) and oil price (€/bbl)	38
Fig. 2. 9	Development of Brent crude oil and marine fuels IFO (2001-2008), index100=2001	39
Fig. 2. 10	Margin of jet fuel price above crude oil price in US\$ and % mark-up	40
Fig. 2. 11	Annual variation in kerosene and crude oil prices (1998-2007)	40
Fig. 3. 1	Breakdown of transport costs (in €/km) for selected EU countries (2008)	43
Fig. 3. 2	Total aviation operating costs structure (2006 and 2008)	46
Fig. 3. 3	Breakdown of total transport costs of short sea shipping	47
Fig. 4. 1	Qualitative assessment of market power by mode of transport	49
Fig. 4. 2	Development of fuel and labour cost for Italy (2004-2008) and their share in total transport costs	50
Fig. 4. 3	Increase in operating costs as reported by road transport operators	51
Fig. 4. 4	France – Total costs, fuel costs, personnel costs and prices in road freight transport (January 2004 = 100)	52
Fig. 4. 5	Decrease in profitability according German and Dutch operators	53
Fig. 4. 6	Tank investment in France: percentage variation for not previously equipped companies	55
Fig. 4. 7	AEA carriers revenue passenger-km (RPK) development (year-on-year % change)	58
Fig. 4. 8	Trend of the BAF applied to freight on the FEFC (US\$/TEU)	61
Fig. 4. 9	Transport Costs Highly Sensitive to Oil Prices	62
Fig. 4. 10	Incidence of transport cost by product	65

Fig. 5. 1	Trend of the EU-27 pkm	72
Fig. 5. 2	Trend of EU-27 freight-km	73
Fig. 5. 3	EU-27 average freight travel distance	74
Fig. 5. 4	Overview of EU-27 Freight Mode shares	75
Fig. 5. 5	Trend of unitary fuel consumption of road freight (index on base year 2008)	76
Fig. 5. 6	Trend of average load factor of road freight vehicles (index on base year 2008)	76
Fig. 5. 7	Trend of average unitary cost of road freight vehicles (index on base year 2008)	77
Fig. 5. 8	Trend of EU-27 goods vehicles fleet and LGVs diesel	78
Fig. 5. 9	Trend of EU-27 transport fuel tax revenues	79
Fig. 6. 1	Sensitivity to oil prices and market power	82

EXECUTIVE SUMMARY

Recent years have experienced a steep rise in oil prices, which reached their maximum quotation on 11th of July 2008 at 147 US\$/barrel. This overall scenario, however, radically changed in the second part of the year, mainly because of the world financial crisis and the economic recession that have especially affected the United States and European countries, with oil prices which dramatically fell below 50 US\$/barrel. All this has had clear and crucial implications for the transport sector and the overall competitiveness of transport operators.

The purpose of this study is to investigate the relationships between oil prices and the transport sector, and to provide 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 in this respect.

Energy demand in the transport sector

Appropriate and detailed information about the amount of energy consumed by the transport sector is of paramount importance in order to properly assess the impacts of oil prices on transport activities. Indeed, the transport sector not only considerably increased its energy consumption between 1990 and 2006, but such increase was also higher than the one recorded for industry and households. When looking at the latest EU statistics, it is evident that transport has augmented its share of total energy consumption (from 26% in 1990 to 31% in 2006) with a difference of three percentage points compared to industry (28% in 2006).

These figures are even more important when considering that transport is also a major consumer of fossil fuel, which constitutes almost 97% of the total energy consumption of the sector. This is because (i) biofuels are currently used in the road sector mainly, and in Europe they are still characterised by high production cost and need significant availability of arable land to be produced on a large scale; (ii) plug-in electric options are still facing technological barriers in terms of the size and cost of batteries; (iii) hydrogen technologies are expected to enter the transport market only in the long term (2030).

Not surprisingly, road transport represents the largest demand for oil-based energy (76% of the total volume for 2006), with a significant gap compared to the remaining transport modes, since aviation maritime, rail and inland navigation take 15%, 7.8%, 2.2% and 1.1%, respectively. It also has to be pointed out that rail is mainly powered by electric traction, and that the value of 2.2% refers to diesel locomotives and railcars still operating in the Union.

However, over the recent years road transport has registered a steady and relevant progress in terms of energy efficiency. In particular, road passenger transport, thanks to technological development and the voluntary agreement within the car industry to reduce CO₂ emissions from new cars, and despite the increase in the average weight of the vehicles, has shown the best performance (+20%). Only minor improvements may be, conversely, attributed to road freight transport. Similarly, positive results have also been achieved by the aviation sector, through renewal of the fleet and higher occupancy factors. Rail and maritime have instead comparatively maintained the same level of energy efficiency, but are still the most energy-efficient transport modes.

It is worth mentioning that, over the period 1990-2006, the gains made through fuel and energy efficiency were not sufficient to offset the 60% increase in freight and passenger

transport demand, resulting in increased total energy consumption of approximately 24% over this period.

Analysis of fuel price trends and correlation with crude oil prices

As already mentioned, extensive increases in crude oil prices have characterized the international markets from 2003 to July 2008. Many reasons may explain this sharp rise: huge demand from fast-growing economies like China and India, (ii) supply shortages due to geopolitical tensions, (iii) short-term speculative market movements, and, finally, (iv) the reduction of oil production from OECD countries, associated with the political instability in several world areas (Gulf region, Nigeria, Venezuela).

It goes without saying that the impacts of high oil prices have been remarkable, although for the Euro-zone they have been mitigated by the strong appreciation of the Euro against the US Dollar on the currency market. This has allowed that between 2004 and July 2008, while the average US Dollar price per barrel has grown by approximately 258%, the corresponding rise in the Euro price was 210%. At the end of 2008, the scenario is thoroughly different, after oil prices have fallen much below 50 US\$/barrel as a consequence of the world financial crisis and economic recession.

All these fluctuations in oil prices have a clear impact on the overall costs of transport activities, even though the effects differ according to the specific transport mode. For example, in the case of road transport, oil prices only partially cover the total fuel price, as the remaining part is dependent upon many other factors like, for example, processing and distribution costs. The level of fuel taxation represents the component that largely determines the final fuel price and this has contributed to alleviate the effects of the sharp boost in oil prices which occurred **in the last four-year period**. For the maritime and aviation sectors, the absence of specific taxation, together with low processing and distribution costs, has led to a much more significant impact of oil price variation on fuel prices.

Share of fuel costs in total transport costs by mode

Understanding the relation between oil prices and fuel transport costs represents a key step in assessing the impacts on the transport activities. The comparative analysis carried out by the study in this regard has drawn the following conclusions:

- for road freight transport, fuel cost is one of most significant components (together with labour costs), but also one of the most variable between countries;
- for the rail freight sector, available data on the impact of energy costs are very aggregate, and thus comparable estimations are hardly possible: however, energy costs are generally not considered to be a major component of rail freight operating costs;
- for aviation, fuel costs as a share of total operating costs have grown from 13% in 2001 to 29% in 2007, and are estimated to account for 33% in 2008;
- for maritime, the share of bunker costs in the daily running costs of a ship may be considerable: the values estimated for a representative corridor is around 30%, which goes up to 50% for an oil price of 100 US\$/barrel.

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 effects of a doubling of the price of crude oil on the cost of moving freight are presented.

Sensitivity of transport costs to crude oil price

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

Evidence of impacts of high oil prices in the transport sectors

The impacts of oil price increases on the specific transport modes, as previously observed, have evident and critical implications for the transport sector and its overall competitiveness. Various countermeasures have been implemented by both private freight transport operators and national governments (and finally the European Commission), so as to tackle and overcome such a negative context. The former focused on energy improvements (permanent cost management, installing own diesel tanks, consumption reduction), whilst the latter have put in place specific policies to help the haulage sector to face diesel price increases.

In the road freight sector, the capacity to react is also linked to the size of the operators, because big logistics companies and express couriers have been able to introduce flexible surcharges for diesel. But on a more general level, and since most of road haulage companies are small and medium-sized firms, the largest part of the higher costs has been absorbed by the compression of profit margins. Here, the gap between road freight cost increases and price increases is widening with particular effect in Central Europe, and with Spain and Portugal as exceptions.

The remaining transport modes present quite a different situation. The rise in fuel prices has been essentially alleviated in the aviation sector through efficiency measures rather than increases in flight prices. In the rail freight sector, due to the fact that transport costs have decreased, the impact of fuel price rises has been limited, although because of current negative competitive conditions, the latest fuel price increases may be a potential source of concern for the railway operators, in particular those operating diesel traction.

Lastly, for global shipping, the study has shown how the increase in ship speed over the last fifteen years has doubled fuel consumption per unit of freight, hence cancelling out to a large extent the economies of scale of larger vessels. However, even in the presence of the acknowledged sensitivity of fuel costs to oil prices, the incidence of oil price fluctuations on the final product value and transport activity has been assessed as modest.

High oil prices scenarios

The overall conclusion drawn up by HOP! project (Fiorello et al., 2008) served as a reference point for evaluating high oil price scenarios and their impacts on the transport sector. According to the estimates produced by this project, from a general point of view it may be affirmed that high oil prices will probably have relevant economic impacts more in the short-term than in the medium/long-term. Only in the case of an extended world recession, or in situations of insufficient energy supply, will these negative impacts multiply by factors of five to ten.

Although, on the one hand, current and future oil price shocks will probably be more serious than past ones (see the shocks which occurred in the 1970s) due to resource scarcities, on the other hand, they will have less potential to influence the whole economy thanks to the fact that: (i) oil intensity of the economy has halved over the past 30 years in developed countries, and (ii) the potential for introducing valid alternatives to oil and a greater energy efficiency is much higher than in the past.

Looking more specifically to the transport sector, larger effects are expected on the passenger side than on the freight side, because the responsiveness of the freight transport sector is expected to slow down the growth in tonnes kilometres with respect to the reference case. Furthermore, the effect of a discount on fuel excise duty would not impact significantly on the competitiveness of road freight transport. Since a discount could significantly decrease fuel tax revenues, lowering fuel taxes as a policy tool to alleviate the impact of fuel prices on motorists and companies could not be very effective and could be quite problematic in budget terms. Eventually, a faster renewal of the road freight vehicle fleet is also expected. Simultaneously, the higher efficiency of road transport would enable hauliers to downsize their fleet without reducing their level of supply.

INTRODUCTION

This study aims at providing the Members of the Committee on Transport and Tourism with background information related to the impact of oil prices on transport costs, and consequently looks at the ways in which the transport of goods is influenced by significant fluctuations in oil prices. Furthermore, the study also focuses on carriers' responses in the different transport sectors.

After more than a decade of cheap oil at around 20 US\$/barrel, prices have risen steeply **during the last four years**. Such large increases in crude oil prices have affected to different extents, oil-intensive sectors and caused concern for oil-importing countries. At the time when the study was commissioned (September 2008), the price of Brent crude oil was at a level of about 100 US\$/barrel, while two months earlier in July it had reached a peak of 147 US\$/barrel. At the end 2008, the oil price fell dramatically below 50 US\$/barrel, as a consequence of the world financial crisis and economic stagnation in both the United States and Europe, which pushed large consumers to reduce energy use. Despite the attempts of the OPEC oil cartel to cut oil production, analysts believe that further price slides may not be avoided during the months to come.

Nevertheless, the sudden rise of oil prices and the impact on transport and the economy is still of major concern, since 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 spikes in the longer run.

Based on this preliminary framework, the study investigates the relations between oil prices and the transport sector, by taking into account the evidence of the impact of recent price hikes on transport businesses and their actual response. Indeed, the spike in oil prices in the first half of 2008 could be considered as an opportunity to carry out an evidence-based analysis of the transport sector's reactions. Future scenarios for scarcity of resources, high oil prices and their effects on the transport sector have been analysed making reference to a specific study based on system dynamics simulation models.

The first part of the study analyses the impact of oil price variation which is different across transport modes and is dependent upon on 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.

The second part focuses on the impacts and reactions of providers of freight transport services to oil price increases. The analysis stems from recent evidence on impacts and reactions collected mainly from newspapers, surveys and recent studies.

The final part of the study draws some key messages from the analysis of future scenarios, based on the outcomes of the HOP! project (Fiorello et al., 2008), where the expected impacts of high oil prices on the economic, energy and transport sectors have been estimated by means of a modelling approach.

In more detail, the study is divided into six chapters:

- 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;
- Chapter Five, future scenarios of the effects of very high oil prices on the transport sector have been estimated by means of system dynamics simulation models;
- lastly, Chapter Six 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.

PART I RELATIONSHIPS BETWEEN THE PRICE OF CRUDE OIL AND ENERGY COSTS IN THE TRANSPORT SECTORS

Chapter 1 Energy demand in the transport sector

1.1 Introduction

This Chapter reviews the most recent available data for the European Union concerning the relationship between energy consumption and transport activities. After having described the changes in final energy consumption in Europe between 1990 and 2006, an overview of a mix of energy sources and the final energy consumption by each mode of transport is given. Finally, a combination of energy and transport activity data, a key indicator of energy efficiency details the differences in relative energy intensity, as well as the efficiency improvements achieved by each transport sub-sector.

Data derived from the Eurostat database have been taken up to the year 2006, as more up-to-date data is available only for aggregated energy supply. In order to cover the maritime and aviation transport activity performed outside of the EU borders, but related to EU countries, Eurostat statistics have been combined with EX-TREMIS (2008) estimates of aggregated national and international EU consumption of marine bunkers and aviation fuels. Data on traffic demand used to calculate energy efficiency by transport mode have been extracted from Eurostat, INFRAS-IWW (2004) and EX-TREMIS (2008).

1.2 Evolution of final energy consumption in transport, industry, services and households

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).

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.

Tab. 1.1 Final energy consumption by sector in the EU 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 %	1,068 100 %	1,140 100 %	1,126 100 %	1,158 100 %	1,171 100 %	1,172 100 %	1,176 100 %	10 %

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.

1.3 Energy consumption in transport

Transport is not only a major consumer of energy; it is in particular a consumer of fossil fuels. This reflects the lack of real alternatives to oil-based energy in the transport sector, because: (i) biofuels are currently used in the road sector mainly, and in Europe they are still characterised by high production cost and need significant availability of arable land to be produced at large scale; (ii) plug-in electric options are still facing technological barriers in terms of the size and cost of the batteries; (iii) hydrogen technologies are expected to enter the transport market only in the long term (2030).

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 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.

Table 1.3 describes how the energy consumption is distributed among transport modes and how such a distribution has changed from 1990 to 2006. Not surprisingly, most of the energy demanded by the transport sector is used in road transport.

Electricity, as a source of energy, 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, according to EX-TREMIS data). Electricity is produced with a different mix of sources in each country, whereas some countries are more fossil fuels-dependent², while in other countries³ a larger share of power is produced using alternative sources.

² According to own calculation on EU Energy and Transport in Figures 2007, in the Netherlands and in Poland more than 90% of electricity is produced from conventional thermal plants while in Denmark it is 76%.

Tab. 1.2 Mix of energy sources in transport in the EU in 1000toe (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 renewables in transport is made of biofuels

³ This is case, for instance, of Spain (50%), Slovakia (63%), and Austria (66%).

Tab. 1.3 Final energy consumption by mode of transport in the EU in 1000toe (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	-	-	-
							234,6	297,7	303,3	29,13	49,86	61,8
TOTAL	9,573	9,435	9,199	5,654	4,368	4,683	08	45	17	8	9	56
% Share	3.4%	2.6%	2.2%	2%	1.2%	1.1%	84.1%	82.4%	73,9%	10.4%	13.8%	14.9%
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

Table 1.3 refers to the amount of fuel supplied in the EU (excluding maritime transport and pipelines), though it must be stressed that the reported sales of marine bunkers and jet-kerosene in the EU may not be directly correlated to transport activity performed in Europe only. Fuel supplies and use outside EU may occur, so that a proper quantification of energy consumption for internationally-oriented transport activities might be difficult.

A complete energy analysis of the transport sector including estimates of marine bunkers consumption for EU-related coastwise (national), short-sea and deep-sea shipping activities, is provided by the EX_TREMIS study⁴. Table 1.4 reports energy consumption estimates for the EU-27 maritime and air transport sectors from a geographical perspective, including national and international traffic, together with other relevant factors like fleet characteristics and fuel restrictions (e.g. sulphur content of marine fuels in Sulphur Emissions Control Areas).

It may be pointed out that final energy consumption figures for aviation fall in the range of fuel supply statistics provided by Eurostat for 1990, whereas in 2006 fuel estimates are

⁴ Reference data are taken from the project EX-TREMIS (2008) carried out by TRT on behalf of the JRC-IPTS (www.ex-tremis.eu); the calculated fuel consumption on international routes to/from non-EU countries is attributed 50% to the EU and 50% to the partner country.

15% higher than fuel sales. Notwithstanding this, the overwhelming role of road transport is not questionable and also the growth of air energy consumption is already clearly documented in Eurostat statistics.

Tab. 1.4 Energy consumption for national and international maritime and air transport in the EU in 1000toe (1990-2006)

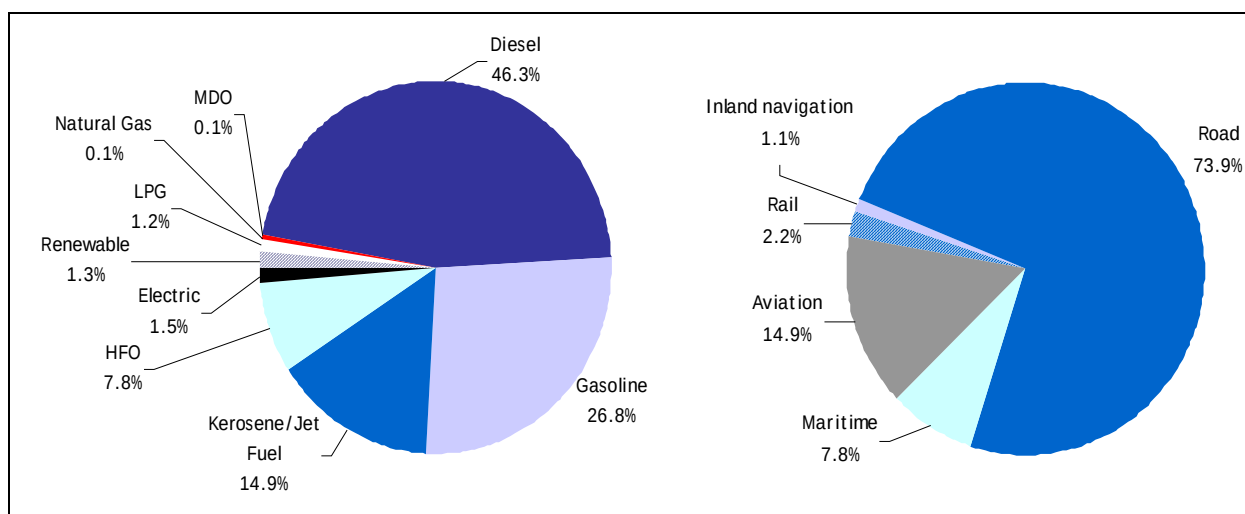
Energy source	Maritime transport			Air transport		
	1990	2005	2006	1990	2005	2006
Marine Diesel Oil (MDO)	1,228	448	359	-	-	-
Heavy Fuel Oil (HFO)	19,250	31,740	31,862	-	-	-
Kerosene/Jet Fuel	-	-	-	29,795	57,761	61,056
Total	20,478	32,188	32,220	29,795	57,761	61,056
Year 1990=100	100	157.2	157.3	100	193.9	204.9

Source: TRT on EX-TREMIS data

Note: Missing air transport figures have been estimated for Czech Republic and Slovakia

By combining Eurostat statistics of energy consumption in transport by source (road, rail and inland navigation only) with EX-TREMIS estimates of aggregated national and international EU consumption of marine bunkers and aviation fuels, the total energy bill for the transport sector as a whole reaches 410.5 Mtoe in 2006.

Figure 1.1 provides the overview of total energy demand by source and mode of transport in EU, covering domestic, internal EU traffic and intercontinental traffic. As highlighted above (table 1.3), road transport is noticeably the largest energy consumer, absorbing up 303 million tonnes of oil equivalent, which is 74% of the total volume in 2006. Aviation is the second largest consumer with a 15% share, followed by maritime transport (7.8%); rail transport accounts only for 2.2% (being electric traction 68% of total rail energy), and finally inland navigation consumes only 1.1%.

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

Source: TRT based on Eurostat and EX-TREMIS data

1.4 Energy efficiency

Transport energy consumption is driven by the size of transport activities, the market shares of transport modes and their energy efficiency. Energy use and transport demand figures are here combined so to calculate the energy intensity of each mode of transport (e.g. consumption per unit of traffic performed). In Table 1.5 transport activity data collected in pkm and tkm are transformed in one single traffic unit to present the change in activity since 1990 and the relative contribution from each mode to the total activity performed.

Apart from the transport of goods, transport on inland waterways and lakes also includes the transport of passengers. Passenger transport data (i.e. pkm) are not available from the Member States, so that a consistent single traffic unit to be compared with total energy consumption cannot be derived. Consistently, Table 1.5 does not include calculations of energy efficiency for transport on inland waterways.

Since 1990, road transport has increased transport activity by 61% but, in parallel, energy consumption has only grown by 29%. 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 its efficiency by 20%, as a result of technological development and the voluntary agreement within the car industry to reduce CO₂ 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.

Tab. 1.5 Transport activity, energy use and unit 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

Table 1.6 uses the same data included in Table 1.5 but points out how many tkm may be travelled using one ton of oil equivalent. This confirms how maritime transport and rail are the most energy-efficient transport modes per single traffic unit performed, having also achieved a further improvement in efficiency during the past two decades. Particularly, rail transport efficiency is due to the predominance of electric traction.

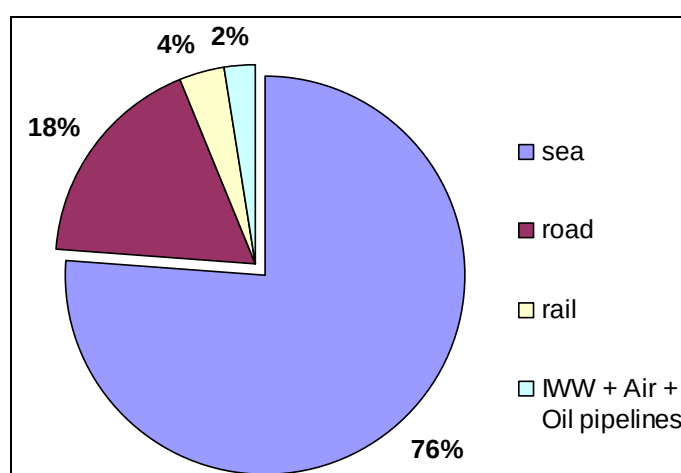
Tab. 1.6 Tkm hauled per one ton of oil equivalent

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

1.5 Modal shares in freight transport

The demand for goods transport for the four land transport modes in the EU (road, rail, inland waterways and pipelines) has added up to 2,595 billion tkm in 2006. If total maritime and air transport (i.e. national and international traffic)⁵ summed to the land modes, then (i) the share of road shrinks from around 80% to 18%, (ii) rail accounts for 4%, and (iii) inland waterways, oil pipelines and air cargo contribute only by 2%. Maritime transport represents the largest modal share, being 76% of the total tkm transported⁶ (Fig 1.2).

Fig. 1.2 Modal shares of performed freight tkm in EU, in 2006



Source: TRT based on Eurostat and EX-TREMIS data

1.6 Summary of key findings

The analysis carried out in this chapter has enabled us to observe the evolution of final transport-related energy consumption in Europe between 1990 and 2006. Indeed, this evolution is such that the transport sector has not only progressively increased its energy consumption over the last 15 years, but this increase has also been higher than the one recorded for the industry and the households. Statistically, this means that in 2006 transport has absorbed around 31% of total final energy consumption (this value was 26% in 1990), compared to 28% for the industry sector. Moreover, this is of utmost importance, when considering that more than a half of the total increase has taken place in the final years of twentieth century, while since 2001 energy consumption has grown slowly (although still faster than in other sectors).

Transport is a major consumer of fossil fuels, which constitutes almost 97% of total energy consumption, and this may be regarded as a consequence of three main factors: (i) limited use of biofuels due to high production costs and to the need for arable land to be produced at large scale, (ii) technological bottlenecks in terms of the size and cost of batteries for plug-in electric options, and finally (iii) commercial availability of hydrogen technologies which is expected only by 2030.

