



Hamburgisches  
WeltWirtschafts  
Institut

# MARITIME TRADE AND TRANSPORT LOGISTICS

## Strategy 2030

CAPITAL AND LIFE IN THE  
— NEXT GENERATION. —  
— AN INITIATIVE —  
OF HAMBURG INSTITUTE OF  
INTERNATIONAL ECONOMICS  
— AND BERENBERG BANK —

*Private Bankers*  *founded 1590*

**BERENBERG BANK**

*John Berenberg, Gossler & Co. KG*





Hamburgisches  
WeltWirtschafts  
Institut

## **Maritime Trade and Transport Logistics**

### **HWWI (Part A)**

Perspectives for maritime trade –  
Cargo shipping and port economics

### **Berenberg Bank (Part B)**

Perspectives of maritime trade and transport logistics –  
Strategies for companies and investors

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Authors:

Dr. Harald Grossmann, Dr. Alkis Otto, Dr. Silvia Stiller, Jan Wedemeier (Part A)  
Cornelia Koller, Wolfgang Pflüger, Axel-Adrian Roestel (Part B)  
Translated by: Susan Salms-Moss, Mannheim, for SIMCONSULT Partnerschaft Hamburg  
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In part, we have drawn upon information collected by others. Certain data may no longer be correct,  
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We can therefore take no responsibility for guaranteeing that all information is accurate,  
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Available from:

Berenberg Bank · Public Relations  
Neuer Jungfernstieg 20 · 20354 Hamburg · Germany  
Telephone +49 (0) 40-350 60-122 · Telefax +49 (0) 40-350 60-907 · E-mail: [presse@berenberg.de](mailto:presse@berenberg.de)

## Strategy 2030 – Capital and life in the next generation

### »Everything flows«

(HERACLITUS OF EPHEBUS, GREEK PHILOSOPHER, ABOUT 540-480 B.C.)

The world is advancing toward a new era. Far-reaching macroeconomic and geopolitical trends will be changing both the lives of people in the next generation and the ways in which they manage their finances.

These include the new dimension of religiously motivated terrorist threats to Western democracies, the introduction of the euro as an international currency coupled with the expansion of the European Union, the emergence of new major economic players in Asia (People's Republic of China, India) with inevitable consequences for the commodities and capital markets, and especially the challenges of a rapidly aging population in many industrialized nations with all of its ramifications for public finances, social systems, labor organizations, location decisions, etc.

All of this is taking place in the context of continued leaps in technology in a globalizing economy. Consequently, political, social, technological and economic changes are occurring with increasing rapidity. Furthermore, they have a reciprocal effect – sometimes intensifying but sometimes inhibiting one another – and thus seem more and more complex and less tangible. This is all the more so because they extend far into the future, in the case of demographic change even across generations.

Despite all of this incertitude, one thing is clear: Politicians, entrepreneurs, and private individuals must consider these profound changes as they plan for the future.

Seeking out navigation signposts, identifying them as such, and describing possible routes as well as destinations certainly constitute a rewarding endeavor. The series entitled Strategy 2030 – Capital and Life in the Next Generation, jointly published by the Hamburg Institute of International Economics (HWWI) and Berenberg Bank, is dedicated to this effort. It unites the expertise of economic analysts recognized beyond the borders of our country and the comprehensive experience of a private bank that holds a leading position in asset management.

We hope to have provided readers with a study that is interesting and useful.

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## Part A

### Perspectives of maritime trade – Cargo shipping and port economics

#### **HWWI**

## Summary

Global economic development in the past decades has been characterized by a rapidly progressing intensification in world trade and international division of labor. In recent decades, as a result of the expansive development of international merchandise trade, cargo shipping has been one of the fastest growing economic sectors. The progressive global integration processes, the future reduction in trade barriers, and the expected increase in prosperity in numerous regions of the world will also call for a marked expansion in world trade