⁵ According to EX-TREMIS, international activities are attributed to the EU by considering only half of the travelled distance between each reporting EU country and its partners.

⁶ Taking into account the whole travelled distance, maritime transportation accounts for 90% of cross-border world trade as measured by volume (UNESCAP, 2002).

Within the different transport modes, and not surprisingly, road transport provides the largest demand for oil-based energy (76% of the total volume for 2006) followed by aviation (15% of total volume). Electricity is almost exclusively used in rail transport, though a significant number of diesel locomotives and railcars are still operating in the Union (amounting to 2.2% of total volume for 2006). Values for oil-based energy consumed by the maritime and inland navigation sector are smaller: 7.8% and 1.1% respectively. Two final considerations are worth noting.

- The first concerns energy efficiency: road transport, even if it is the largest energy consumer, is also the transport mode that has performed the best in terms of energy efficiency since this has improved by 20% for the same period (1990-2006). This may be interpreted as the result of the technological development achieved in the last years, which has been strengthened by the voluntary agreement within the car industry to reduce CO₂ emissions from new passenger cars. Only minor improvements may be, conversely, attributed to road freight transport over these last years. Similar positive results have also been secured by the aviation sector, namely through the renewal of the fleet and higher occupancy factors. Rail and maritime have maintained more or less the same level of energy efficiency and yet remain the most energy-efficient transport modes.
- The second final consideration refers to modal shares in freight transport. Here the study has described how, in global terms, maritime transport represents the largest modal share, being 76% of the total tkm transported. Road freight transport ranks second (18%), followed by rail (4%), and inland waterways, oil pipelines and air cargo (2%).

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

2.1 Introduction

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. Transport fuel is manufactured from crude oil, which is processed and blended to precise specifications in modern refineries and moved through a complex global network of tankers, pipelines, tank trucks and terminals to service stations. Fuel price at the pump, which is what concerns transport operators, reflects not only the crude oil prices but also taxes and the cost of refining and distribution, including measures for environmental protection and, over the long term, a reasonable return for investors.

2.2 Oil price trends

The price of crude oil is set by the supply and demand conditions in the global market overall, and, more particularly, in the main refining centres: Singapore, Northwest Europe, and the US Gulf Coast. On a pre-tax level, crude oil prices are the most important determinant of petroleum product prices, and are often the most important factor in price changes as well.

After four years of a rising trend, oil prices reached a peak in July 2008 and then fell below 50 US\$/barrel by the end of 2008. This is mainly due to the world financial crises and economic stagnation, which have contributed to pushing down energy consumption, as well as to short-term market speculative movements. Nevertheless, the low oil price might be short-lived as affirmed by many analysts including the International Energy Agency (IEA), which, in its World Energy Outlook 2008 (2008), expects oil to trade at an average of more than 100 US\$ per barrel between now and 2015 as supply shortages become a reality.

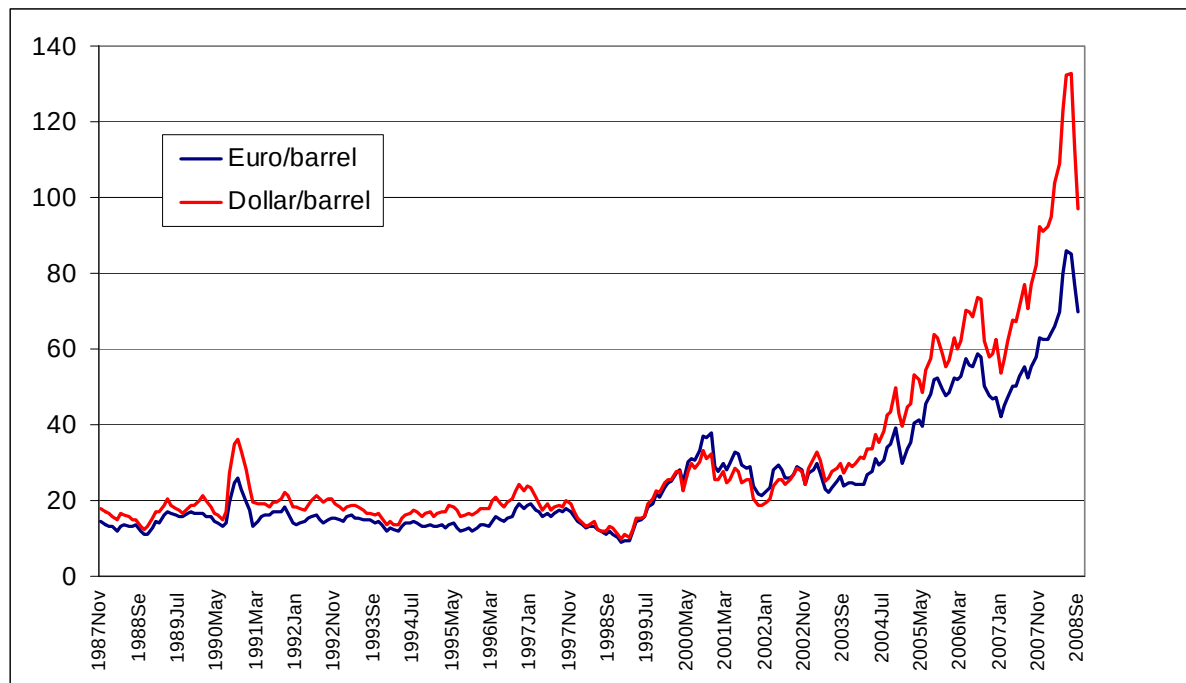
The scarcity of energy supplies and the concept of a peak in oil production is being widely accepted by governments and organisations, such that even the IEA has stated in its World Energy Outlook 2008: *“While market imbalances could temporarily cause prices to fall back, it is becoming increasingly apparent that the era of cheap oil is over”* (IEA, 2008).

The oil price increase recorded between 2003 and July 2008 has reflected the boosting of demand from fast-growing economies like China and India, as well as supply shortages originating from geopolitical tensions and short-term market speculative movements. Besides this, the reduction of oil production from OECD countries, associated with political instability in the Gulf Region, Nigeria, and Venezuela have contributed to higher oil prices too. Furthermore, major oil exporting countries have experienced strong economic growth, and at the same time they have subsidised their local oil demand to such an extent that the available oil exported to the world market has been reduced by the growth of domestic demand.

All these developments have strongly driven up oil prices since 2003. The prices for natural gas have followed, owing to the price adjustment clauses (e.g. indexation to the oil price) that are part of long-term supply contracts for natural gas. However, in such a complex scenario, the strong appreciation of the Euro currency against the US Dollar in the recent years has mitigated the impact of the oil price increase in the Euro-zone. As highlighted in

Figure 2.1, over the period 2004-July 2008 the average US Dollar price per barrel has risen by approximately 258%, while in Euro terms the corresponding raise has been 210%.

Fig. 2.1 Development of crude oil nominal prices (monthly averages 1987-2008)



Source: TRT elaboration on European Central Bank and EIA data. Monthly average for Brent crude oil

2.3 Relation between crude oil prices and fuel prices for road transport

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 oil⁷. 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.

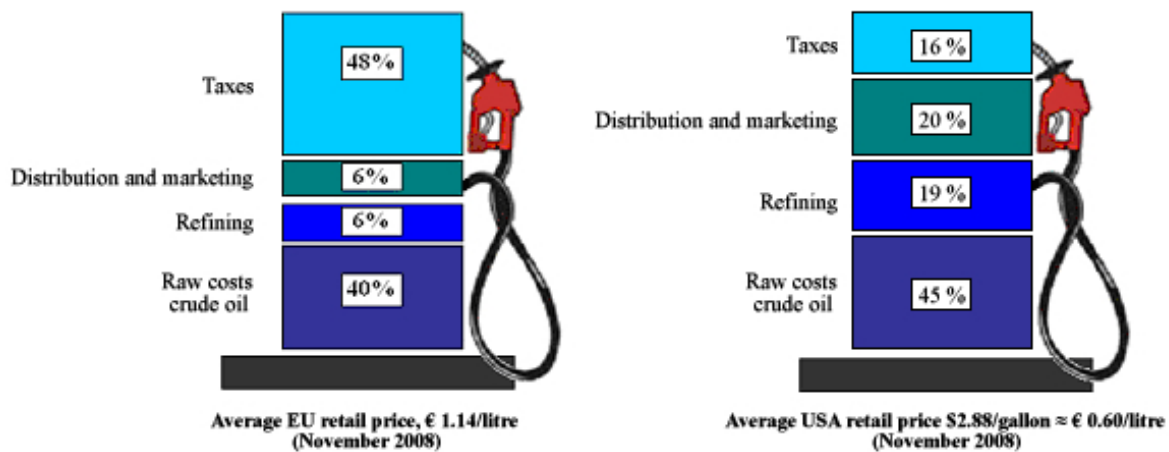
In general, there are three components that may aggravate or moderate the impact of tied to the changes in crude oil prices: (i) the variation in the US\$/Euro exchange rate, (ii) fuel related taxes (excise duty variation and Value Added Tax), and finally (iii) a mark-up component that may be regarded as a proxy for the profit margins of the fuel production and distribution companies (European Commission, 2002). Additionally, it should be said that besides the excise duty on diesel fuel, some countries impose other fuel-related taxes and duties (i.e. environmental taxes, stockpiling fees).

As regards the second component, since excise taxes are levied in absolute values (by quantity) rather than in relative terms (by value), they constitute a fixed element of the final consumer price of fuel. Each time either increases or reductions of crude oil price take

⁷ In addition, price adjustment clauses (e.g. indexation to the oil price) that are part of long-term supply contracts for natural gas should also lead to increases in final prices of natural gas.

place, the changes affect only the part of the final pump price that is related to the industrial production of fuel (primarily raw material costs). This share is depicted in Figure 2.2 for the United States and Europe, along with the other main components of 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.

Fig. 2.2 Cost components of one litre of diesel in EU and USA in November 2008



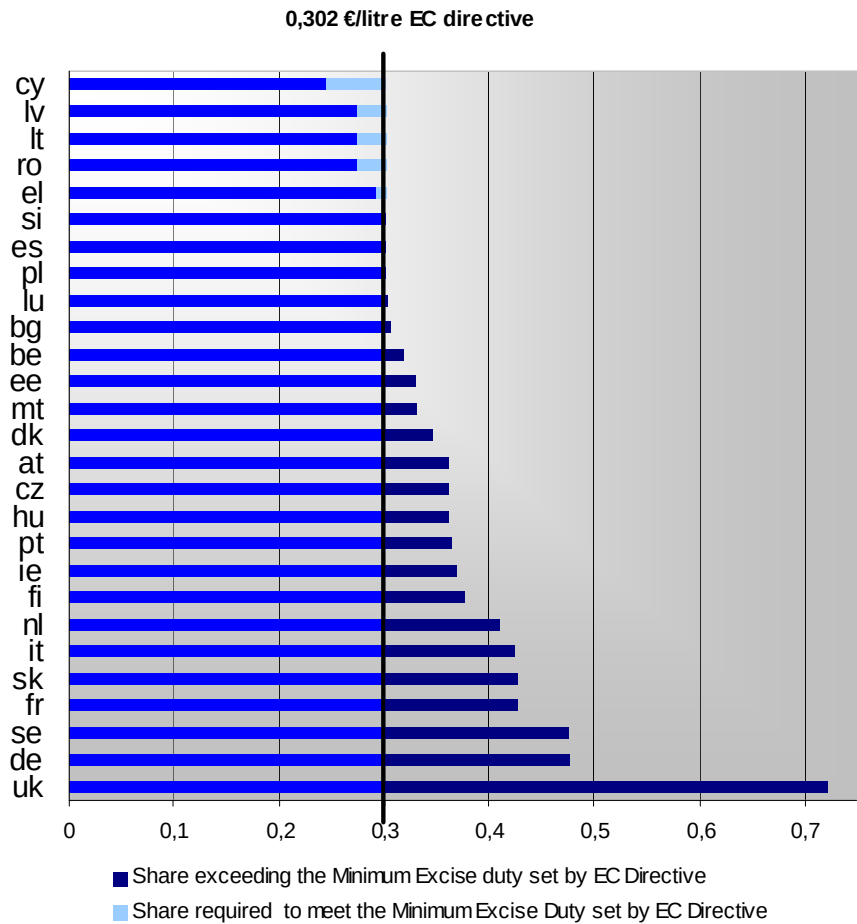
Source: EIA 2008, Eurostat 2008

In Europe the taxation of energy products falls under the provisions of the Council Directive 2003/96/EC, which since 2004 sets the minimum rates of excise duties at 0.359 €/litre for unleaded petrol and 0.302 €/litre for diesel fuel. As shown in Figure 2.3 for diesel fuel, the excise duty levels are substantially different between countries, the histograms with the upper part in dark-blue refer to the countries whose excise on Diesel is higher than the one ruled by Directive 2003/96/EC, while the light-blue refer to those countries imposing a lower excise duty than the minimum level introduced by the EU directive⁸.

In Figure 2.4 the diesel fuel price at the pump is split by pre-tax and tax components. The latter include excise duty, VAT and other fuel-related taxes and duties (i.e. environmental taxes, stockpiling fees). While the pre-tax diesel fuel price at the pump varies little around the average of 0.59 €/litre, the tax component ranges from a level of 0.89 €/litre in the United Kingdom to 0.38 €/litre in Cyprus, accounting on average to the 48% of the total price paid at the pump. Since the level of taxation is the component that determines to a large extent the final fuel price, this has contributed to mitigating the effects of the sharp increase of oil prices which occurred in the last four-year period in the total road fuel price.

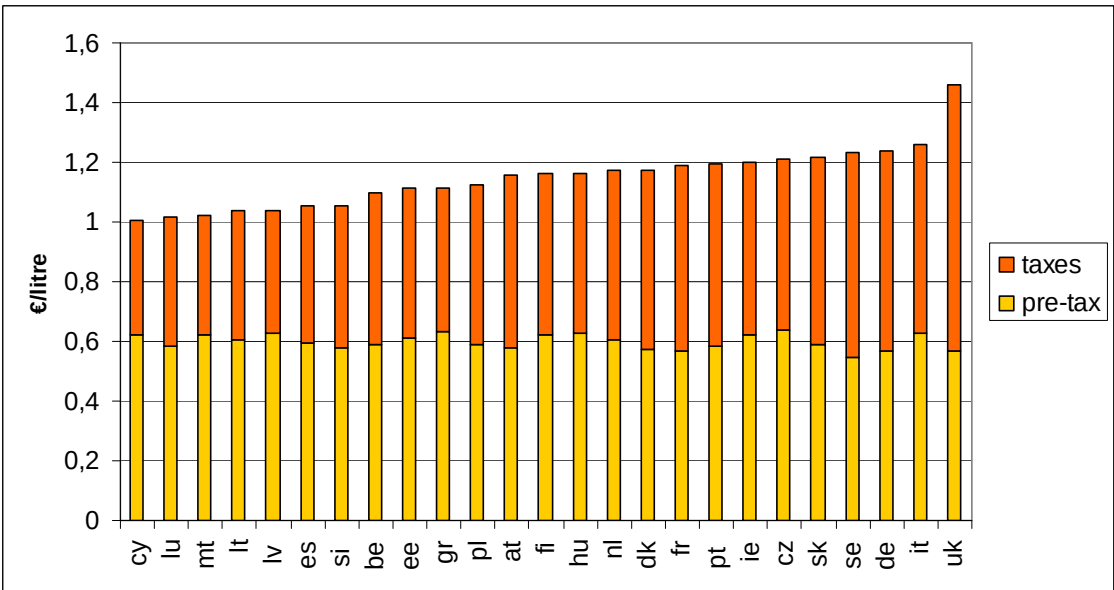
⁸ Directive 2003/96/EC provides for a transitional period for Member States with difficulties in implementing this level of taxation. As a consequence, Cyprus, Bulgaria, Latvia, Lithuania and Romania have a lower excise duty than the minimum level imposed by EU directive.

Fig. 2.3 Level of excise duties on diesel (€/litre) by country in the EU



Source: Elaboration TRT on DG TAXUD data, European Commission 2008

Fig. 2.4 Price at the pump of diesel fuel for the EU-25 in the first semester of 2008

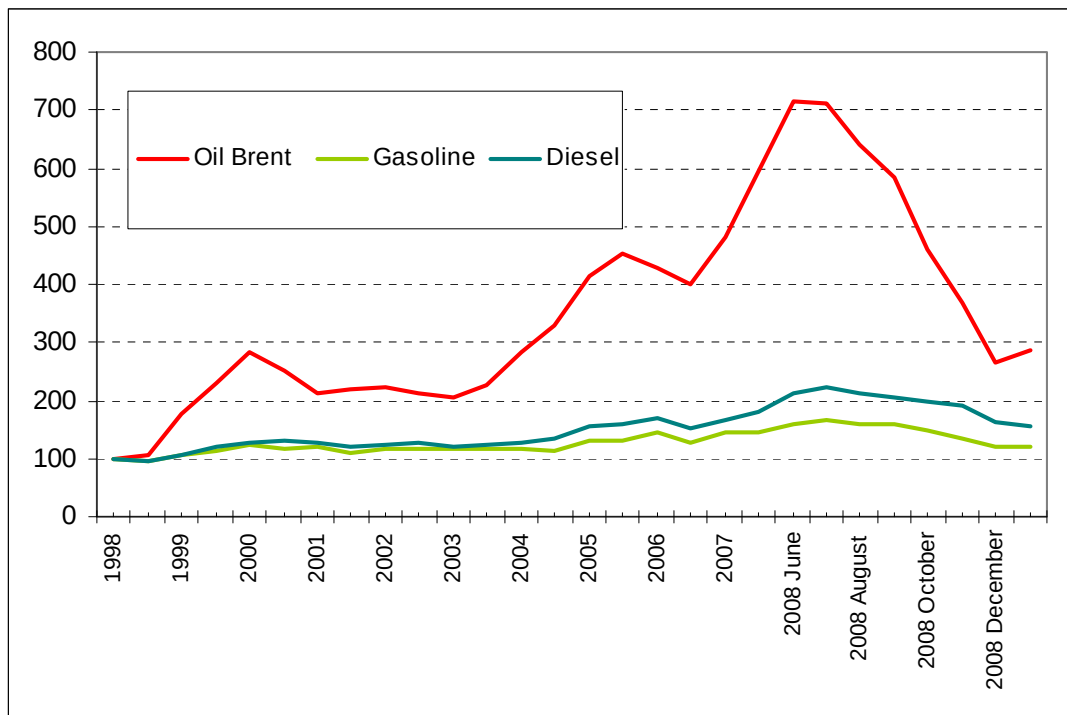


Source: Elaboration TRT on Eurostat data

Figure 2.5 illustrates the average variation of unleaded gasoline and diesel prices at the pump which in the EU-25⁹ 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 of the variation in oil prices and the variation in fuel prices differ significantly. Indeed, looking at the period of increase until July 2008, the price of crude oil encompasses a larger variation (an increase of 600 in index terms), while the price variation for fuel at the pump rises by 60 for petrol and 110 for diesel in index terms. Thus, it may be concluded that, when compared to crude oil price trends, the effect of this increase in oil prices on final diesel and petrol prices has been relatively moderate.

Figure 2.5 includes the development of prices which occurred in last months of 2008: the reaction of both gasoline and diesel prices at the pump appears to be quite slow when the reduction in crude oil prices occurred. This behaviour may be explained by the fact that the fuel industrial price depends partially upon the cost of the commodity and to a larger extent upon labour and capital costs that generally vary less than crude oil prices. This explains why, when the crude price reduces, oil companies are generally slow to pass the lower costs of the commodity on to consumers. However, an abuse of their market power may not be excluded.

Fig. 2.5 Increases in the pump price of unleaded petrol in the EU (1998–2008)
Index100=1998

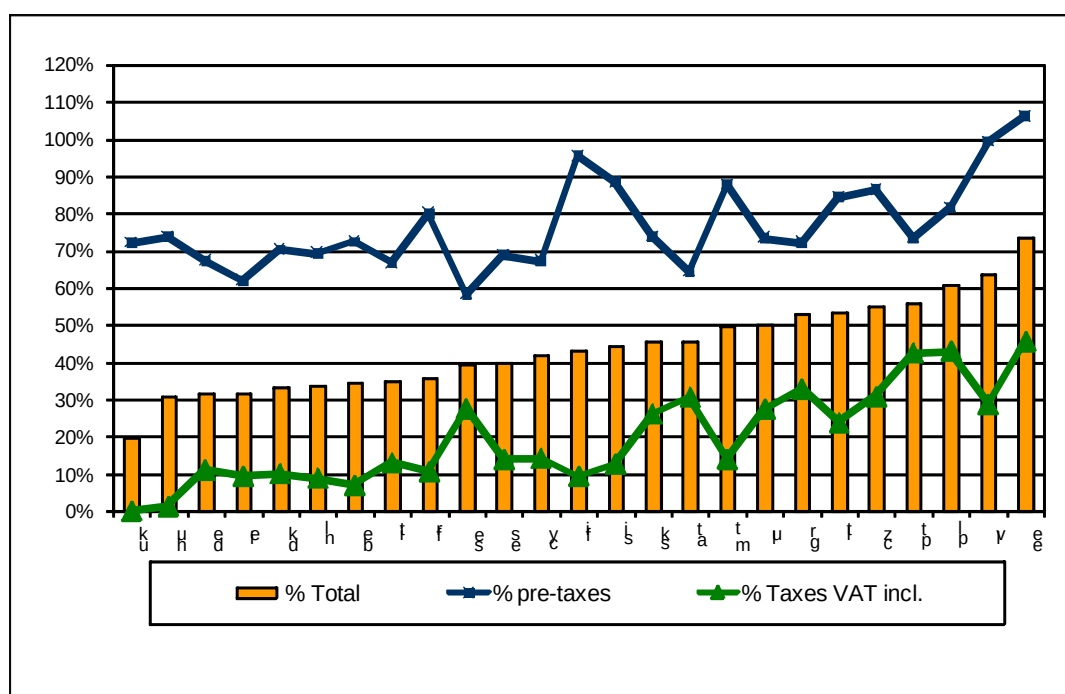


Source: TRT on European Central Bank and Eurostat

⁹ Data for Romania and Bulgaria is not available from Eurostat

Figure 2.6 illustrates the variation of diesel fuel prices which occurred in the period 2004-2008, when the crude oil price increased by more than 200% in Euro (current prices). On average, across the EU, the diesel price (orange histogram) increased by 44% between 2004 and 2008, with the largest increase occurring in Latvia (64%) and Estonia (74%). The smallest rises have been recorded in Germany (30%), Hungary (31%) and the United Kingdom (20%). The price variations generated in these countries reflect the relatively small variation in taxes (green line in the figure), which represent 0% in the United Kingdom and 1% for Hungary respectively, while taxation on fuel in Germany has increased by 20%. The most significant increases in taxation are reported for Estonia (46%) and Poland (49%). Looking only at the price increase contributions due to pre-tax prices (blue line in the figure), it may be seen that the contributions over the period are in a range of 106% (Estonia) to 30% (Latvia).

Fig. 2.6 Percentage increases in the pump price of diesel for EU-25 countries (first half of 2008 compared to second half of 2004)



Source: TRT on data Eurostat

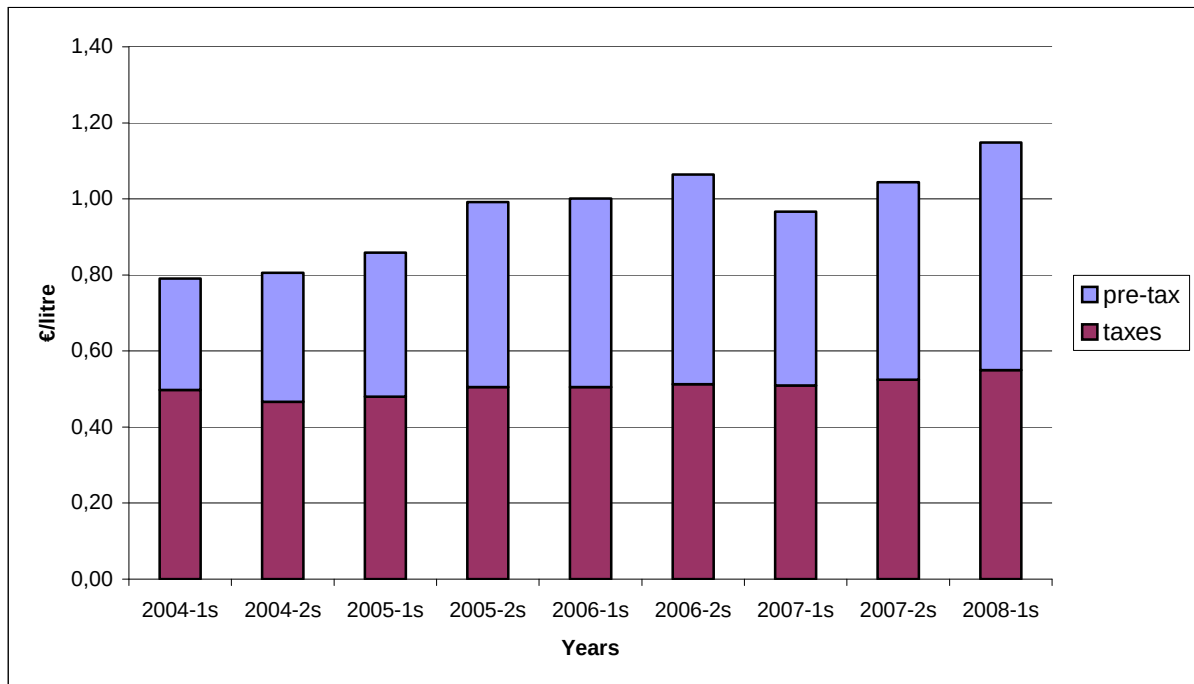
Although in the above mentioned countries the total diesel price increments seem to be more correlated with tax changes, the following figure shows that this does not hold if the EU average is considered. In fact, the EU average diesel taxation differs little between 2004 and 2008, while the increments registered during these years (+44%) are due to changes in pre-tax components (Figure 2.7). This last information also confirms that the EU Governments in the recent period of high oil prices have not turned to temporary tax reliefs. After the peaking registered in July, political debates at EU level regarding cutting VAT and excise duties have taken place, but so far definite actions have not been undertaken, due also to the recent plunging price of crude oil and the economic crisis.

When looking at the same type of information for unleaded petrol, a more modest increase for the price at the pump may be noticed, which on average accounts for 26%. In comparison to diesel trends, larger differences are reported for the pre-tax component of petrol, which is characterised on average and across the EU during the period 2004-2008

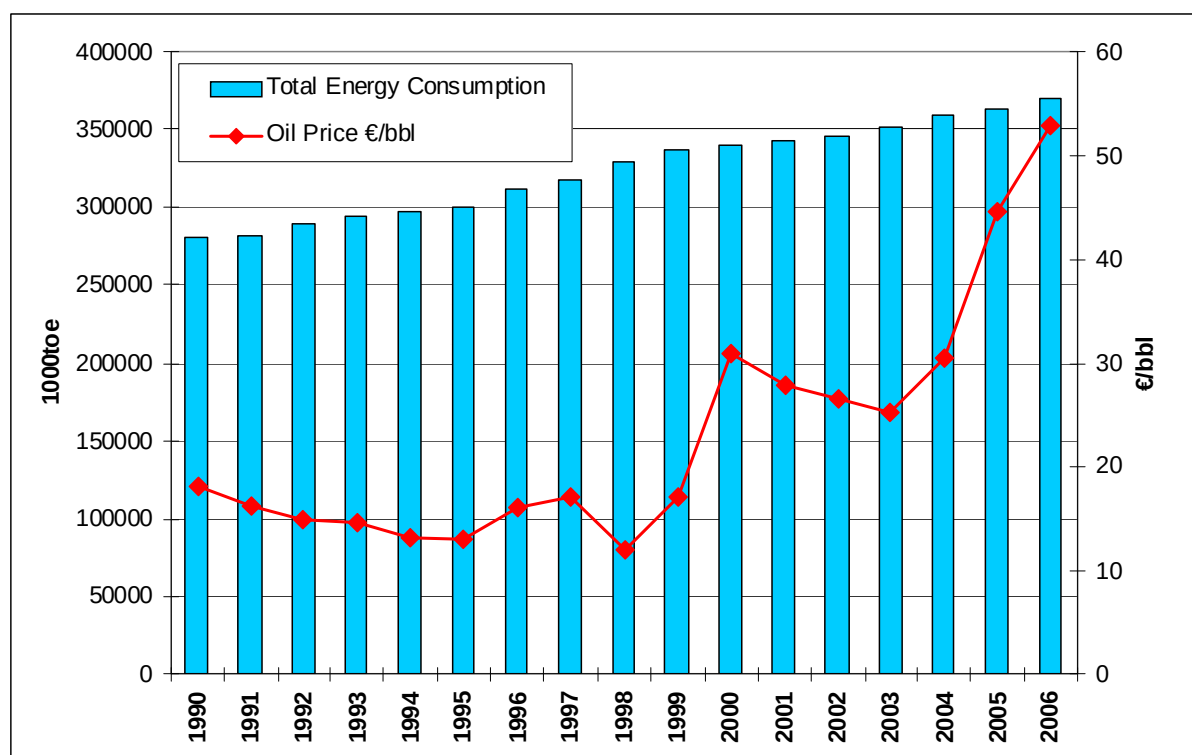
by an increase of 31% compared to 77% for diesel. The taxes for petrol increased on average less than those for diesel fuel (13% compared to 20%).

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 2.8). Another part of the explanation lies in the share of fuel prices in total transport costs (see also Chapter Three).

Fig. 2.7 Components of average EU diesel price (€/litre)



Source: TRT on Eurostat data

Fig. 2.8 Evolution of EU total fuel consumption in transport (1000 toe) and oil price (€/bbl)

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

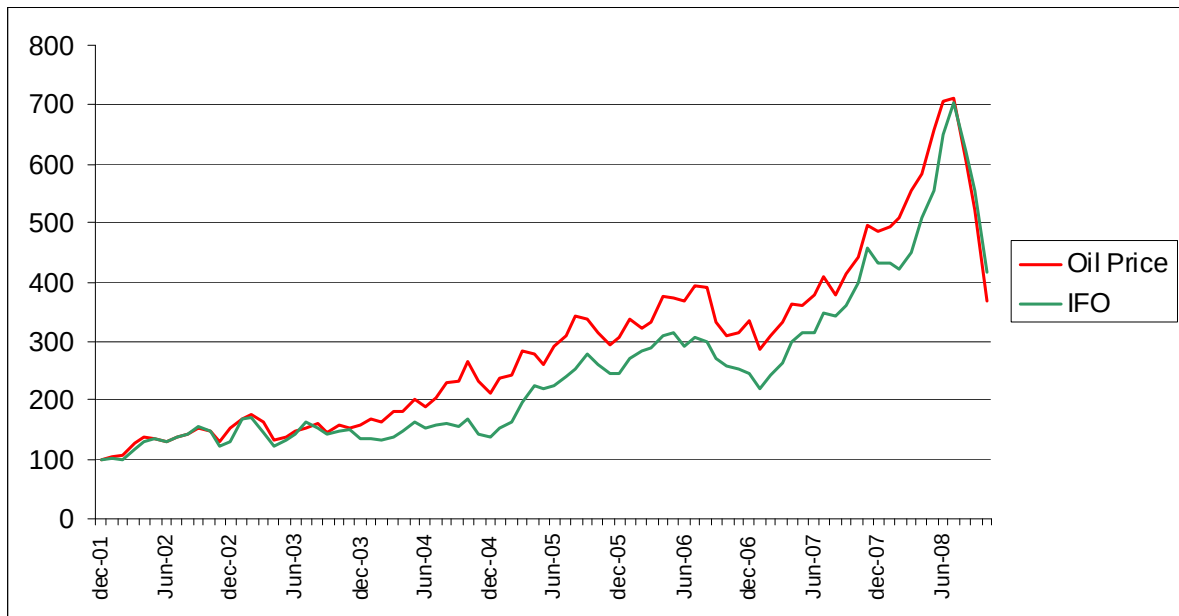
2.4 Relation between the price of crude oil and the price of marine fuels

Since marine fuels are exempted from government taxation, price rises of crude oil have a direct effect on the level of marine bunker prices. Several types or grades of marine fuel are used by seagoing vessels, but in general IFO (Intermediate Fuel Oil) 380 cSt fuel oil is used for main engines (i.e. while at sea) and MDO (Marine Diesel Oil) for auxiliaries (i.e. while in port)¹⁰. Gas oil is the main fuel source for inland waterway transport.

Figure 2.9 illustrates the trends of Brent crude oil prices and the Intermediate Fuel Oil traded on the Rotterdam market in the last years. Similarly to what happens for diesel and gasoline, bunker prices are closely linked to oil prices, even though with a smoother trend, which is evident since the end of 2003, when crude oil prices went up again sharply until July 2008.

¹⁰ MDO is considerably more expensive than IFO 380 cSt of a factor of 1.5-2.0.

Fig. 2. 9 Development of Brent crude oil and marine fuels IFO (2001-2008), index100=2001



Source: TRT elaboration on Shipping Review & Outlook 2001, 2006, 2008 and EIA data

2.5 Relation between the price of crude oil and the price of jet fuel

Jet fuel has seen its mark-up over crude oil prices rising from around 6 US\$ per barrel in 2002-2003 to over 40 US\$ per barrel in July 2008; still, in percentage terms, the mark-up has fluctuated around a relatively stable level of 24% (Figure 2.10). According to the International Air Transport Association (IATA), the rise up to 2007 (i.e. besides the “bubble” which drove the rise during the first half of 2008) may be explained by real underlying changes, in particular, by increased production costs, i.e. a sharp rise in the cost of finding and extracting oil from new fields. For this reason, IATA assumes jet fuel prices will remain 24% higher than crude oil prices over the medium-term (IATA, 2008).

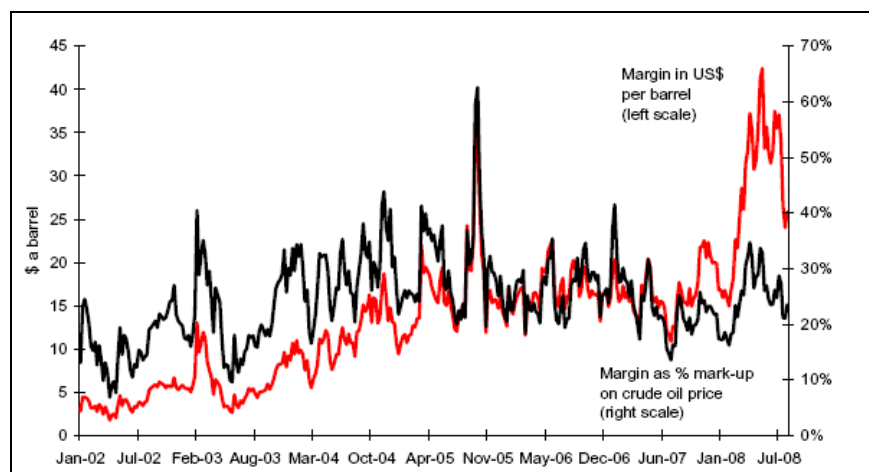
Box 2.1 The taxation of aircraft fuel

Council Directive 2003/96/EC provides for a mandatory exemption from the harmonised excise duty for energy products supplied for use as fuel for the purpose of air navigation other than for private pleasure-flying. However, it has introduced for the first time provisions which allow Member States to tax aviation fuel for domestic flights and, by means of bilateral agreements, fuel used for intra-Community flights. In such cases, Member States may apply a level of taxation below the minimum level set out in this Directive.

During the discussions, prior to the adoption of Directive 2003/96/EC, all but two Member States agreed that, as a matter of principle, commercial aircraft fuel should be taxed on the same basis as any other fuel. Nevertheless, the question of competition with third countries needs to be taken into account and any distortion of competition with socio-economic implications has to be avoided.

Due to the absence of taxation for jet fuel, an increase in oil prices directly reflects the cost of jet fuel for airline companies. This is evident when looking at Figure 2.11, which illustrates the average annual variations for both crude oil price and kerosene (jet fuel) over the period 1988-2007.

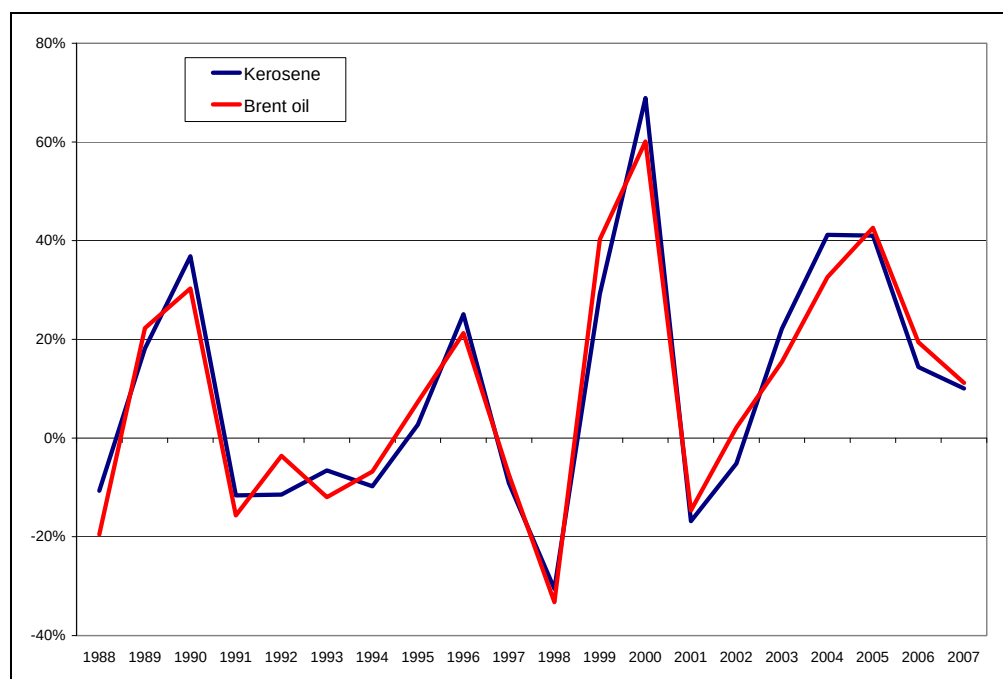
Fig. 2.10 Margin of jet fuel price above crude oil price in US\$ and % mark-up



Note: In black and right scale: the % mark-up; in red and left scale: the value in US\$

Source: RBS, Platts in IATA, October 2008

Fig. 2.11 Annual variation in kerosene and crude oil prices (1988-2007)



Source: EIA 2008, Amsterdam-Rotterdam-Antwerp (ARA) Kerosene-Type Jet Fuel Spot Price (Cents per Gallon). Europe Brent Spot Price FOB (Dollars per Barrel)

2.6 Summary of key findings

An analysis and explanation of the linkages existing between oil price trends and transport fuel prices have been provided for road, aviation and maritime (rail traction plays here a minor role as it is mostly powered by electricity). This chapter has described in detail the overall international scenario that has characterised recent oil price trends on the market: the continuous growth until July 2008 and the following sharp decline. It has been emphasised that oil price impacts on the transport sector have been compensated in the Euro-zone by the strong appreciation of the Euro against the US Dollar on currency markets.

Looking instead at the relationships between crude oil and fuel prices for the different transport modes, the study has focused here on three distinct transport sectors: road, aviation and maritime.

As far as road transport is concerned, oil prices only partially represent the total fuel price, since the remaining part is closely tied to the interaction of various other factors like scarcity of specific fuels, market forces, processing and distribution costs, etc. In particular, fuel prices for the road sector are dependent upon excise taxes that constitute a fixed element of the final consumer price of fuel. This means that each time either an increase or reduction in crude oil price occurs, these changes affect only the part of the final pump price related to the industrial production of fuel (e.g. primarily raw material costs).

At a European level, the regulation of taxation for energy products is provided by Directive 2003/96/EC, which since 2004 has set the minimum rates of excise duties for unleaded petrol and diesel fuel at 0.359 €/litre and 0.302 €/litre, respectively. Generally speaking, since the level of taxation represents the component that largely fixes the final fuel price, this has contributed alleviating the effects of the sharp boost in oil prices which occurred in the last four-year period in the total road fuel price.

On average, across the EU, the diesel price has increased by 44% between 2004 and 2008, while the price for unleaded petrol has recorded a smaller increase (26%) but, compared to trends in diesel, with larger differences in the pre-tax component of petrol.

Finally, as regards the maritime and aviation sector, due to the absence of taxation and the low processing and distribution costs, the variation in the price of crude oil directly affects these two transport modes. In conclusion, the relatively limited correlation between oil price and fuel user prices partly explains why the sharp increase in the former has not led to a reduction of fuel consumption in the transport sector.

On the basis of the evidence registered in the recent years in terms of the variation in fuel prices versus oil prices, and considering also the effects of taxation, the impact of a doubling crude oil prices on fuel costs may be roughly estimated as illustrated in table 2.1. The percentages in the table were considered as a share of the production costs of crude oil in total fuel costs. In road transport, the average for the EU was 40% (see paragraph 2.2). This data has been compared with recent developments of both crude oil and fuel prices to check consistency of assumptions. For aviation and maritime, recent evidences have shown a very high sensitivity of fuel costs to high oil prices, also considering that the refining and distribution costs are much less than those of road transport fuels.

Tab. 2.1 Sensitivity of fuel costs to crude oil prices

Petroleum product	Effect of doubling of crude oil prices on fuel costs
Road freight diesel	~40%
Rail freight –diesel	~40%
Rail freight –electric	~15%
Inland navigation gas oil	~100%
Maritime shipping bunker fuels	~100%
Aviation jet fuel	~100%

Chapter 3 The share of fuel costs in total transport costs by mode

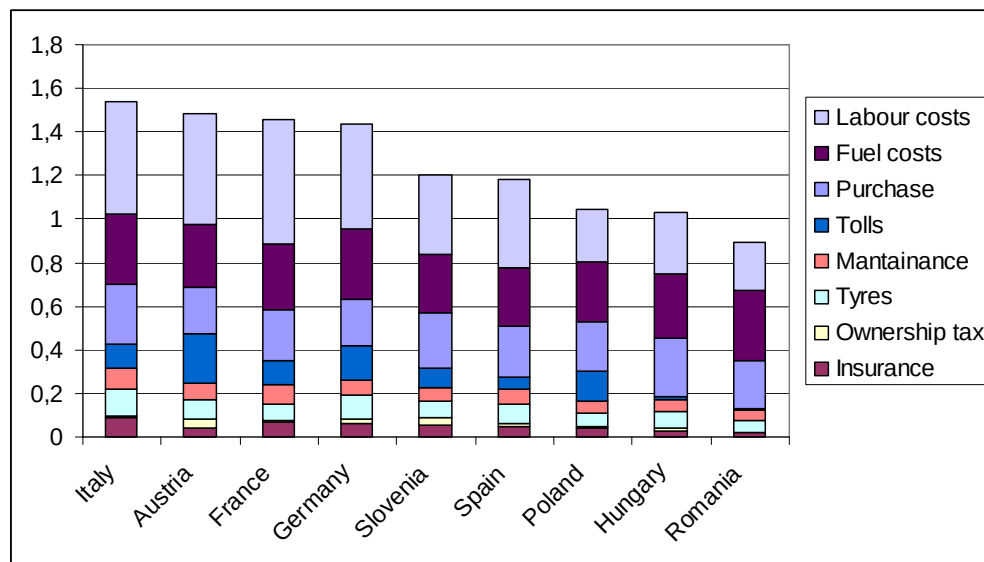
3.1 Introduction

The structure of the transport costs by mode of transport is here analysed looking at the relevance of fuel costs with respect to other items such as labour costs, insurance, maintenance costs, etc. In this analysis, a long term perspective is considered, thus the impact of energy costs on total (variable + fixed) transport costs is taken into account. A comparative overview by transport mode is provided in a synthetic figure at the end of the chapter.

3.2 Road

Figure 3.1 illustrates the breakdown of road freight transport costs in a sample of EU countries for the year 2008. Within these countries, the costs of a representative truck range from around 0.90 €/km for Romania to 1.54 €/km for Italy. The main components are fuel costs, purchase of vehicle and labour costs, together accounting for 70-85% of total running costs. Labour costs and fuel cost are the components varying most between countries.

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

Once again, as indicated in Table 3.1, the share of labour in total cost for road haulage companies differs between countries, ranging between 25% (Romania) to 39% (France). As a consequence, only in Romania, Poland and, to a lesser extent, Hungary is the fuel cost share higher than labour cost. Fuel costs (VAT excluded) vary between 19% (Austria) to 36% (Romania) of total costs, and respectively between 24% and 49% of total operating

costs¹¹. For the selected countries, fuel taxes account for between 9% and 11% of the total costs of a road haulage business.

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

	Italy	Austria	France	Germany	Slovenia	Spain	Poland	Hungary	Romania
Purchase Share	0,28 18%	0,22 14%	0,24 16%	0,22 15%	0,25 21%	0,23 19%	0,23 22%	0,27 26%	0,22 24%
Insurance	0,09 6%	0,04 3%	0,07 5%	0,06 4%	0,06 5%	0,05 4%	0,04 4%	0,03 3%	0,02 2%
Ownership tax	0,01 0%	0,04 3%	0,01 0%	0,02 2%	0,04 3%	0,01 1%	0,01 1%	0,01 1%	0,00 0%
Tyres	0,13 8%	0,09 6%	0,08 5%	0,11 8%	0,07 6%	0,09 8%	0,06 6%	0,07 7%	0,05 6%
Fuel costs (incl. tax)	0,32 21%	0,29 19%	0,30 21%	0,32 22%	0,27 22%	0,27 23%	0,27 26%	0,29 28%	0,32 36%
<i>Fuel tax</i>	0,14 9%	0,20 8%	0,14 10%	0,16 11%	0,10 9%	0,10 8%	0,11 10%	0,12 11%	0,10 11%
Maintenance	0,09 6%	0,08 5%	0,08 6%	0,07 5%	0,06 5%	0,07 6%	0,05 5%	0,06 6%	0,05 5%
Tolls	0,11 7%	0,23 15%	0,11 8%	0,16 11%	0,09 7%	0,06 5%	0,14 13%	0,01 1%	0,01 1%
Labour costs	0,52 33%	0,51 34%	0,57 39%	0,48 33%	0,37 31%	0,41 34%	0,24 23%	0,28 28%	0,22 25%
Total	1,54 100 %	1,49 100 %	1,46 100 %	1,44 100 %	1,20 100 %	1,18 100 %	1,04 100 %	1,03 100 %	0,89 100 %

Source: CSST 2008

3.3 Rail

Commercial rail freight operators are very reluctant to provide an insight into their operating costs. This implies that only very aggregate and hardly comparable estimates are available on the importance of energy costs. The cost calculation models developed by NEA and Transcare (NEA, 2004) provide figures as those reported in Table 3.2 for two typologies of international trips: container and bulk transport, respectively of 300 km and 800 km.

¹¹ The share of fuel cost on total operating costs stems from data in table 3.1, where the total operating costs are obtained by deducting the costs of purchase, insurance and ownership.

Tab. 3.2 Overview of cost breakdown in rail freight transport using the VKM model calculations

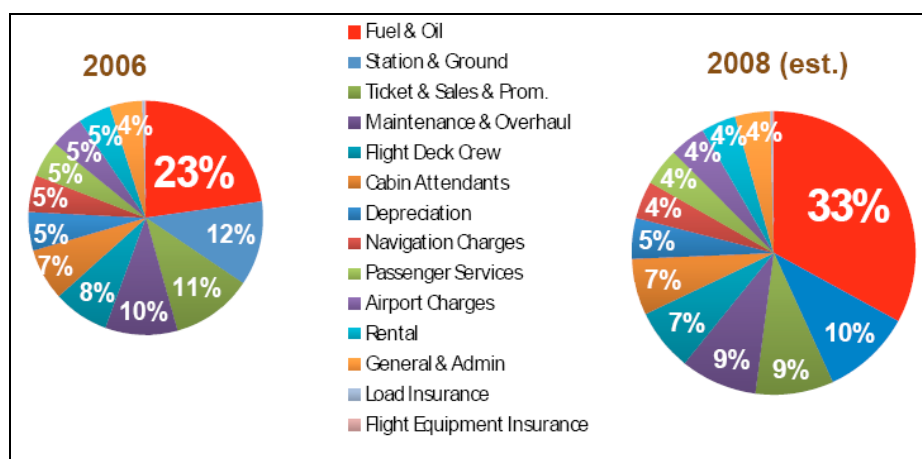
Category	International transport of containers 60 TEU				International transport of dry bulk 1,800 ton			
	Diesel		Electricity		Diesel		Electricity	
Distance (km)	300	800	300	800	300	800	300	800
Fixed costs per trip (€)	2,197	4,293	1,953	3,642	5,693	8,680	5,495	8,154
Other variable costs/trip (€)	1,326	3,536	1,218	3,248	1,530	4,080	1,455	3,880
Energy costs per trip (€)	1,080	2,880	576	1,536	1,314	3,504	936	2,496
Total costs per trip (€)	4,603	10,709	3,747	8,426	8,537	16,264	7,886	14,530
% energy/total	23.5%	26.9%	15.4%	18.2%	15.4%	21.5%	11.9%	17.2%
Energy costs per tkm	0.0075	0.0075	0.0040	0.0040	0.0024	0.0024	0.0017	0.0017
Total costs per tkm	0,032	0,0279	0,026	0,0219	0,0158	0,0113	0,0146	0,0101

Source: Ecorys, 2006

According to these calculations, the share of energy costs in rail freight transport ranges 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. Calculations made in the TRIAS project (TRIAS, 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 to about 10% of variable costs and about 5% of total costs. The difference between the two estimates may not be readily explained. Most likely, different assumptions have been made with regard to the cost items to be considered and different company data has been available. In conclusion, it may be stressed how energy does not represent a major component of rail freight operating costs, even if the lack of detailed data from financial reports does not allow the proper estimation of its actual incidence on them.

3.4 Aviation

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 are predicted to rise further 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 (see figure 3.2).

Fig. 3.2 Total aviation operating costs structure (2006 and 2008)

Source: AEA, 2008

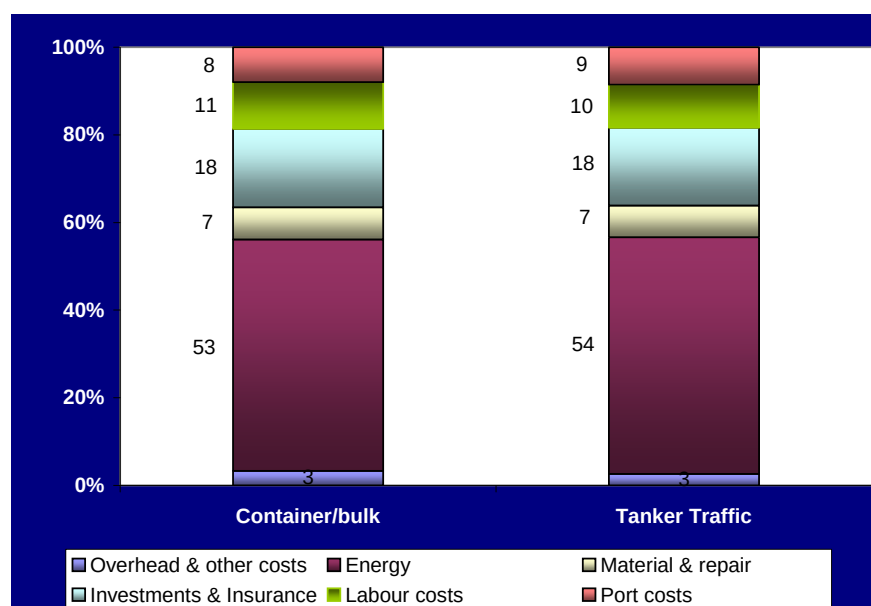
The relative importance of fuel costs on total operating expenses increases further on long-haul flights for all the airlines without exception, whereas budget carriers also register a consistent increase in this item on medium and short-haul, with fuel representing – in the mid of the year 2008 - nearly 50% of their total operating costs, compared to 36% in 2007 and the beginning of 2008¹². 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.

3.5 Maritime shipping

The share of bunker costs in the daily running costs of a ship is substantial. According to recent analyses (CIBC, 2008), during the recent high oil price periods energy costs may have amounted to 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 (REALISE, 2002) 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 at around 30%. The same data updated at 2008 values for oil price (assuming a price of 100 US\$/barrel) brings figures to over 50% (Figure 3.3). It must be noted that the share of energy costs is generally lower for deep sea traffic.

¹² This figure is taken from the Ryanair *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, 3rd June 2008).

Fig. 3.3 Breakdown of total transport costs of short sea shipping

Note: Simulated year 2008 assuming 100 US\$/barrel oil price, based on data of selection of West-European countries

Source: TRT elaboration on Ecorys, 2006

3.6 Inland navigation

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 (CCNR 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 vessel acquisition (e.g. interests and insurance), which is partly the result of strong demand for new construction 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 operating costs for a new self-propelled vessel with a capacity of 2,500 tonnes (Table 3.3); such a share may vary between 10% and 25% depending on the type, size and age of the vessel.

Tab. 3.3 Structure of costs for new self-propelled inland navigation vessels

Cost category	2004	2007
Cost of fuel oil	20%	21%
Cost of salaries and personnel	40%	30%
Other costs (interests, insurance, maintenance)	40%	49%

Source: CCNR and DG TREN, 2007

3.7 Summary of key findings

Understanding the relation between oil prices and transport fuel prices represents a key step in assessing the impacts of oil price fluctuations on transport activities. On the basis of the findings achieved through the analysis of the different transport modes, Table 3.4 provides an overview of the significance of energy costs in total transport costs.

- For road freight transport, fuel cost is one of most significant components (together with labour costs), but also one of the most variable between countries since – excluding VAT – it goes from 19% in Austria to 36% in Romania, in relation to total costs.
- In the rail freight sector, energy cost is generally not considered to be a major component.
- In the aviation sector, fuel cost as a share of total operating costs has grown from 13% in 2001 to 29% in 2007, and is estimated to account for 33% in 2008.
- Finally, the share of bunker costs in the daily running costs of a seagoing ship may be considerable and, for a representative short sea shipping corridor, the share of fuel costs has been estimated up to 50%.
- The relative importance of fuel in inland vessel total operating costs accounts for a range between 10% and 25%.

Tab. 3.4 Indicative share of energy costs in total transport costs for different modes

Mode of transport	Share energy costs in total transport costs
Road freight	25 %
Rail freight – diesel	27 %
Rail freight – electric	12 %
Inland navigation	21 %
Maritime shipping	50 %
Aviation	33 %

PART II THE IMPACTS OF THE PRICE OF OIL IN TRANSPORT SECTOR: REACTIONS OF TRANSPORT CARRIERS AND USERS, GOVERNMENT AND ECONOMIC ACTORS

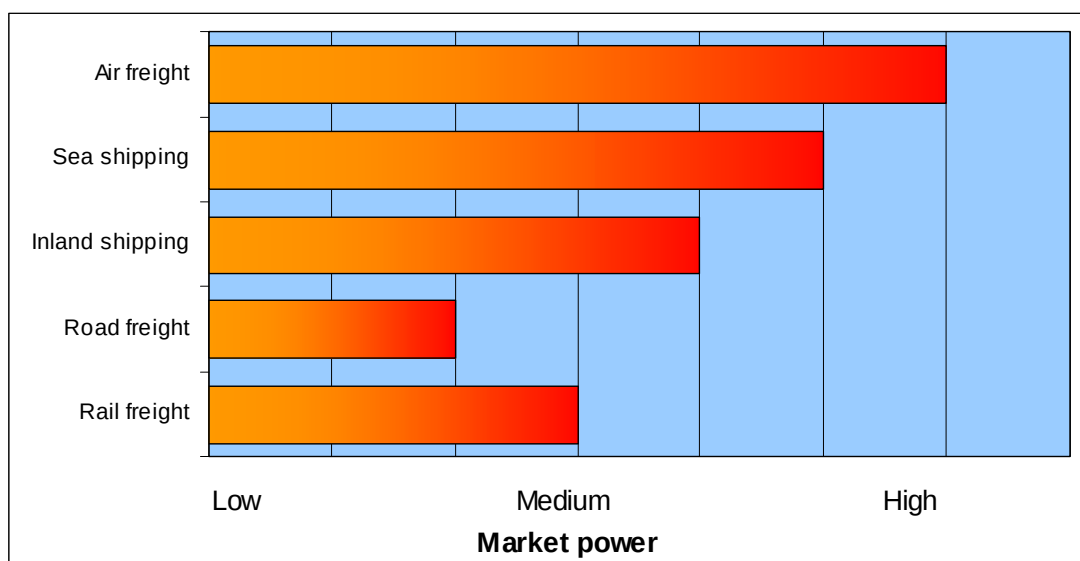
Chapter 4 Evidence of the impact of high oil prices in the transport sector

4.1 Introduction

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 from official sources, and (iii) the economic crisis in the sector whose effects overlap those of the oil price increase occurred in the last four years period. The analysis is based on significant examples from specific countries, associations or companies, even though they may not be considered as completely exhaustive in respect to all the European Union, and in the light of the effective sector reactions and the actual policies of governments.

Moreover, the ability of the transport operators to change their 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 oil prices, as demonstrated by the analysis made in the previous chapters.

Fig. 4.1 Qualitative assessment of market power by mode of transport



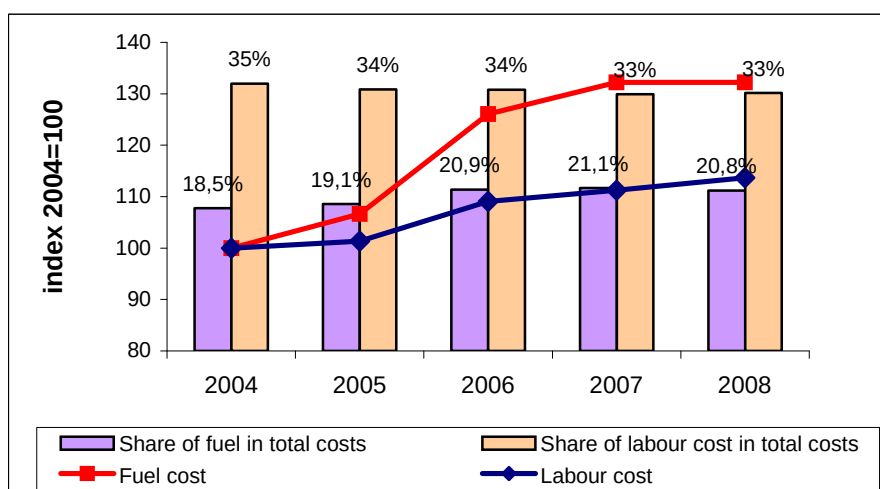
In particular, the road haulage transport market in Europe is rather fragmented and often characterised by small enterprises with already low profit margins. This holds especially for owner-drivers who work for freight rates that are very close to the cost price. Any factor bearing upon the structure cost may have consequences for the ability of such companies to remain in business. Reducing profit margins or introducing surcharges to absorb higher fuel costs are not the only possible reactions. Still on the fuel side, operators may economise on fuel use and, in the longer run, shift to more fuel efficient engines. However, savings may be obtained also in other directions: e.g. by increasing load factors, rearranging business so as to make more use of cheaper labour, or shifting to larger capacity vehicles.

4.2 Road freight

4.2.1 Overview and impacts

The road freight sector shows an increased level of competition between operators, who have difficulties in transferring the higher fuel costs on to the final customer. As reported in Figure 4.2 for Italian haulers (CSST, 2006 and 2008), the increase of fuel costs has been stronger than the rise in labour costs in the period 2004-2008. Accordingly, the share of fuel costs in total transport costs has increased from 18.5% to 21% in the last four years. Similar patterns appear to be common to most of the remaining EU countries.

Fig. 4.2 Development of fuel and labour cost for Italy (2004-2008) and their share in total transport costs



Source: Elaboration TRT on CSST 2006 and 2008

Considering the incidence of fuel price in road freight transport, it is interesting to note the changed composition of the “long distance index” in France in the period 2003-2007¹³. The changing incidence of the cost items reflects soaring diesel prices and in 2007, for the first time since 2000, the incidence of diesel costs becomes as dominant as the incident of personnel costs (see Table 4.1).

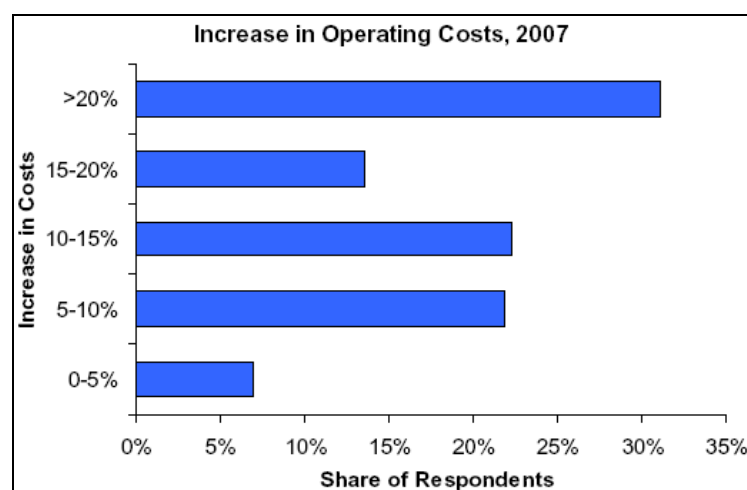
¹³ The “long distance index”, elaborated by the Comité National Routier (CNR) (www.cnr.fr), aims at showing the changing pattern in costs of the professional road transport.

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

According to the European Transport Barometer¹⁴, a pan-European annual survey on road freight transport trends (Figure 4.3), 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. Across Europe, road haulage companies are generally unable to pass on increasing costs to their customers simply by raising their prices. The evidence reported below confirms this trend. A study carried out by the Bank of Italy (TRT Trasporti e Territorio, 2008) pointed out that international road freight rates from 2006 to 2007, with the exception of some specific areas, have shown a very small increase (and sometimes a decrease)¹⁵. Table 4.2 summarises the road freight rates for 2006 and 2007 and the percentage variation from and to Italy for a fully loaded truck.

Fig. 4.3 Increase in operating costs as reported by road transport operators

Source: European Transport Barometer, 2008

¹⁴ The European Transport Barometer is carried out by the industry magazine TruckEurope and the business intelligence Analytiqa. The 2008 survey was conducted between December 2007 and February 2008, involving over 2,800 respondents from 18 countries and covering both large companies and small transporters.

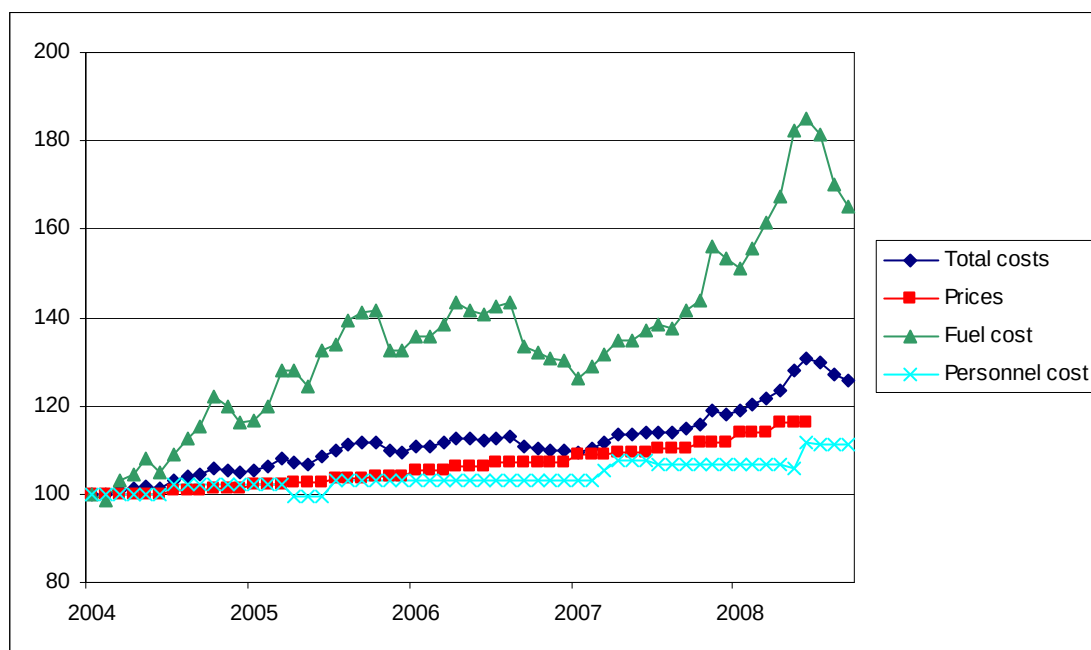
¹⁵ The study was implemented through an extensive survey of transport operators: the outcome from the interviews was used to derive cost functions on the basis of an accurate identification of relevant variables such as distance, duration of a trip and its origin/destination.

Tab. 4.2 Road freight prices between Italy and the main European regional areas in 2006 and 2007 (€/vehicle)

European area	From Italy			To Italy		
	2006	2007	Variation	2006	2007	Variation
France	1232	1242	0.8%	1252	1260	0.6%
Germany	1230	1239	0.8%	1238	1247	0.7%
Benelux	1311	1313	0.2%	1320	1322	0.1%
Austria-Switzerland	1081	1104	2.2%	1104	1125	1.9%
Spain-Portugal	1798	1861	3.5%	1800	1863	3.5%
Scandinavian countries	2847	3013	5.8%	3010	3182	5.7%
United Kingdom	2714	2727	0.5%	1323	1334	0.8%
Greece-Turkey	2519	2519	0.0%	1284	1284	0.0%
New Member States	1256	1357	8.1%	1303	1426	9.4%
Balkan countries	1910	1834	-4.0%	1718	1572	-8.5%
Baltic countries	3449	3298	-4.4%	1972	1887	-4.3%
Russia	4306	4110	-4.5%	2126	2080	-2.2%

Source: TRT Trasporti e Territorio, 2008

Further evidence comes from a detailed analysis of the French market (CNR, 2008): Figure 4.4 highlights the difficulties in relation to the last two years, when fuel costs rose dramatically while prices only showed a low increase. The gap between cost increases and price increases is growing larger in Central Europe, with Spain and Portugal as exceptions (Table 4.3). In the year 2007, Romanian operators have seen costs growing by 19.1% and prices decreasing by 4.5%. Conversely, road haulers in the Czech Republic are making progress in “closing the gap”.

Fig. 4.4 France – Total costs, fuel costs, personnel costs and prices in road freight transport (January 2004 = 100)

Source: TRT on CNR data

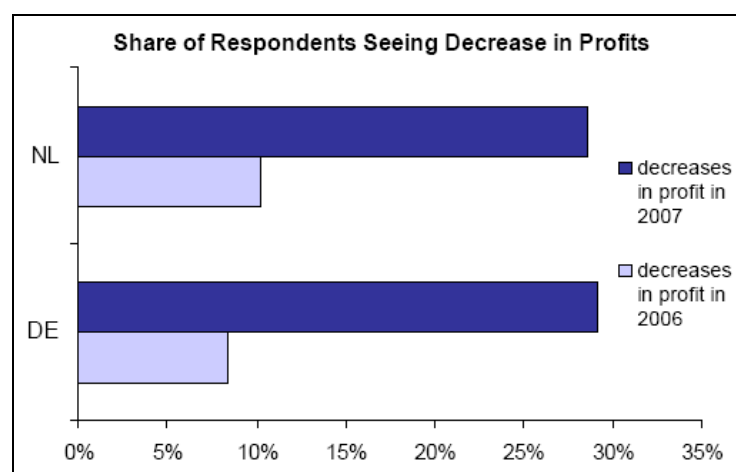
Tab. 4.3 From costs to prices: an increasing gap

Country	Average change in costs in 2007	Average change in prices in 2007	Gap between cost and prices in 2007	Gap between costs and prices in 2006
Romania	19.1%	-4.5%	23.6	<i>n.a.</i>
Czech Republic	16.8%	6.0%	10.8	13.8
Poland	17.4%	6.9%	10.5	9.6
Spain	23.5%	5.5%	18.0	2.4
Portugal	18.4%	4.6%	13.8	<i>n.a.</i>
Germany	14.0%	4.4%	9.6	2.4
United Kingdom	13.4%	5.7%	7.7	5.0
Italy	13.0%	5.7%	7.3	<i>n.a.</i>
France	15.4%	8.9%	6.5	<i>n.a.</i>
The Netherlands	8.2%	3.4%	4.8	2.5
Belgium	8.5%	5.2%	3.3	2.4

Source: European Transport Barometer, 2008

The existing high level of competitiveness in the road transport sector makes it difficult for the operator to renegotiate the tariffs at the time of an annual review of trade agreements, since customers are often able to find competing offers on the market. Often, and particularly in times of economic crisis, the customers' choice is directed towards lower quality services, thus damaging even big operators that may offer competitive prices and good standard services. Consequently, the largest part of the increasing in 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 significant percentage of German and Dutch operators experienced a decrease in profits (about 30% in 2007 as against less than 10% in 2006).

Fig. 4.5 Decrease in profitability according German and Dutch operators

Source: European Transport Barometer, 2008

4.2.2 Sector reactions

During the peak oil price period of 2007 and early 2008, the situation was quite mixed: logistics operators and express couriers introduced a flexible surcharge for diesel on the basis of officially published diesel price data¹⁶, sector associations asked for urgent and immediate measures¹⁷ and advised their members to apply fuel adjustment to their contracts and technical organizations provided tools to help in estimating extra fuel costs¹⁸. However, most road haulage companies were not able to pass on higher transport costs completely with a consequent very negative impact on their profitability. The measures listed below give an overview of initiatives taken by the sector's operators and governments.

Efficient cost management

Permanent and efficient cost management of the company may facilitate the achievement (i) systematic tracking of market price developments on the company's purchase side, (ii) further exploitation of internal latent company resources, (iii) productivity gains, and finally (iv) a solid basis for working out and negotiating reasonable freight rates on the sales side.

Examples of cost-conscious management measures recommended by the European Association of Road Freight Transport Companies (IRU) (IRU, 2007) include:

- fleet cost management (e.g. a careful choice should be made between "invest" and/or "lease");
- fuel cost management (e.g. application of economic driving techniques, such as reducing vehicle speed, using in-board devices, monitoring tyre pressures etc.);
- staff cost management (e.g. leased temporary workforce);
- overheads and energy cost management (e.g. reduce lighting costs by using energy cost-effective lighting appliances);
- insurance cost management (e.g. fix franchises at an appropriate level).

Consumption reduction

The French logistics group Norbert Dentressangle launched a series of technical training programs. The company accelerated fleet renewal, tested alternative fuels (such as bio-fuel, or tyres with low rolling resistance), and reduced the maximum speed of vehicles¹⁹. Through analysis of consumption, drivers were encouraged (even with incentives) to adopt a driving style to save fuel consumption.

¹⁶ DHL Freight, for example, in Austria refers to the Austrian sale 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.

¹⁷ IRU (International Road Transport Union), Resolution on the fuel price crisis, 26.6.2008.

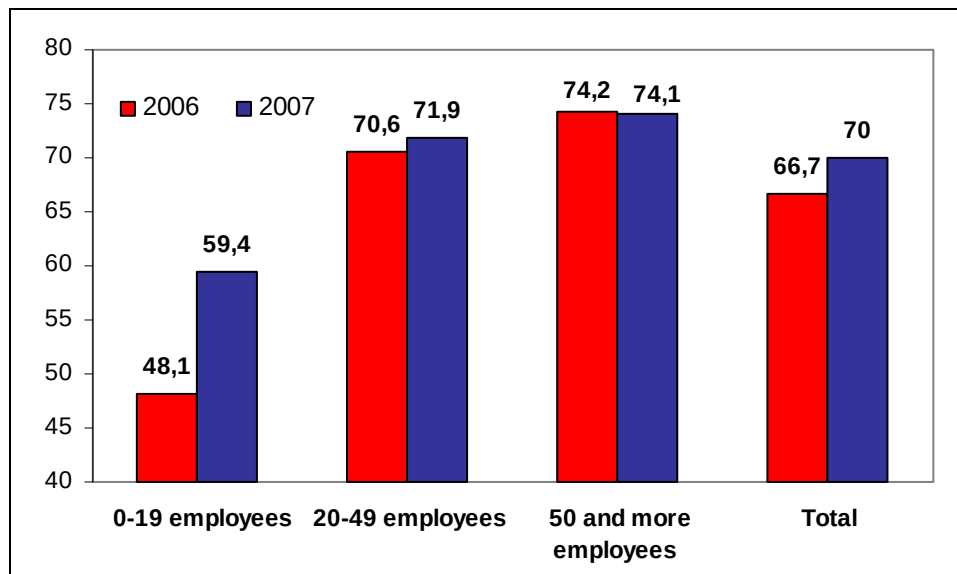
¹⁸ Relevant examples are the United Kingdom Road Haulage Association (RHA) Fuel Adjustment Guide (www.rha.net) and the Comité National Routier *Evolution du prix du gazole et incidence sur le prix de revient, situation au 30 septembre 2008* in France (www.cnr.fr).

¹⁹ A minor reduction of average vehicle speed might generate significant savings. The Californian company Con-Way reduced the maximum speed of their vehicles on highways from 65 to 62 miles per hour (i.e. from 105 to 100 km/hour). It seems a minimal difference, but, taking into account the consistency of the fleet and the mileage, the result is a saving of about 12 million litres of diesel per year. Con-Way is also increasing load factors and reducing partial load trips.

Tank investment

The surge in the price of diesel fuel has encouraged trucking companies to invest in diesel tanks to reduce their supply costs. In fact, there are real 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). This trend is evident especially for small companies (see Figure 4.6 for France).

Fig. 4.6 Tank investment in France: percentage variation for not previously equipped companies



Source: CNR, Enquete long distance 2007, 2008

Cooperative logistics

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 undertaken has been run have turned out to be very successful. For instance, a group of about forty British leading food and consumer goods companies started to share vehicles on certain routes for their delivery operations, aiming at reducing deliveries with part-filled trucks or trucks returning empty ("Sustainable Distribution Initiative").

Government policies

After the protests against rising fuel prices which occurred in June 2008, the EU acted by preparing both long term and short term policy responses, including tax breaks for energy savings and increased transparency of oil inventories. In particular, the European Commission announced the following measures, expected by November/December 2008, and then postponed due to the economic crisis:

- a revision of the energy taxation directive;
- a reduction of VAT rates to encourage energy savings;
- a revision of the Eurovignette directive on road charging for lorries.

The European Commission rejected requests formulated by some Member States of cutting VAT and excise duty on fuels, stating that high fuel prices may play an important role in creating a more efficient transport system, i.e. steering the consumer behaviour towards more efficient modes and preventing from future more dramatic price peaks. The European Commission also noted that some sectors (namely aviation and maritime) are currently favoured over others, even though no specific measures were announced.

Here the specific measures launched by some national governments to help the haulage sector to face diesel price increase are summarised.

- In **France**, the law actually in force²⁰ already provides that the transport price stipulated must be revised if the diesel price rises at the moment of carriage; this revision is calculated through the CNR indices (see above). An amendment to the law on the modernisation of the economy²¹ makes provision for fining shippers up to €15,000 if they fail to pay for the variation in the cost of charges such as fuel, road tax and toll gate fees, between the conclusion of the contract and carriage. According to Fédération Nationale des Transports Routiers (FNTR), France's biggest road haulage association, without a penalty clause attached, some shippers have either refused to comply or sought to compensate themselves by demanding discounts from haulers.
- In **Spain**, the agreement of June 2008 between the Government and the National Committee for Road Transport established that the Public Works Ministry will launch on the Internet the publication of the weekly increase in diesel prices. This information facilitates the calculation of the clause for the automatic updating of the price agreed in contracts, according to the variation in the price of diesel. The Government was also studying a package deal to reduce energy consumption, which includes lower speed limits for trucks (80 km/h) on motorways in order to reduce fuel consumption.
- The **Italian** government approved the so called "diesel clause"²², that is, an automatic adjustment mechanism of transport tariffs on the basis of the price of diesel fuel, whose real effects on the trucking companies may not however be assessed, because the clause requires a transitional period before the monitoring activity by the Road Transport Observatory becomes operational²³. In the transitional period, the adjustment is provided when the percentage change in the diesel price exceeds 2% compared to the month that the contract comes into operation (the reference diesel price comes from the Economic Development Ministry).
- The **Finnish** Ministry of Transport stipulated a voluntary energy efficiency and energy saving agreement with transport operators, including freight and public transport operator associations. The aim is to reach at least a 9% improvement in energy efficiency of freight and public transport by 2016. This will mean energy efficiency requirements for procurement of transport services, eco-driving and technical measures, such as tyre pressure and other inspection and maintenance measures.
- Following trials run in November 2007, and a series of specific studies, the **Dutch** government allowed all road carriers to operate longer and heavier trucks (a length limit of 25.25 metres, and a weight limit of 60 tons), on the whole domestic network of trunk roads and motorways. This authorisation is acknowledged to have resulted in

²⁰ Law 95-96, February 1995 as modified by Law 2006-10, January 2006.

²¹ Law 2008-776, August 2008.

²² Law 133/2008, August 2008.

²³ Really, from July (when the Law became into force) to the date when the diesel price started to decrease, with consequently no adjustment necessary.

more productivity for hauliers as well as in a potential reduction of CO₂ emissions²⁴ (see also the following box).

Box 4.1 Mega-trucks for road freight transport

At the European level, the European Commission (Communication of 18.10.2007) is considering the opening of the road haulage market to so-called Mega Trucks. Mega Trucks are long vehicles (25.5 m long and 60 tons of payload) that could make road transport more efficient. It is estimated that, in comparison to a standard 40 tons truck, fuel consumption per ton is 17% lower. This predetermination in favour of mega trucks was, however, stopped by the EU Council of Transport Ministers at the end of 2007. The final version of the “action plan” now states that before the current limits on goods vehicles may be amended, the potential impact must be examined.

Some experiences with Mega Trucks have been carried out, especially in Central and Northern Europe. In Sweden the maximum weight limit for trucks was increased from 40 tons to 60 tons in 1993. In The Netherlands, local experiments have been conducted on specific short distance, domestic corridors where the haulage market is generally small.

Caution on this matter, despite the promising gains in terms of fuel efficiency (and reduction of CO₂ emissions), is necessary because of a number of threats. In particular, demand shifts from rail and waterways to roads could arise due to more price efficiency and more attractive loading conditions (weight and volume). In case these shifts happened, fuel savings within the road market would be more than offset by increased consumptions in comparison to rail or inland navigation.

According to recent analysis (TNO-TML, 2008), with regard to road safety, a slight increase of mass or length only would not lead to a decrease in road safety and the calculated reduction of vkm due to LHVs (Long and Heavy Vehicles) may outweigh the higher risks induced by individual LHVs. Regarding congestion, fewer trucks on the roads are expected and fewer trips will be needed to transport the same amount of goods.

4.3 Aviation

4.3.1 Overview and impacts

It is widely recognised that most of the world’s air cargo is carried in the bellies of passenger aircraft on scheduled services: in fact, all-cargo flights cover only 2% of the total number of arrivals and departures in European airports and, according to Boeing, these flights cover 30% of cargo traffic, while the remaining 70% is flown in passenger aircraft. Consistently, most of the impacts related to high oil prices may be better analysed by looking at the reactions of passenger airlines.

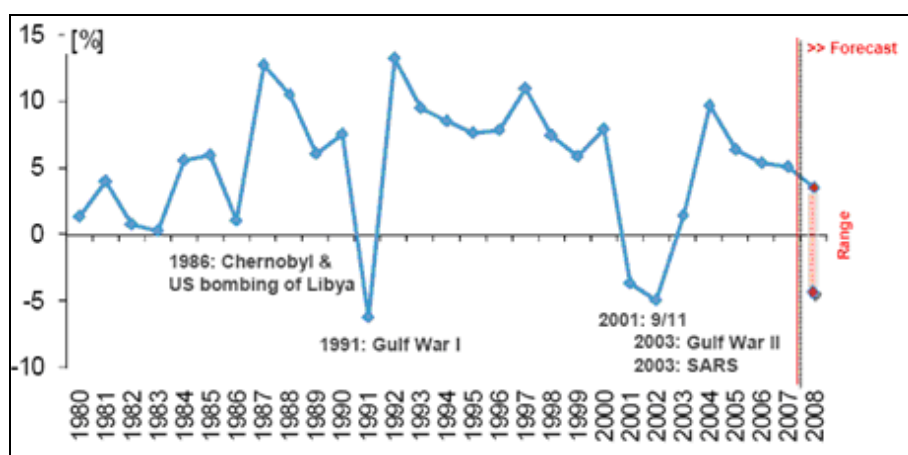
Jet fuel expenditure for the major network carriers that are members of the Association of European Airlines (AEA) has doubled between 2004 and 2007, reaching 18 billion €, and a further increase is predicted for 2008 (AEA, 2008). This is mostly due to the record fuel costs suffered by the air transport 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

²⁴ In Sweden, Finland and some road sections in Denmark and Belgium, such trucks were already allowed. Other countries, such as France, the United Kingdom or Germany, are less confident, or even reluctant, to allow longer and heavier trucks to be operated on their road networks.

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.

Despite the weakness in oil prices in late 2008, the industry's medium and long term expectations are of a growing trend characterised by irrational exuberance and fluctuations. This is therefore enough to endanger the revenues of airlines and change the competitive scenario. At the end of 2008, the average growth rate in revenues per flown passenger-km (RPK) for AEA carriers registered a modest 3.1% increase on an annual basis (September 2007-September 2008), with the final rate predicted to range from very bad performances, similar to the period after 11th September 2001, to a moderate worsening compared with 2007 (see Figure 4.7). The magnitude of parallel profit losses in the budget airline sector will probably initiate a structural consolidation led by carriers with strong balance sheets, suitable slots and loyal passengers (i.e. Ryanair, EasyJet and Air Berlin).

Fig. 4.7 AEA carriers revenue passenger-km (RPK) development (year-on-year % change)



Source: AEA, 2008

The industry's continuing expansion is now under the pressure of concomitant negative elements: global recession, tightening of disposable income, inclusion of aviation in the EU Emission Trading Scheme and, in the end, the proliferation of national taxes on passenger air transport. Nonetheless, the strong price competition has 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 *vis-à-vis* 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 period of 2008. In order to reduce fuel costs and offset their fluctuations, both network and low-fare airlines are forced to constantly adjust their hedging positions and accelerate the sale and return of expensive aircraft.

4.3.2 Sector reactions

The rise in fuel prices has fundamentally changed the relative cost structure of all airlines and this has a consequence for the nature of the adjustment process. 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.

A number of airlines have already announced structural capacity cuts, in particular, starting from the 2008-2009 winter timetable, already have grounding their aircrafts on unprofitable or marginally profitable routes. 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).

Fuel surcharges were largely adopted to transfer most of the fuel increase to final air cargo users. During the last oil shock, these charges were extremely high and in some cases even exceeded the net transport fare, similar to the maritime transport tariff structure.

4.4 Rail

4.4.1 Overview and impacts

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.

4.4.2 Sector reactions

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.

Stimulating more energy-efficient driving behaviour was one of the few available options in theory, but the development of tools helping to put this into practice is still in its initial stages. In the longer term, the purchase of new and more energy efficient locomotives, or a shift from diesel to electric traction, are two options for the operators, but, due to fierce competition, the purchasing power and willingness to invest is at present very low. The expected drastic increase in the prices for the use of rail infrastructure adds to the worrisome conditions in this sector.

4.5 Maritime

4.5.1 Overview and impacts

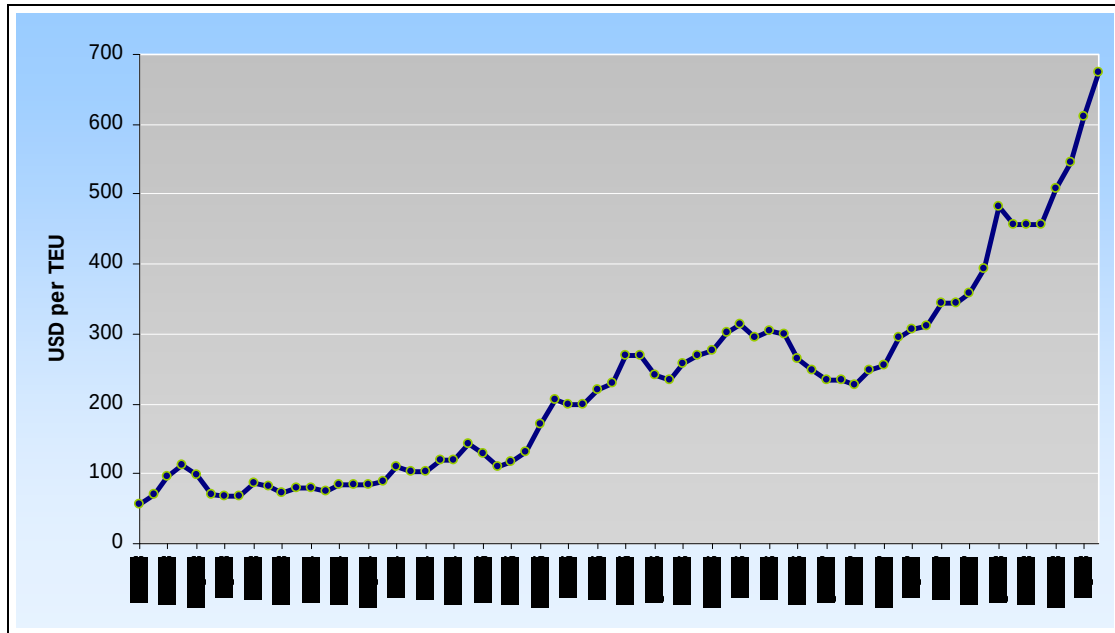
Shipping costs for bulk cargo are mainly represented by raw material costs and have strong and even sudden variations over the last years (with also evident differences between dry and liquid cargoes). Conversely, container transport based on liner services has been characterised by an almost steady trend.

Looking at earning rates in 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. As a result, bunker prices represented a highly fluctuating share varying between 17% (when freight rates for ships were at a maximum) and 61% (when freight rates were at lower levels) of transport costs for a representative trip of a Very Large Crude Carrier (VLCC). Rising bunker price results therefore are somehow hidden. On the other hand, in the dry bulk sector, the same fluctuation between 2007 and 2008 may be restricted to a band between 7.5% and 15%. These values, which may appear low in comparison with the corresponding value for other transport modes, depend upon the historical record of the freight rates observed in the dry bulk sector. The market trends in this field are completely decoupled from bunker prices as they are mainly influenced by other drivers such as: the demand and supply of raw materials (coal, iron ore, etc.), fleet composition and renewal, the availability of ships, etc.

Containerised transport offers more elements for the analysis. The speed factor is the most important driver of fuel consumption: in global shipping, the increase in ship speed over the last fifteen years has doubled fuel consumption per unit of freight. Using Lloyd's and Clarkson's vessel information, it may be demonstrated that in general the larger (more modern) post-Panamax size vessels have been increasing in design service speeds (i.e. are typically in the 23-26 knot range) compared with the older Panamax and lower size vessels (1,000-4,000 TEU) which have design service speeds in the range 18 to 22 knots. This increase in design speed has offset to a large degree the economies of scale of larger vessels.

4.5.2 Sector reactions

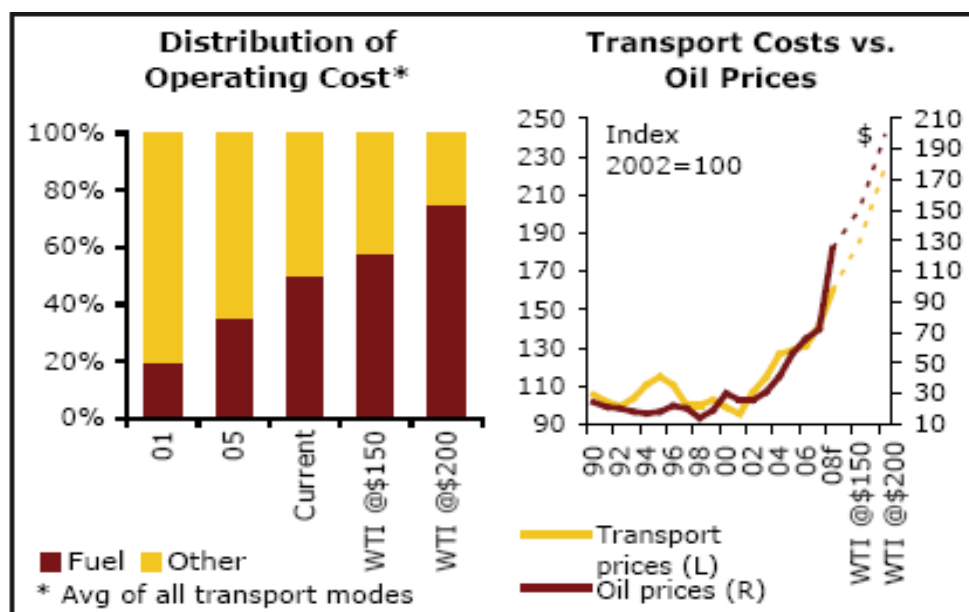
In the quotation of freight rates, the additional cost due to higher oil prices is levied through the Bunker Adjustment Factor (BAF), which is directly translated from shipping companies to shippers. Once corrected for the BAF, container shipping rates would show quite a flat trend. The application of 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. Figure 4.8 synthesised the BAF levied on freight rates on the Far Eastern Freight Conference (FEFC).

Fig. 4.8 Trend of the BAF applied to freight on the FEFC (US\$/TEU)

Source: Elaboration on FEFC data

The regular application of the BAF shows a strong correlation with changes in oil prices. Over the last three years, every one dollar rise in world oil prices has fed directly into a 1% rise in transport costs. The following Figure 4.9, extracted from a recent study by CIBC World Market (Rubin J. and Tal B., 2008), highlights the strong correlation between transport costs and oil prices: the first chart describes how oil prices, measured through the WTI (the barrel price quoted at the New York stock exchange market), expected to increase up to 150 US\$ and 200 US\$, will impact on overall operating costs: at the 200 US\$ peak, it would represent around the 70% of the operating costs. The second graph shows the strong correlation between transport price (index) and oil price.

Looking at freight rates trends on a sample route may help in understanding the way oil prices (levied through the application of BAF) have conditioned the market. 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.

Fig. 4.9 Transport Costs Highly Sensitive to Oil Prices

Source: RMT, CIBCWM

Tab. 4.4 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

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 about a 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 prices represent a consistent share of 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 reactions²⁵. 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.

Other strategies adopted by 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.
- Research towards **energy efficiency improvements**: besides the renewal of the fleet and the use of bigger (and more energy efficient) vessels, a lot of small improvements are being tested and implemented: they may be grouped into improvement of engine efficiency, and improvement into the propulsion systems. Future challenges include, amongst others, the test of alternative propulsion systems such as the kite-powered ship system.

4.6 Inland navigation

4.6.1 Overview and impacts

In terms of vessel operation, 2007 has featured an increase in volumes transported in most segments, with the transport price level also tending to increase. The concordance of these elements should not however lead to the conclusion that operators' profits have increased in the same proportion. The increase in income has in fact been accompanied by an increase in transport operating costs for both dry and tanker goods.

The main increase in the price of fuel oil occurred in 2005 and the price then stabilised at a high level during 2006. In 2007, fuel prices increased continuously and such an increase even accelerated over the closing months of the year, and into the first half of 2008. The average price over the first four months of 2008 is approximately 20% higher than the average price in 2007.

4.6.2 Sector reactions

Most ship owners have transport contracts which include a special gas oil clause, enabling them to charge extra fuel costs to clients. There are also a lot of ship owners, however, who are dependent on the daily spot market for prices, which makes it difficult for them to negotiate the right prices with their clients, and also because the 'bunker surcharge' in periods of price hikes in gas oil is not yet a common practice.

As in road trucking, part of the supply of inland shipping transport services stems from small family type businesses which operate only one vessel. In these cases, higher transport costs which cannot be charged to customers and cannot be levelled off by improving technology and/or load factors and/or cutting down on other cost components,

²⁵ 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..

will necessarily be reflected in lower profit margins. These companies operate to some extent on a cash flow basis and wait for better times, e.g. higher freight rate.

4.7 The incidence of transport costs on industrial sectors

The industrial demand for freight transport does not seem to be influenced very much by increases in oil prices, because the price of transport is only a very small part of the final price of goods. There are sectors, however, in which the influence of transport costs on the demand for transport services is much higher: in general, expensive products or high value added activities may bear higher transport costs more easily than low value products or low value added activities. Further, the impact of increasing transport costs is relatively modest if transport costs have only a minor share in total logistics costs (including costs for warehousing, assembly and administration).

According to the ECOTRA project (TRT Trasporti e Territorio, 2006)²⁶, transport costs are a relatively small part of the cost structure of industry and may range from 1% to 10% of final product value. Its analysis of logistic chains in four types of industry (processed food, textiles, coffee and automotive) shows evidence of different degrees of transport intensity, which appears to be related to:

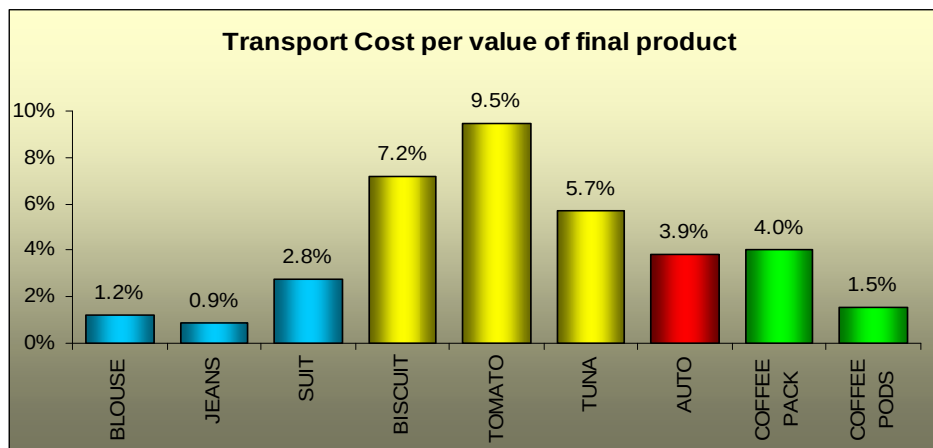
- the level of outsourcing: this could involve transport, inbound and outbound logistics, production or any combination of such activities;
- the geographic dimension of both supply and distribution markets;
- the characteristics of the end customers' demand and distribution patterns; these have an impact on delivery fragmentation and the number of intermediate legs.

The overall incidence of transport costs on the final prices of goods on average lies within a range of 5% to 10% for the processed food sector, slightly under 4% for the automotive sector and is lower (1-3%) in the textile sector. Traditional distribution of coffee (coffee packs) has a 4% value while recent tendencies in home delivery and single dose packing sold at higher price indicates an incidence of below 2% (Fig 4.10).

The incidence of transport cost on the whole chain depends upon a series of factors:

- raw materials prices and the extent of their markets;
- overall added value;
- overall production costs;
- the extent and widespread coverage of the distribution network.

²⁶ The ECOTRA project aimed to provide quantitative and qualitative information concerning energy use, transport intensity and costs for the transport of goods in Europe, covering the whole chain from raw materials to end user. The detailed analysis of the whole transport chain for a "basket" of typical consumer and industrial goods was used to derive estimates of total energy consumption, total volume of transport generated and share of transport costs in the total cost and final price of the goods.

Fig. 4.10 Incidence of transport cost by product

Source: TRT Trasporti e Territorio, 2006

Transport policies might differentially affect production sectors: where transport costs represent less than 2% or 3% of product value, increases in transport costs may not be perceived as a major threat to competitiveness, while the impact could be different for sectors where the incidence of transport rises to 10%. Therefore, as reported in the third section, there is a limited impact of energy costs on transport costs, and, in turn, this represents a small part of the final price of goods, such that even high oil prices, at least in short to medium term, may have a modest impact on the value of the transported goods especially in relation to road and rail transport.

4.8 Summary of key findings

This Chapter has enabled us to observe that there is a significant difference in the capacity of freight transport operators to offset the higher costs of fuel by pushing up final prices. This, indeed, is dependent upon their market power, and amongst all operators, road freight transport operators are those which have proved to suffer the most from price hikes, as reflected in the low profitability in this sector.

Again, the situation in the various Member States is not similar; conversely, the gap between road freight cost increases and price increases is increasing with particular evidence of this in Central Europe, with Spain and Portugal as exceptions.

The capacity to react to this scenario is also linked to the size of operators. Large logistics companies and express couriers have been able to introduce flexible surcharges for diesel, but on a more general level, and, since most of road haulage companies are small and medium-sized firms, the largest part of the higher costs has been absorbed by the compression of profit margins.

Several initiatives have been undertaken in order to mitigate such negative impacts. These measures have been taken by both private companies and national governments. The former have focused on energy improvements (permanent cost management, installing own diesel tanks, consumption reductions, aggregation between companies), whilst the latter have specifically put in place particular policies to help the haulage sector to face diesel price increases.

The situation is slightly different for the remaining transport modes.

- Concerning **aviation**, and in the light of the strong price competition between the airline companies, the rise in fuel prices between 2001 and 2006 has been essentially mitigated through efficiency measures rather than increases in flight prices. The industry's continuing expansion is now under the pressure of concomitant negative elements: global recession, tightening of disposable income, inclusion of aviation in the EU Emission Trading Scheme and, in the end, the proliferation of national taxes on passenger air transport.
- Due to transport cost reduction, the consequences of fuel price rises on **rail** freight costs have been limited in recent years. Rail transport operators are continuously integrating combined transport and logistic services in their traditional activities. Thus, the impact of oil price peaks on the sector as a whole is difficult to assess. Nevertheless, because competitive conditions are very difficult for rail operators, the analysis concluded that the latest fuel price increases may have been a potential source of concern for the railway operators, in particular for those operating diesel traction.
- Finally, for **maritime** shipping the study has shown how the increase in ship speed over the last fifteen years has doubled fuel consumption per unit of freight, hence compensating to a large degree the economies of scale of larger vessels. In the period 2007-2008, the bunker price has been a highly fluctuating share of transport costs in the maritime liquid bulk sector, ranging between 17 and 61% (and between 7.5 and 15% in the dry bulk sector).

There is a limited impact of energy costs on transport costs, and in turn this represents a small part of the final price of goods (from 1% to 10% of final product value) such that even high oil prices, at least in short-mid term, may have a modest impact on the value of transported goods especially in relation to road and rail transport. This explains why the demand for freight transport does not seem to be affected to a great extent by increases in oil prices.

PART III THE IMPACTS OF FUTURE OIL PRICE INCREASES

Chapter 5 High oil prices scenarios

5.1 Introduction

While the previous Chapter has provided some recent evidence about the impact of high oil prices in the year 2008, this Chapter deals with the possible effects in the near and medium term future and is based on the outcome of the HOP! project, where the expected impacts of high oil prices on the economic, energy and transport sectors have been estimated by means of a modelling approach (Fiorello et al., 2008; Schade et al., 2008).

The HOP! research project (Macroeconomic Impact of High Oil Prices, www.hop-project.eu) was co-funded by the European Commission DG Research to provide quantitative and qualitative analysis of direct and indirect impacts on the European economy of long term oil price escalation. In order to quantify direct and indirect impacts on the transport, energy and economic systems, a System Dynamics modelling approach was applied by combining the global partial equilibrium energy model POLES with the ASTRA model, a strategic tool for the analysis of the interaction between transport, economy and environment. According to an already tested methodology, the two models were used in an interlinked way to run alternative scenarios corresponding to different sets of assumptions about the cost of oil and alternative energy and transport technologies, making reference to the time horizon to the year 2050.

Oil price trends in the HOP! project scenarios are not an exogenous input of the modelling tools, but are endogenously calculated depending on reserve-to-production ratios, the spare production capacities of large oil producing countries, and on the impact of the "market power" of a few oil producing countries. To get a comprehensive picture of the economic impacts, a series of scenarios were defined and compared with a reference projection (in all scenarios, oil prices are expressed in €₂₀₀₀ per barrel). The results reported in this chapter make reference to:

- The Reference Scenario assumes high amounts of oil reserves and can be seen as an optimistic scenario. It reaches an oil price of about 70 €₂₀₀₀/bbl in 2020, smoothly rising to 140 €₂₀₀₀/bbl by 2050. Investment in energy efficiency and alternative energy sources follows common trends. Taxation takes the current excise duties plus the changes through the diesel directive into account.
- The High Oil Price scenario assumes a smoothly increasing oil price which reaches a level of 150 €₂₀₀₀/bbl in 2020; this leads to increased investment in energy efficiency as well as in alternative sources.

5.2 Differences with previous oil price shocks

Some learning about the expected impacts of oil price shocks comes from a comparison between the recent situation and the previous experiences when oil prices reached very high levels. Even if the steeply increasing oil prices in 2007 and the first half of 2008 have some similarities to the oil price crises in the 1970s, the latest oil price peaks are based on different grounds. Furthermore, economies and institutional settings have developed substantially since the 1970s. For this reason, it is not surprising that the most recent oil

price shock did not give rise to the same effects as those of the 1970s and there are elements to assume that, also in the coming years, the world and European economies are going to react differently.

A better understanding of the factors determining the differences may help in predicting the effects of future oil price peaks. An overview of the main factors is shown in Table 5.1; some main items shall also be explained as follows:

- It is widely accepted that the most recent oil price highs reflect a demand-supply gap to a much larger extent than previous shocks, notwithstanding the influence of speculation. On the one hand, demand for oil has been rising rapidly: between 2002 and 2007, China has more than doubled its oil imports and in India they have risen by more than 50%, leading these two countries to account for some 12% of global oil consumption by 2006, compared to less than 10% in 2002. On the other hand, supply has been increasing at a lower pace, influenced by a lack of spare production and refining capacity. It is reasonable to assume that future oil price shocks will also tend to reflect resource scarcities to a larger extent than the shocks of the 1970s.
- The point above suggests that oil price shocks are and will be more serious than the past ones. However, there are some positive remarks as well: firstly, the oil intensity of the economy (i.e. the amount of energy required to produce one unit of value added) has halved on average over the past 30 years in developed countries, and has been reduced by one third even in developing countries (IMF, 2005). This means that the dependency on petroleum is lower and oil price shocks have less potential to influence the whole economy. A second positive remark concerns the availability of oil substitutes such as electrical vehicles or biofuels, and fossil fuel substitutes in general (such as renewable energy carriers). Most of these were definitely unavailable 30 years ago, while they have experienced important cost reductions together with major technical improvements over the past decades. So, at least from a technical point of view, the potential for developing alternatives to oil to alleviate pressure on prices is much higher.
- Other differences exist, but may not be readily regarded as positive or negative. For instance, the monetary policy of central banks (especially the European Central Bank) primarily focused on keeping inflation at low levels during the recent oil price peaks. Such restrictive policies may contribute to avoiding accelerating inflation, which may prove to be ultimately unsustainable for the economy. On the other side, however, such a policy, together with more flexible labour markets and wages have contributed to weakening of economic growth in EU compared to e.g. the United States, and reduced the contribution of internal demand, making the European economy more dependent on exports to the United States and other countries.
- Also the liberalisation of financial markets and trade globalisation may play a positive role (e.g. for the mobilisation of venture capital for investments in alternative energy sources, or to keep inflation low by outsourcing production to low-wages countries), although effects may well be negative, when severe problems of non-sustainability in the financial economy, rooted outside the Union, may heavily involve the real European economy.

Tab. 5. 1 Major differences between oil price crises over time

Past oil price crises	Current oil price crisis	Future oil price crisis
Nature of the oil price shock		
Supply shock (also sudden)	Demand shock (rather incremental, thus less of a crisis)	Demand and supply shock (incremental)
Expectation of short-term price hype because of: - No resource constraint; - Reserve/Production Ratio high; - Prospects of availability of undiscovered resources at low extraction cost; - Sufficient spare production capacity.	Expectation of sustained price increase because of: - Looming resource constraint; - Reserve/Production ratio shorter (especially for crucial Non-OPEC players like Russia); - Some signs of exhaustion of cheap resources; - Low availability of non-conventional resources, with high extraction costs; - Little spare production capacity.	Sustained price increases because of: - Obvious resource constraint. - Reserve/Production ratio shorter (especially for crucial Non-OPEC players like Russia). - Exhaustion of cheap resources - Higher availability of non-conventional resources, with high extraction costs.
Economic environment		
Economic growth with significant existing inflation but relatively low unemployment especially in EU. (Average yearly GDP growth 1970-74: USA 4.9%; EU-25 4.5%; rest of Europe 3.6%; World 4.9%).	Lower and very uneven economic growth with low or no inflation but higher unemployment. (Average yearly GDP growth 2004-07: USA 3.8%; EU-25 2.2%; rest of Europe 2.9%; World 3.8%).	Unknown
USA, Europe and Japan are largely the dominant economies.	China + India economic actors.	China/India/Brazil/Russia important and growing economies.
Strong unions and active macroeconomic policies protect purchasing power of workers and make for pressure on prices.	Weak unions due to globalisation, micro- and macroeconomic policies.	Unknown
Monetary policies enforce inflation.	- Monetary policy devoted to avoiding inflation in EU. - Expansive deficit spending and monetary policy in USA. - Cheap production in China and India led to deflation.	- USA economic imbalances (twin deficits) may prove to be unsustainable. - Deflationary effect of China, India will probably change in the future.
Bretton Woods institutions control financial and monetary markets. Capital flows under control.	Liberalisation of capital flows, huge growth of financial economy.	Unknown
Technology and Energy use		
Lock-in into fossil fuel energy technology.	Availability of alternative technologies.	Increased availability of alternative technologies, their competitiveness increases with oil price.
High oil intensity (Euro Area in 1973: 0.15 kg oil per unit PPP-adjusted GDP, IMF 2005).	Oil intensity halved compared to 1973 (Euro-Area in 2002: 0.075 kg oil per PPP-adjusted GDP).	Oil intensity probably further decreasing.
Transport close to 100% dependency on oil.	Transport in EU depends to 95% on oil.	Significantly reduced dependence of transport on oil.

5.3 Estimated future impacts of high oil prices

The HOP! project simulated several scenarios where oil price is high in the horizon year of 2020 and afterwards. The application of two models, ASTRA and POLES, has produced estimates of the expected impact of high oil prices up to the year 2050, with special emphasis on the economic impacts, but with consideration also of the impact on transport.

5.3.1 Overall impact on the economy

In general, the overall conclusion of HOP! is that high oil prices may have a significant economic impact in the short-term and a more limited impact in the medium- and long-term. In the first instance, a high oil price will have a negative effect due to increases in costs in many areas of the economy, but this may be offset by the boost of investment induced by the search for alternatives to fossil fuels and for more efficient technologies. The key messages derived from the HOP! scenario analyses may be summarized as:

- GDP and employment will probably be negatively affected during the peak period of oil price increases with employment being reduced significantly more;
- the impact after the peak period of oil price increases will depend strongly on the mechanisms initiated by the price increases. Mitigating the impacts by investing in energy efficiency and alternatives could even lead to a positive economic impact in the medium to long-term, while a world recession, or a situation with insufficient energy supply could multiply the negative impacts by factors of five to ten;
- the most relevant impact to counterbalance the negative impact of high oil prices are investments into energy efficiency and alternatives, as first they directly provide a positive stimulus for the economy as part of final demand, and, secondly, they indirectly help to reduce the vulnerability of the economy to oil price increases by reducing energy demand, energy costs and imports of fossil energy;
- if oil prices will experience a rapid increase over the next few years, the lack of response time due to a high inertia of industry could hamper the mobilisation of alternative sources, leading to a more profound impact on GDP growth. In the medium term, at least, rapid price increases would be advantageous compared with a smooth price increase since the shock most effectively triggers compensating mechanisms, particularly investments into energy efficiency and alternatives. This presupposes that investors expect sustained oil price increases and not a temporary ones, and that governments do not take actions to lower fossil fuel prices artificially, thereby distorting the price signal;
- in terms of impacts on employments the most important issue is how the energy sector may pass on the price increases to other sectors. A full passing on of price increases causes the strong losses observed for employment and boosts the profits of the vertically integrated large energy companies. Limiting the passing on of prices increases, either indirectly by the energy companies, reinvesting their profits into efficiency technologies and alternatives that are produced domestically in the EU, or directly by the government taxing the profits and creating investment incentives into efficiency technologies and alternatives by subsidies, would strongly reduce the negative impacts on employment.

Box 5.1 Overview of alternative fuels and propulsion technologies

An immediately available technology that could replace the quantity of fossil fuels used in transport is still not available. Alternative non-fossil energy technologies still face major technological obstacles and commercial barriers to penetrate the market. In the future, four potential alternative ranges of technologies may be identified as promising in road transport: biofuels, natural gas, hydrogen and electrical vehicles. The capability of biofuels to take on a role in reducing EU dependency on fossil fuels is particularly debated in these years while hydrogen technologies are still considered as a long term research and development initiative. A future viable option is considered to be the electric vehicle, which is undergoing a small technological revolution with the diffusion of lithium batteries. Today the cost of such vehicles is still high and the market is minuscule. The following table provides an overview of alternative technologies in transport and their advantages and drawbacks.

Fuel	Advantages	Technical Disadvantages	Note
Compressed Natural Gas	Very low particulate emission compared with diesel. Low NOX emission compared with advanced diesel engine . Zero sulphate and SO2 emissions.	More complex refuelling system. 4 times larger tank size requirement. Engine efficiency in bus operation 20% lower than that of diesel engine.	The main challenge will be the establishment of a new distribution infrastructure. Like petroleum products it is a fossil resource subject to depletion and strong rises in price.
Ethanol (Biofuel)	Mixable with gasoline. High octane number. Low NOX emissions. Large potential to reduce CO2.	Cold start problems. More corrosive than hydrocarbons. Induces emission of aldehydes.	Environmental concerns due to cultivation phase of biofuels. Land use conflicts with other land uses such as food production. Concerns about the capability of the EU to produce enough biomass feedstock.
Dimethyl ether (Biofuel)	Very low PM. Zero sulphate and SO2 emission. Low NOX levels without after-treatment.	Lower viscosity. The injection system needs to be developed.	
Biodiesel (Biofuel)	Higher cetan number. Good lubricity. Zero sulphate and SO2 emissions. Particulates of lower toxicity.	Corrosion properties. Lower heating value. Higher freezing point Increased NOX emission. Increased odour.	
Electric	Fewer local problems related to air pollution (health) and produces less noise in urban areas.	Size and costs of batteries; recharging issues make them suitable for short-distance motoring only, still very expensive.	Full benefits exist if the electricity is produced by renewable sources.
Hydrogen Fuel Cell	Full benefits in terms of energy efficiency, CO2 and pollutants emissions.	Most hydrogen technologies are much more costly than the conventional.	At this stage it is recommended to consider hydrogen as a research and development initiative only.

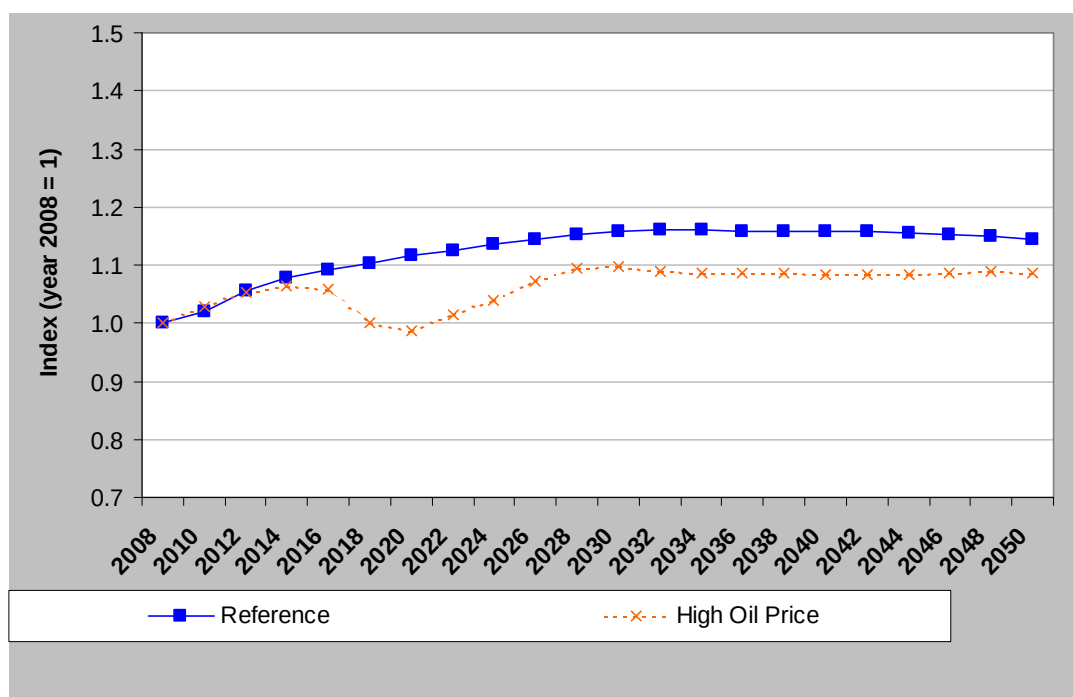
Source: TRT, 2007

5.3.2 Impacts on the transport sector

The transport sector is very energy intensive and therefore the impact of higher oil prices – translated into higher fuel prices – is significant. It is generally believed that transport demand is very rigid and therefore only minor adjustments should be expected. Nevertheless, the analysis in Chapter Four has demonstrated that responses are being undertaken after the recent price growth and further adjustments may be expected in the future in a sustained high oil price scenario.

The HOP! modelling simulations suggest that passenger transport demand reacts most reactive to higher fuel prices. In Figure 5.1, the trend of total pkm in the EU-27 is illustrated. In the reference scenario, passenger demand is growing sharply until about 2030, then it is stable or declining, given the expected reduction of population in Europe. The growth of conventional fuel prices leads passenger performance to slow its growth, and then even proceed to a reduction. In 2020, pkm are forecasted to be lower than in 2008 at a level of 150 Euro₂₀₀₀/bbl. This expected reduction of transport performance is especially the result of shorter trip distances than of a lower number of trips. Passenger mobility reduction is associated with a different modal split, with car and air losing mode share, whereas public transport and slower modes increase their demand. Car share could be reduced from 71% to 67%-68% (so car would still remain the dominant mode) at 2020 (when oil price peaks), to recover some share latterly but staying below the current level. Air demand growth would be significantly retarded: the air market could lose about 20% of its demand between 2014 and 2020. At the same time, rail could attract demand more than any other alternative, climbing from 8% to 11%-12% in the year 2020, and remaining over 10% even after the oil price peak.

Fig. 5.1 Trend of the EU-27 pkm

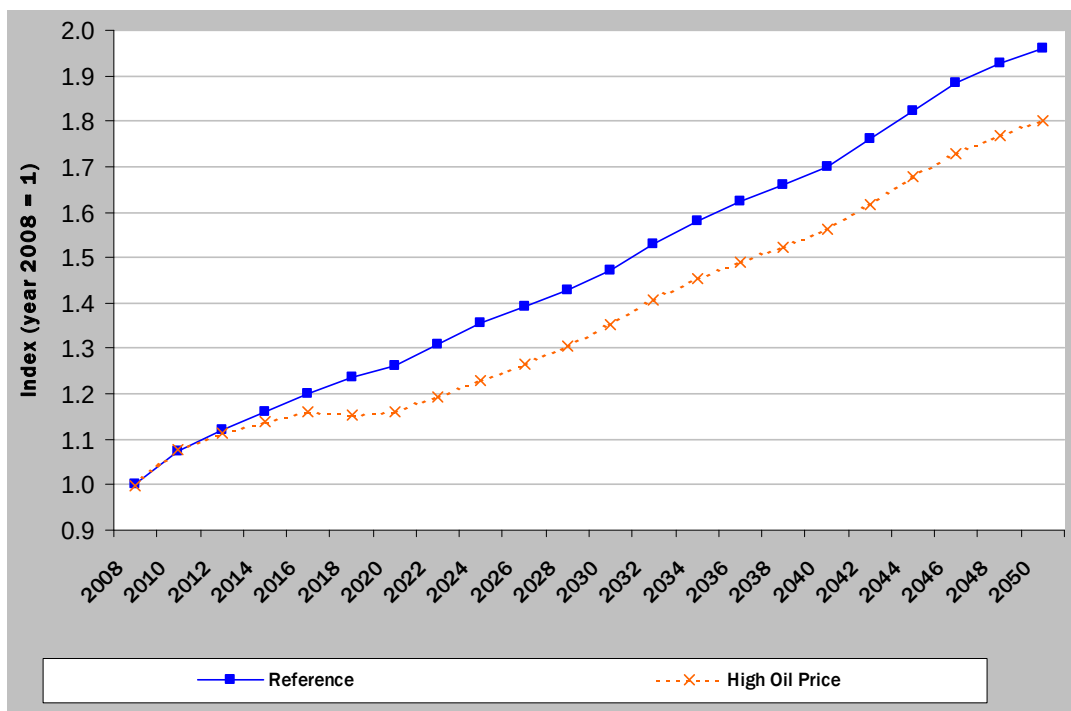


Source: ASTRA calculations in HOP! (Fiorello et al., 2008)

The impact of energy prices on freight performance (Figure 5.2) is expected to be more limited in absolute terms. The increase of fuel prices should only be able to slow down the growth of tkm for the peak price years (between 2010 and 2020), but not to reduce freight traffic. Instead, the total number of tkm in the EU-27 is expected to increase by 15% in the peak price year (2020) with respect to the 2008 level. This does not mean, nonetheless, that freight transport is insensitive to oil price growth. Even if 15% larger than in 2008, freight transport performance is expected to be 8% under the projected level of 2020 in the reference scenario (where oil price is assumed to be around 70 Euro₂₀₀₀/bbl).

The higher rigidity of freight traffic largely depends on the economy. In the HOP! scenarios the high oil price does not give rise to an economic downturn: GDP development is significantly affected, though a number of compensating mechanisms like investments into alternative energies, and modal shift to public transport, dampen the negative impacts. Even though at a slower pace, the economy is then expected to show a continuously upward growth trend²⁷. So demand for transporting goods should be also growing, and therefore freight traffic performance would be largely maintained, or even slightly increased, even when oil prices reach their peak.

Fig. 5.2 Trend of EU-27 freight-km



Source: ASTRA calculations in HOP! (Fiorello et al., 2008)

The responsiveness of the freight transport sector should manifest itself in a slowing down of the growth pace of tkm with respect to the reference case, as explained above, but also in an adjustment in the structure of freight traffic. To better explain this point, it may be considered that the demand for the transport of goods may be roughly segmented into two groups: on the one side, the demand associated with the international trade of goods

²⁷

The level of detail in the ASTRA model is neither appropriate to simulate the economic cycle nor does the model deal with finance, so economic turbulences like the ones experienced in the last months of 2008 are not reflected in the forecasts, which concern the trend of the economy.

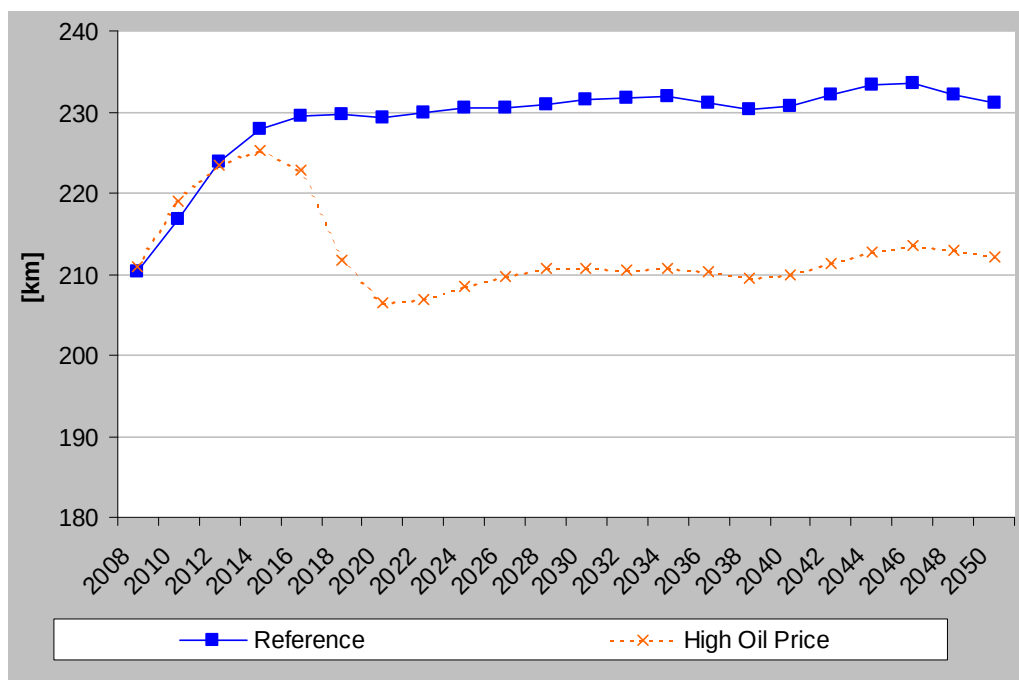
between countries, or domestic trade between regions of the same country; on the other side demand associated with the short distance delivery of goods within the same region. The simulations carried out in HOP! suggest that the increase of oil prices would have a different impact on these two demand segments.

When energy prices, and then transport costs, are increased, the growth of intra-EU export is slowed down with respect to the reference scenario. Local suppliers become more competitive with respect to competitors from other regions and countries, so that transport of goods between regions is reduced (Rubin, 2008). Since the impact of oil prices on transport costs is expected to be small (see below), so the foreseen reduction of trade is small as well, but not insignificant.

At the same time, high oil prices are expected to have a differential impact on economic sectors. Specifically, the production of goods should be increased in sectors like energy and construction (e.g. for the implementation of infrastructures to produce and distribute alternative sources of energy, for the implementation of energy savings devices, etc.) which generates significant amounts of bulk goods often travelling over shorter distances (e.g. both crude and manufactured building materials are often produced locally). Therefore, the transport of goods within regions is increased especially in terms of tonnage.

The combination of two such effects is to shorten the average movement distance of transported goods (Figure 5.3), but at the same time to increase the amount of tons transported. Thus, even if the traffic performance (i.e. total number of tkm) is only slightly changed, such a number of tkm is made up of more tons and less kilometres travelled than in the reference scenario.

Fig. 5.3 EU-27 average freight travel distance

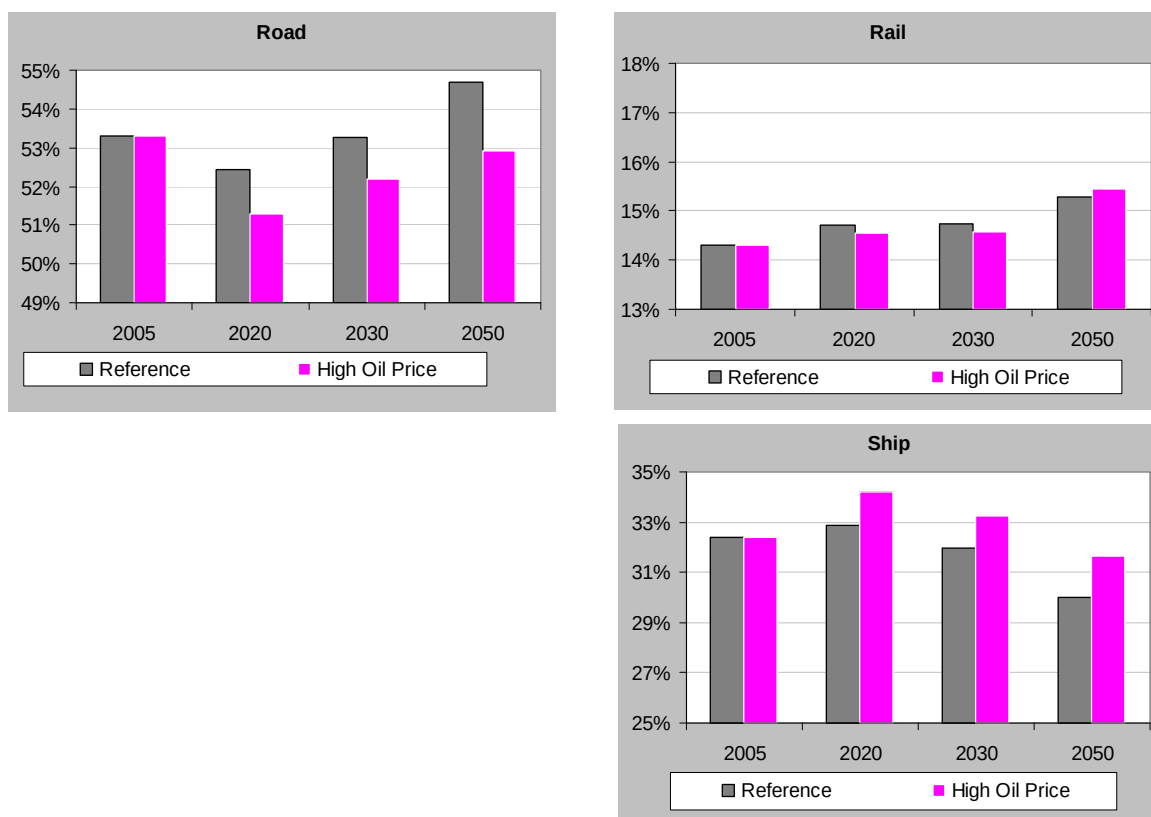


Source: ASTRA calculations in HOP! (Fiorello et al., 2008)

Some small changes are expected in the mode split of freight transport. As shown in Figure 5.4, the share of road freight in terms of tkm is forecast to be about a couple of percentage points lower when oil prices are high than in the reference case: alternative modes – maritime and rail – gain market share, but still road remains largely dominant in the freight transport market.

Since oil prices affect transport modes differently, as discussed in Chapter One, this result may be surprising at first sight. Nevertheless, there are reasons which explain this minor mode shift. Initially, it should be noted again that the structure of freight demand would change as explained above and the new market shares would be the results of separate effects: on longer distances, the mode shift is larger and maritime gains more than rail, whereas, and on the shorter distance, the road share remains high since truck is often the only mode available, because the competition of rail or inland navigation suffers from the higher fixed costs and times.

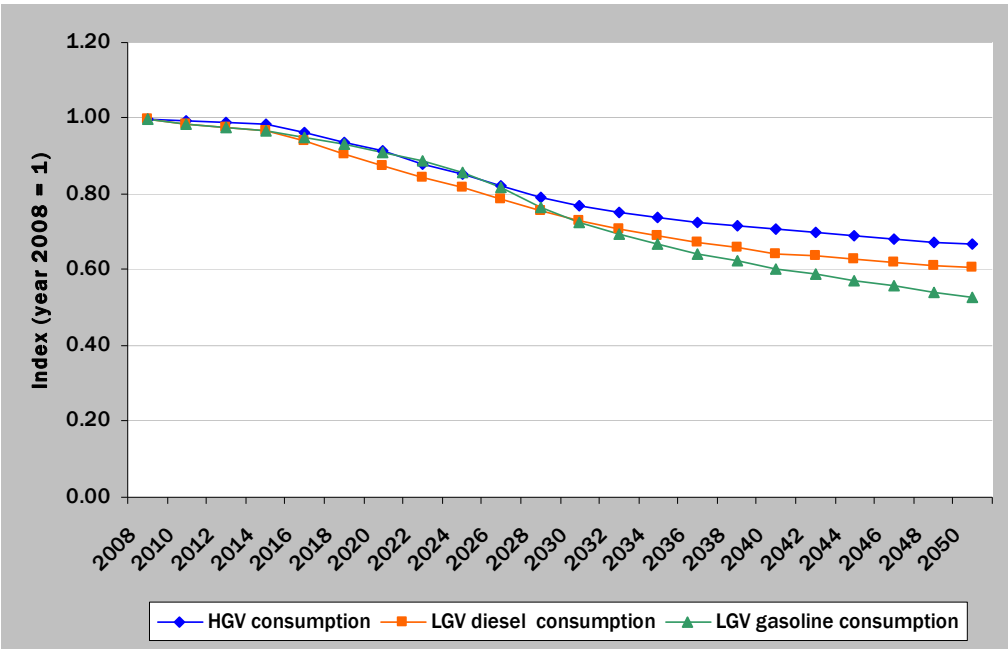
Fig. 5.4 Overview of EU-27 Freight Mode shares



Source: ASTRA calculations in HOP! (Fiorello et al., 2008)

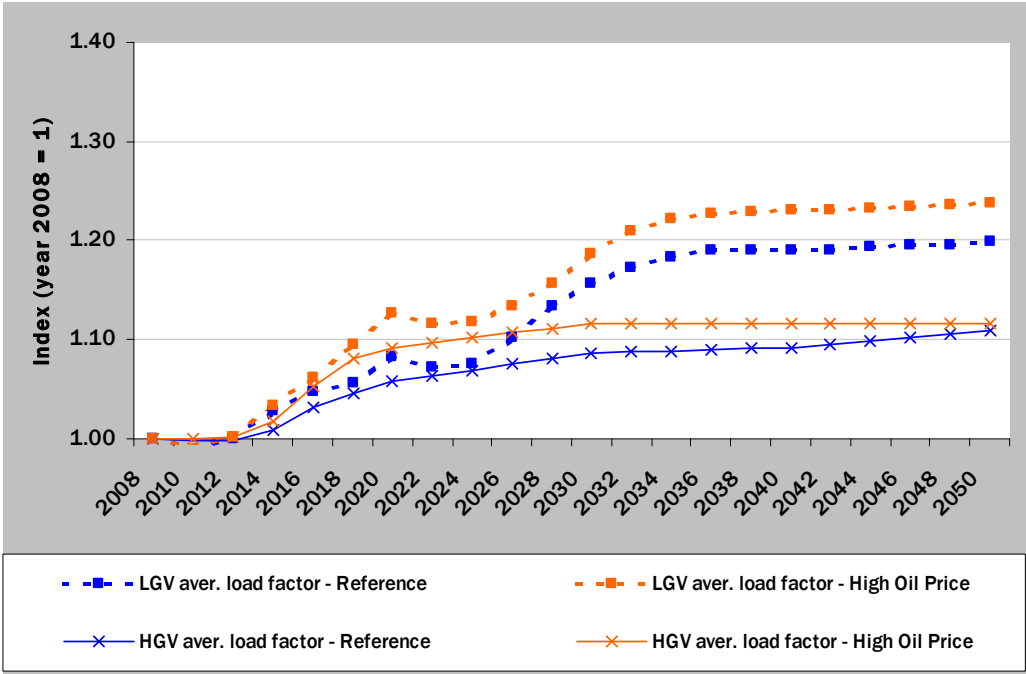
Even when this consideration is taken into account, however, the expected mode shift is slight. Two major explanations for this effect are the expected reactions on the freight transport supply side. Namely, two reactions are expected: on the technology side, and on the organisation side. The response in technological terms would mainly consist in accelerating the renewal of the fleet and using vehicles with lower unitary fuel consumption. Figure 5.5 shows the expected reduction of unitary fuel consumption for Heavy Goods Vehicles (HGVs), diesel Light Goods Vehicles (LGVs) and petrol LGVs. Even if significant savings are achieved only in the longer period, still, in the medium horizon in 2020, unitary fuel consumptions are expected to decrease by about 10%.

Fig. 5.5 Trend of unitary fuel consumption of road freight (index on base year 2008)



Source: ASTRA calculations in HOP! (Fiorello et al., 2008)

Fig. 5.6 Trend of average load factor of road freight vehicles (index on base year 2008)



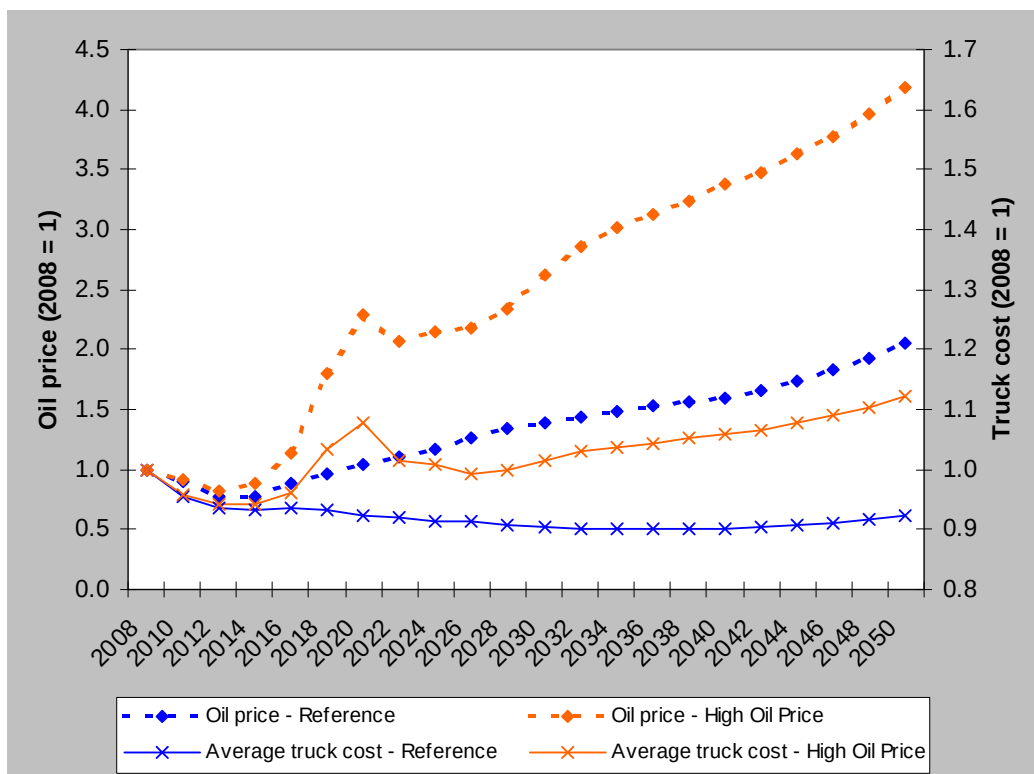
Source: ASTRA calculations in HOP! (Fiorello et al., 2008)

The other expected reaction of road haulers to higher energy prices concerns the improvement of the efficiency of deliveries. This means, essentially, a better optimisation of payloads, with higher load factors and reduced empty trips, since a higher average load factor is the most significant indicator, reflecting improvements on the organisation side. As described in Figure 5.6, the simulations carried out in the HOP! project anticipate that the average load factor (including empty trips) of LGVs and HGVs would be increasing in the reference scenario, and even more under the assumption of high oil prices.

As for fuel consumption, also organisational improvements need some time to be put into practice, so gains are relatively limited in the short/medium terms, though in 2020 (peak oil price) the average payload of heavy goods vehicles would increase of about 9% (6% in the reference scenario), while for light vehicles the increment would be larger than 10% in case of high oil price. The improvement is larger for light vehicles since they start from a less efficient utilisation.

Given the reactions described above and given that energy cost amounts to only a share of total operating costs of road freight, it may be readily understood that the impact of even a sharp increase of oil price on road hauling costs may be low. Figure 5.7, where the left scale measures the oil price index – bold dotted lines – and the right scale measures the truck cost index – thin lines – shows that at the peak, where oil would cost almost 2.5 times than in 2008, truck average cost would increase by less than 50% thanks to improved efficiency. This slight impact on road freight is reflected in the marginal mode shift, as previously described.

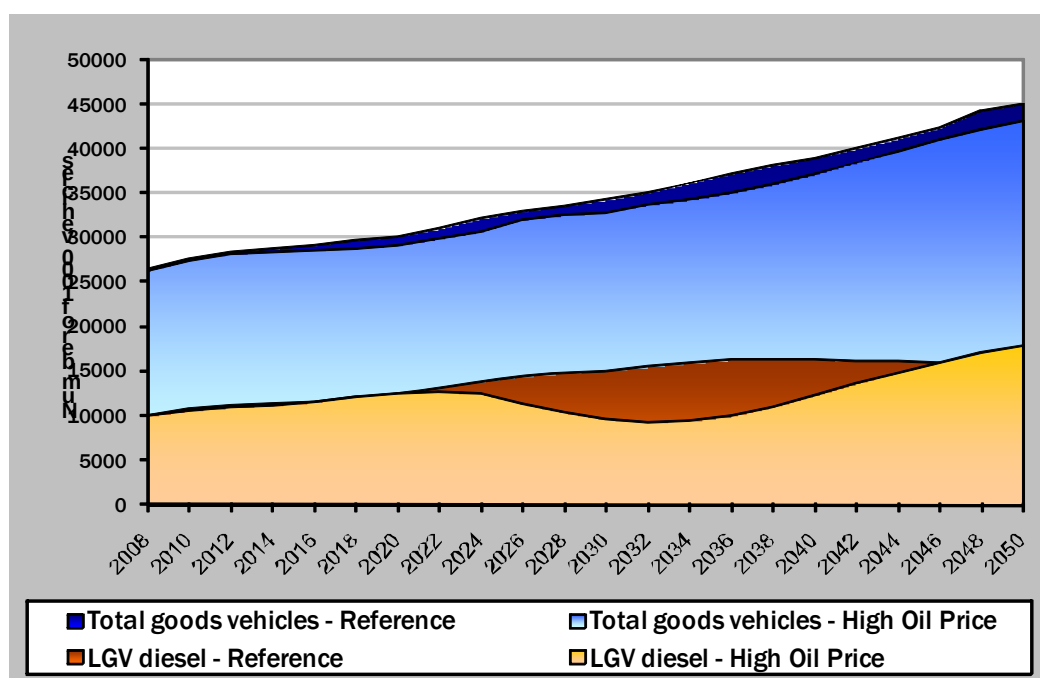
Fig. 5.7 Trend of average unitary cost of road freight vehicles (index on base year 2008)



Source: ASTRA calculations in HOP! (Fiorello et al., 2008)

Again above, another expected impact of high oil price on the freight transport sector is an accelerated renewal of the road goods vehicles fleet. At the same time, the increased efficiency of road transport (less empty trips, higher average loads) allows haulers to downsize their fleet without reducing their level of supply. Therefore, the stock of good vehicles should be smaller if oil price is higher than in the reference scenario, even in case the difference is not significant, while the fleet composition is also changing. Figure 5.8 indicates that the total number of vehicles is lower in case of high oil price and that diesel LGVs are less and less used after oil peak for a dozen of years, when are replaced by heavy vehicles, which became more attractive as costs are lower using one large truck instead of two light vehicles. Later, thanks to improvements in load optimisation and in fuel efficiency, diesel LGVs are expected to recover their competitiveness and market share.

Fig. 5.8 Trend of EU-27 goods vehicles fleet and LGVs diesel



Source: ASTRA calculations in HOP! (Fiorello et al., 2008)

5.4 Some transport policy impacts of high oil prices

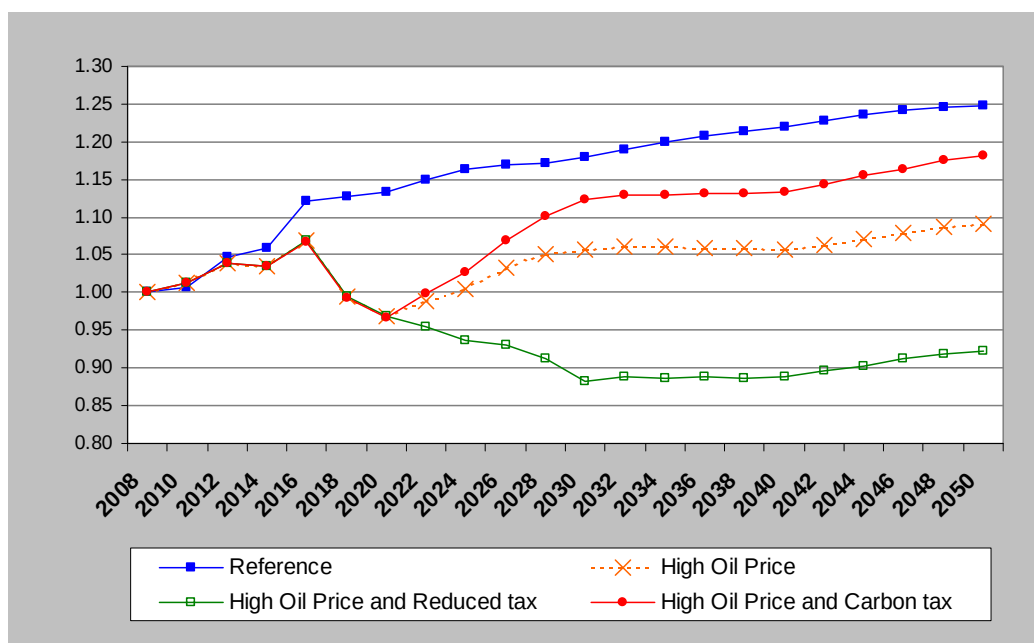
In the HOP! project, the application of a carbon tax (40 Euros in 2030 per ton of CO₂ emitted) or a discount of fuel excise duty (reduction by 20% after 2020) has also been tested. The results demonstrate that both measures would not affect significantly the trend of fuel prices. In fact, the average cost of trips would be changed only by 1% or 2%. Not surprisingly, such minor differences are not expected to cause significant changes in transport demand.

The impact of an excise duty discount could on the other hand be not as low if the revenues from fuel taxes are considered. In the tested scenario, revenues are reduced to even a lower amount than in the year 2008 (see Figure 5.9). This result may have some significant implications for transport policy. Using the leverage of pricing and taxes to lead the transport system towards sustainability is one priority of European policy as well as of the national policies of at least some Member States. The effectiveness of pricing policies is linked to other objectives like fairness (e.g. polluters pay), but also to financial considerations, since transport taxes provide a significant contribution to public budgets.

For instance, the Dutch Government has been studying a reform of transport taxation where fixed taxes like registration taxes are abolished, and the use of vehicles is charged for, and, at the same time, this guarantees budget neutrality. Car-ownership fixed taxes amount to something less than 20% of total transport tax revenues in the EU-27. When fuel tax revenues are reduced as an effect of lower fuel consumption due to higher oil prices, eliminating car-ownership fixed taxes would cut total revenues by about one third or more with respect to current values. At the same time increasing fuel taxes to offset the loss could be politically impracticable. On the other hand, reducing fuel taxes as a policy tool to alleviate the impact of fuel prices on motorists and firms would be even more problematic in budget terms.

This suggests that taxes or discounts which are able to affect prices significantly could become politically impracticable in one sense or another: either because to impose high carbon taxes on the top of high resource fuel costs would be very unpopular, or because the reduction of revenues for the public sector would be too large. This effect may be seen in current developments in British transport policy, where perceptions of high fuel prices have induced the government to cancel some of its proposed tax increases on fuels for environmental purposes.

Fig. 5.9 Trend of EU-27 transport fuel tax revenues



Source: ASTRA calculations in HOP! (Fiorello et al., 2008)

5.5 Summary of key messages for future scenarios

This chapter draws some key messages for future scenarios, based on the outcomes of the HOP! project, where the expected impacts of high oil prices on the economic, energy and transport sectors have been estimated by means of a modelling approach.

According to the forecasts, one can assume that probably that future oil price shocks will also tend to reflect resource scarcities to a larger extent than the shocks of the 1970s, which means that current and future oil price shocks are more serious than past ones. This is, however, associated with the opposite trend which does not highlight the fact that the oil intensity of the economy has halved over the past 30 years in developed countries, but

also that the potential for introducing valid alternative to oil is much higher than in the past. Consequently, oil price shocks have less potential to influence the whole economy.

The overall conclusion drawn up by HOP! project is that high oil prices may have a relevant economic impact in the short-term but a more limited impact in the medium/long-term; only in case of long-standing world recession or situations with insufficient energy supply these negative impacts may be multiply by factors of five to ten.

In this context, the study has demonstrated how investments into energy efficiency and alternatives may be regarded as the most crucial factors for counterbalancing the negative impact of high oil prices. In fact, they may (i) directly provide a positive stimulus for the economy as part of final demand, and (ii) indirectly they help to reduce the vulnerability of the economy to oil price increases by reducing energy demand.

Looking specifically to the transport sector, larger effects are expected on the passenger side rather than on the road freight side. This is why the responsiveness of the freight transport sector is expected to slow down the growth pace of tkm with respect to the reference case. When transport costs increase, local suppliers become more competitive with respect to competitors from other regions and countries, therefore transport of goods between regions would be reduced.

At the same time the production of goods should be increased in sectors like energy and construction that generates significant amounts of bulk goods often travelling on shorter distances, which implies that transport of goods within regions increase especially in terms of tonnage. The combination of these two effects is to shorten the average distance of transported goods but furthermore to increase the amount of tons transported. Even a sharp increase of oil price on road hauling costs would not reduce extensively the market share of trucks, because on short distances road transport has no alternatives and in any case fuel price is only a part of overall transport costs, while its growth may be contrasted thanks to organisational improvements and more energy efficient vehicles.

For the same reasons, the impact of a discount on excises would not be significant for the competitiveness of road freight transport. Since a discount could decrease significantly fuel tax revenues, lowering fuel taxes as a policy tool to alleviate the impact of fuel prices on motorists and companies could be not very effective and quite problematic in budget terms. On the other hand, also increasing transport costs using the leverage of pricing and taxation for a more sustainable transport policy might have additional difficulties, in a context of high oil prices.

Finally, another expected impact of high oil price on the freight transport sector may be a faster renewal of the road freight vehicles fleet. Simultaneously, the higher efficiency of road transport would enable haulers to downsize their fleet without reducing their level of supply.

CHAPTER 6 Conclusions

6.1 The impacts of oil price across the modes of transport

Overall, the impact of oil prices on transport sector depends upon the following three elements, which have been analysed throughout the study: (i) the relevance of the oil price on the cost of the energy used for each transport mode; (ii) to what extent oil price is transferred to transport fuel prices; (iii) the relative weight of the energy cost on total operating costs for each mode.

- (i) The scarce availability of oil substitutes in the transport sector 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, freight modes are still heavily dependent on oil-based fuel. Even though road modes have significantly improved their efficiency through the years, maritime transport and rail continue to be the most energy-efficient transport modes per single traffic unit performed.
- (ii) The majority of transport operators has been affected by the development of crude oil prices over the last four years. However, the relation between oil and fuel costs is not direct as it is influenced by other elements, such as production, distribution costs, and specially taxes. For road transport in the EU, where the fuel taxation accounts for 48% of the total price, a surge of oil price weighs partially upon the final fuel costs (40%). Whereas due to the absence of taxation and lower distribution and refining costs, the variation in the price of crude oil affects directly the jet fuel, marine bunker and gas oil used in inland navigation.
- (iii) Fuel cost is only one of the main components of total transport costs and its role in total freight transport costs differs by type of shipment, distance, load factors, but also per country. Last available data (2008) for freight road reports a share of fuel cost accounting 25% of the total transport costs. This share may change in those European countries where labour costs are more relevant. Fuel costs as a share of total operating costs in the aviation sector account for 33% (2008). Finally, the share of bunker costs in the daily running costs of a ship is the most substantial accounting for 50% of total transport costs.

Tab. 6.1 Sensitivity of transport costs to crude oil price

	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 freight - diesel	~40%	27%	~10%
Rail freight - electric	~15%	12%	~2%
Inland waterways	~100%	21%	~25%
Maritime	~100%	50%	~50%
Aviation	~100%	33%	~33%

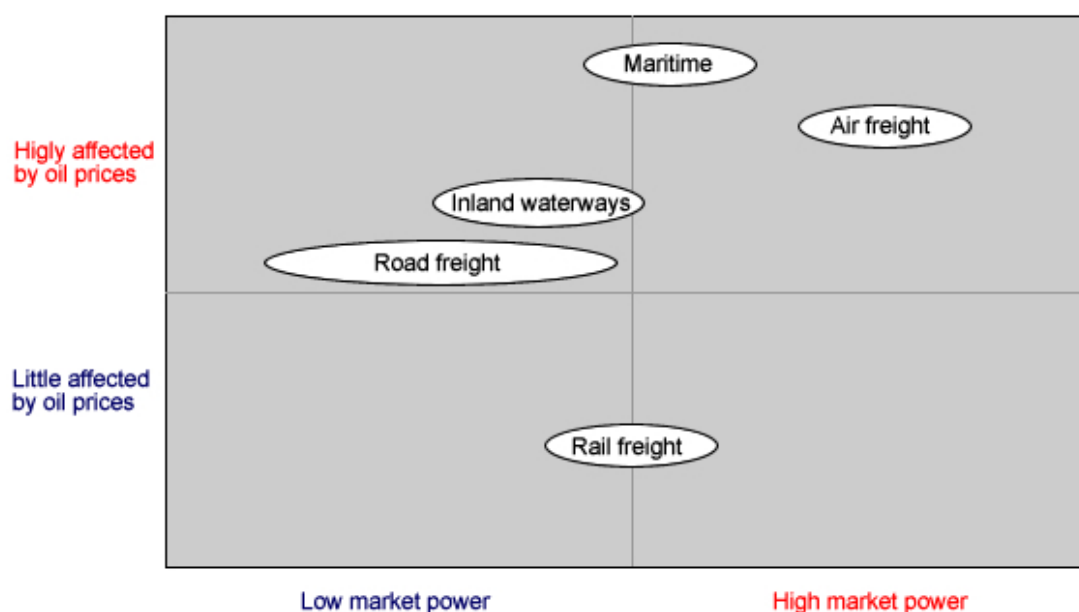
Note: Elaboration on data from tables 2.1 and 3.4.

Table 6.1 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: the most affected modes of transport are maritime, aviation and inland waterways.

6.2 The reaction of the freight transport sector

The second part of the study was focussed on the analysis of how the increase of energy prices until July 2008 has influenced the costs of transport and the prices charged for transport services. It is quite obvious that the different modes of freight transport were affected in different ways, according to their dependence on petroleum products as well as on the operators' capability to pass the higher fuel costs to their users, which very much depends on their market power. The next figure (6.1) illustrates the relation between market power and level of affection by oil prices: small transport companies in road (driver/owner) and inland shipping have substantially lower market power than large companies (third-party logistics providers). Table 6.2 at the end of the paragraph summarises the measures undertaken in freight transport sector to tackle the negative effects of higher transport costs caused by energy costs.

Fig. 6.1 Sensitivity to oil prices and market power



Source: Ecorys, 2006

Even considering that the impacts of recent high oil prices on freight demand volumes may hardly be assessed because of the relatively short period of oil price hikes, it is worth to notice that road freight transport demand does not seem to have been affected to a large extent. This is explained by the fact that transport costs represent a small part of the final price of goods, ranging from 1% to 10% of final product value.

Road

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 in road sector. Indeed, almost one out of three European operators has declared an increase in transport costs of more than 20% because of higher fuel prices. According to data collected for the period 2004-2008, the share of fuel costs in the total transport costs increased on average by four/five percentage points.

Data collected in the study have shown that the rise in transport costs has not been followed by an equivalent increase in tariffs for many road haulage companies. Higher transport costs have been absorbed by reducing profit margins, leading to an overall lower profitability of the sector.

In response to this context, some strategies have been undertaken by freight operators, mainly focused on energy improvements: permanent cost management, instalment of own diesel tanks, and consumption reductions. Here, the experiences of collaboration amongst shippers, such as the “Sustainable Distribution Initiative” in the United Kingdom, have been proved to work successfully.

Aviation

The analysis of the aviation sector doesn't distinguish between passengers and cargo, as most of the freight service is provided by scheduled passenger services. In this sector, fuel costs represent a significant share of transport costs (33%) and crude oil prices have a direct impact on jet fuel prices due to the absence of taxation. Indeed, air companies have doubled their expenditure on jet fuel since 2004 and - in general - higher costs have been absorbed through efficiency measures rather than increases in flight prices. More recently, air cargo companies have reacted by applying fuel surcharges, sometimes exceeding the basic freight transport rate.

During 2008, a number of airlines have announced structural capacity cuts, in particular from the 2008-2009 winter timetable, and immediately grounded their aircraft on unprofitable or marginally profitable routes. Network adjustments were addressed by all carriers, whereas pricing strategies seem to range from generalised increases in ticket prices (e.g. fuel surcharges) and induced changes in air travel behaviour by price sensitive flyers (i.e. by increasing baggage charges).

Rail

High oil prices have been far less of a problem for rail transport: fuel oil is a very small percentage small percentage of total rail operating costs. However, rail freight faces a very significant set of capacity problems and so rail has only a very limited ability to expand market share. Railway operators usually transfer these cost increases to their customers, even if, in the short term, many rail freight operators have had very limited options to react.

Maritime

Maritime transport represents the largest freight modal share, being 76% of the total EU-related tkm and the most energy-efficient mode, but it is also the sector more sensitive to oil price increases. An increase of oil prices impacts directly on marine bunker fuel due to absence of taxation and low distribution and refining costs. Furthermore, in the first half of 2008, fuel costs have gone up to roughly 50% of total shipping costs. Nevertheless, the shipping sector has been but slightly affected and trade flows have not been slowed down by increased oil prices. Recent drops in freight rates are the consequence of the world economic crisis. The growth of traffic flows up to mid-2008 has been led by the strong

world demand in the bulk (commodities) and containerised sectors and the related high level of competition which has imposed a declining trend in freight rates in real terms.

Tab. 6.2 Overview of measures to respond to the effects of increasing oil prices

Sector	Objective	Intervention	Implementation barriers	Potential role for government
Road	Passing on higher energy costs to users.	Use of the fuel surcharge and inclusion of rate adjustment clauses in annual contracts.	Market fragmentation.	Low
	Improve vehicle load factors.	Reduction of the % of empty trips and rightsizing of the fleet operated.	Strong opposition to the “mega truck” concept.	Low
	Fleet renewal.	Replacing the old fleet with more energy efficient vehicles.	Difficult in particular for the owner-driver to invest in the short-term.	High
	Reduce fuel costs in operating the existing fleet.	Wider knowledge and use of fleet management and energy saving measures (e.g. predictive maintenance, tyre management, vehicle adaptation, etc.). Investments in electronic devices, filters and telematics. Ecodriving training.		Medium
	Network redesign.	Integration of intermodal short-sea and rail freight services for long distances.		High
	Cooperation strategies.	Vehicle sharing agreements, procurement communities.		Low
Rail freight	Passing on higher energy costs to users.	Use of the fuel surcharge and inclusion of rate adjustment clauses in annual contracts.		Low
	Improve service attractiveness.	Reducing delivery times.		High
Aviation	Passing on higher energy costs to users.	Use of the fuel surcharge and inclusion of rate adjustment clauses in annual contracts.		Low
	Fleet renewal.	Replacing the old fleet with more energy efficient aircraft.		Low
	Insure the risk of higher oil prices.	Improve jet fuel hedging strategies.		Low

Maritime	Passing on higher energy costs on users.	Bunker adjustment factors.		Low
	Cut down fuel costs in operating the fleet.	Decrease vessel cruising speed. Use of shore-side facilities in port.		Low
	Cooperation strategies	Vessel sharing agreements.		Low
Inland navigation	Passing on higher energy costs on users.	Use of the fuel surcharge and inclusion of rate adjustment clauses in annual contracts.	Market fragmentation	Low
	Fleet renewal.	Replacing the old fleet with more energy efficient inland vessels.		High

6.3 Government measures

At European Union level, policy actions have been initiated in a reaction to the hikes in oil prices occurred along the 2008, and after the protests moved across Europe over the same year. The EU has acted preparing both long term and short term policy responses, including tax breaks for energy savings and increased transparency of oil inventories. These measures are expected to be enacted in the near future within the green taxation package.

Most of the recent Governments' responses have tried to protect the road freight transport hauliers by the sudden increase of the diesel price, by earmarking such raises to the transport prices (see for instance the "Diesel clause") and introducing automatic adjustment mechanism of transport tariffs on the basis of the diesel price. Lastly, it has also to be stressed that on the whole EU countries have not implemented fuel tax relieves or fiscal compensation during the last period of higher crude oil prices.

6.4 Future scenarios

In its last interim Economic Forecast Report of January 2009, the European Commission has revised its economic forecast for 2009, predicting long-lasting recession: Europe GDP is expected to shrink of 0.1% in 2009. Reflecting the impact of the fiscal packages and monetary easing, economic growth is expected to turn positive in 2010, but remaining still relatively subdued until the end of 2010 with an annual growth of only 0.4 %. In this situation, pressures to reconsider strategies and EU priorities in investing in more energy efficient transport system may emerge. Also, the downward trend in oil prices makes new technologies less competitive than traditional ones. Indeed, the drop of oil prices and the current economic crisis are already posing problems, for example, for the alternative energy sector. As oil prices goes down, so do the incentives for people to buy more expensive renewable energy.

On the other hand, facing the challenges of climate change and obtaining secure access to diminishing resources of oil are still on the agenda of the European Union. At this regard, spending in green technology and energy efficiency represents the opportunity to stimulate the economy in short-term and being sustainable over the long-term.

This is crucial considering that in the mid to long term, oil prices may go up, (i) as oil production has already peaked in many areas of the world, and (ii) oil price falls are delaying the development of new fields and this can lead to more severe constraints on oil supply in the future.

Another possible cause of oil supply shortages may be geopolitical tensions, which are currently rising in Russia and the Ukraine and in the Middle-East. In a situation of low oil production capacity, any peak of oil demand can create at least problems of volatility, which would hamper any kind of investment, not only in the oil sector.

Box 6.1 Oil price development

The study has analysed the impact of oil price changes across transport modes by taking as reference the continuous oil prices rises which occurred from 2003 until July 2008. Since that date, oil prices started to sharply decline below 50 US\$/barrel, due to the global economic crisis and demand contractions. Many analysts warn that, as for any commodity price crash, the oil price downturn carries the seeds of its own reversal and it may come unexpectedly quickly this time. Indeed, low prices and tight credit are not only hurting economically marginal projects, such as those related to unconventional oil (tar sands, oil shales, etc.) – even some conventional deepwater oilfields no longer meet oil companies' investment criteria. The International Energy Agency estimated that projects worth 100bn US\$ have been shelved in the last year. Different problems are being faced by renewable energy companies, as most of these require high investment capital. A third element worth mentioning is oil price volatility, which may temporarily reduce aggregate output because it may delay business investment by raising uncertainty or inducing costly sectoral resource reallocation. In brief, the short term relief of plunging oil prices is being provided at a cost of serious long term harm. Indeed, there is a general consensus among the experts that an increase in energy prices should be regarded as a structural condition and the latest World Energy Outlook, prepared yearly by the IEA in Paris (IEA, 2008), assumes a 2030 reference scenario of high oil prices.

The high oil price scenario simulations presented in Chapter Five suggest that future oil price shocks will tend to reflect resource scarcities to a greater extent than the shocks of the 1970s, which means that future oil price shocks may be more serious than the past ones. Nevertheless, oil price shocks have less potential to influence the whole economy because of the lower oil intensity of the economy and a higher potential for introducing valid technological alternatives than in the past.

The impact of high oil prices on the economy may be relevant in the short-term but more limited in the medium/long-term. Mitigating the impacts by investing in energy efficiency and alternatives could even lead to a positive economic impact in the medium to long-term, while a world recession or a situation with insufficient energy supply could multiply the negative impacts by factors of five to ten.

Investments in energy efficiency and alternatives may be regarded as the key factor for dampening the negative impacts of high oil prices as they may (i) directly provide a positive stimulus for the economy as part of final demand, and (ii) indirectly help to reduce the vulnerability of the economy to oil price increases by reducing energy demand.

Looking at the effects of high oil prices specifically on transport, the impact will be stronger on personal mobility than on freight transport because of the higher rigidity of freight

traffic, which is strictly linked to the behaviour of the economy. Transport cost increases will provoke a slow down in trade but it is expected to be small because of less pronounced impact of oil prices on transport costs. At the same time, high oil prices are expected to have a different impact on economic sectors with increased production in sectors like energy and construction, which generates significant amounts of bulk goods often travelling over shorter distances. The result will be to shorten the average distance of transported goods, but at the same time to increase the number of tons transported.

6.5 Suggested measures

The policy response to high oil price situations should be sufficiently prompt in order to allow the EU economies to adapt to the new environment. To be effective, the policies should cover all modes of transport and should include ambitious fuel-efficiency targets, improved standards for vehicles and fuels, reductions in road and air transport activity through pricing, logistics and behavioural changes. The three main mutually supporting policies are:

- Technological improvement (use of new vehicle technologies and alternative fuels),
- Pricing and taxation (reform of road vehicle taxation, road pricing, Eurovignette),
- Soft and eco-friendly measures (ICT, transport demand management, logistics measures) able to optimise the use of private vehicles, improve the use of public transport as well as to promote behavioural changes.

The following table (6.3) indicates in more detail the main recommendations, showing how and in which way the EU can contribute to the implementation of the measures.

Tab. 6.3 Recommended measures to improve energy efficiency

Measures	Best level to act	How can EU contribute
Compulsory targets for CO ₂ emissions of cars and vans.	EU	Community strategy to reduce CO ₂ emissions from light commercial vehicles.
Improve alternative fuels and energy efficiency.	EU Member States	Promotion of energy efficiency in all transport modes Promotion of alternative fuels.
Reform of road taxation.	EU Member States	Redefinition of road vehicle registration tax and annual circulation tax by linking taxation to CO ₂ emissions and energy consumption.
Road pricing for long distance freight.	EU Member States	Toll differentiation according to vehicle weight and environmental performance and extend it to the entire interurban road network.
Information Communication Technology.	EU Member States	Promotion of ICT research and development applications on freight transport services and infrastructure management.
Improve efficiency in logistics.	EU Local	Support for cooperative logistics schemes Support for city logistics schemes.
Eco-driving .	EU Member states	Promotion of European strategy for improving driving behaviour for energy efficiency and traffic safety.

Source: Elaboration on TRT, 2007

7. Bibliography

- AEA (Association of European Airlines), *State of the Industry, Emissions Trading Scheme and Single European Sky*, 17.9.2008, <http://www.aea.be/research/economics/index.html>.
- Casamassima G., *Scenari energetici e prospettive per il sistema dei trasporti*, Quaderno 13, Ricerche e Trasporti, 2008, www.ricerchetrasporti.it.
- 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.
- Clarkson Research Services, *Shipping Review & Outlook*, London, 2001, 2006, 2008.
- CNR (Comité National Routier), *Enquete long distance 2007*, 4/09/2008, www.cnr.fr.
- CNR (Comité National Routier), *Evolution du prix du gazole et incidence sur le prix de revient, situation au 30 septembre 2008*, 2008.
- Council Directive 2003/96/EC of 27 October 2003 restructuring the Community framework for the taxation of energy products and electricity. OJ L 283 of 31.10.2003.
- CSST (Centro Studi Sistemi di Trasporto), *Indagine e monitoraggio sui costi e fiscalità*, 2006 and 2008, www.alboautotrasporto.it/adm/Media//SintesiCostiFiscal.pdf.
- 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, www.eia.doe.gov/oil_gas/petroleum/info_glance/petroleum.html.
- European Central Bank, Statistical Data Warehouse, <http://sdw.ecb.europa.eu/>.
- European Commission, DG TAXUD, European taxation data, 2008 http://ec.europa.eu/taxation_customs/taxation/excise_duties/energy_products/legislation/index_en.htm.
- European Commission, *EU Energy and transport in figures 2007/2008*, Statistical Pocketbook 2008, Luxembourg, 2008.
- European Commission, Communication from the Commission: Freight Transport Logistics Action Plan, COM(2007) 607 final, Brussels, 18.10.2007 http://ec.europa.eu/transport/logistics/freight_logistics_action_plan_en.htm.
- European Commission *The effects of fuel price changes on the transport sector and its emissions simulations with TREMOVE*, Jacques Delsalle, DG ECFIN Economic Papers N° 172 July 2002.

- European Commission – DG ECFIN - Interim Economic Forecast, Brussels, January 2009, http://ec.europa.eu/economy_finance/db_indicators/db_indicators9237_en.htm.
- European Environment Agency, EEA Report No 1/2008, *Climate for a transport change. TERM 2007: indicators tracking transport and environment in the European Union*, Copenhagen, 2008.
- European Transport Barometer of the year 2008, July 2008.
- EUROSTAT, Jelle Bosch *Panorama of Energy*, Luxembourg, OPOCE, Edition 2007.
- EUROSTAT, Glen Campbell *Panorama of Transport*, Luxembourg, OPOCE, Edition 2007.
- Fiorello D., Martino A., Schade W., Walz R., Schade B., Wiesenthal T. (2008): High Oil Prices: Quantification of direct and indirect impacts for the EU - Summary. Deliverable 5 of HOP! (Macro-economic impact of high oil price in Europe). Funded by European Commission 6th RTD Programme. Milan, 2008, www.hop-project.eu.
- ICEG European Center, Gábor Pellényi *The Impact of Sustained High Oil Prices on Trade Flows*, August 2007.
- INFRAS-IWW, *External costs of transport: update study*, Final report Karlsruhe/Zürich/Paris, October 2004.
- IATA (International Air Transport Association), *Medium Term Outlook for Oil and Jet Fuel Prices*, October 2008, www.iata.org.
- IATA (International Air Transport Association), *Industry Financial Forecast*, September 2008.
- IEA (International Energy Agency), *World Energy Outlook 2008*, Paris, 2008.
- IMF (International Monetary Fund), *World Economic Outlook 2005. Chapter 4: Will the oil market continue to be tight?*, 2005.
- IRU (International Road Transport Union), *Resolution on the fuel price crisis*, Brussels 26.6.2008.
- IRU (International Road Transport Union), *Analysis of the influence of fuel price development on bankruptcy rates*, Genève 15 February 2008.
- IRU (International Road Transport Union), *Efficient cost management – A key to success*, Genève 30 July 2007.
- Lloyd's Register–Fairplay, *Shipfinder Online Service*, 2008 (<http://www.shipfinder.org/>).
- NEA, Transcare, *Factorkosten van het goederenvervoer: een analyse van de ontwikkeling in de tijd*, 2004, www.verkeerenwaterstaat.nl/english/.
- Newing R., *Finding better ways to deliver the goods*, in "Financial Times Special Report – Sustainable Business", 9.10.2008.

- PricewaterhouseCoopers, Carrie Yu, *Global Sourcing: Shifting Strategies A Survey of Retail and Consumer Companies*, 2008.
- Ryanair, *Financial Report 1st Quarter results*, 2008.
- Rubin J. and Tal B. (CIBC World Markets), *Will Soaring Transport Costs Reverse Globalization?*, in "StrategEcon, pages 4-7, 27.5.2008.
- Schade W., Fiorello D., Beckmann R., Fermi F., Köhler J., Martino A., Schade B., Walz R., Wiesenthal T. (2008): High Oil Prices: Quantification of direct and indirect impacts for the EU. Deliverable 3 of HOP! (Macro-economic impact of high oil price in Europe). Funded by European Commission 6th RTD Programme. Milan, 2008, www.hop-project.eu.
- 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.
- TNO-TML, *EC study on long and heavy vehicles in the EU*, 2008, http://ec.europa.eu/transport/strategies/studies/strategies_en.htm.
- TRT Trasporti e Territorio for JRC-IPTS, *ECOTRA - Energy use and COst in freight TRANsport chains*, Final Report, Milano, 2006.
- TRT Trasporti e Territorio for European Parliament's Committee on Transport and Tourism, *Energy and environmental aspects of transport policy*, PE 389.598, Brussels, 2007, <http://www.ipolnet.ep.parl.union.eu/ipolnet/cms/lang/en/pid/456>.
- TRT Trasporti e Territorio for Italian Central Bank, *Sample survey on the international transport for the period 2005-2007*, Milano, 2008.

DIRECTORATE-GENERAL FOR INTERNAL POLICIES

POLICY DEPARTMENT **B** STRUCTURAL AND COHESION POLICIES

Role

The Policy Departments are research units that provide specialised advice to committees, inter-parliamentary delegations and other parliamentary bodies.

Policy Areas

- Agriculture and Rural Development
- Culture and Education
- Fisheries
- Regional Development
- Transport and Tourism

Documents

Visit the European Parliament website: <http://www.europarl.europa.eu>

PHOTO CREDIT: iStock International Inc., Photodisk, Phovoir



ISBN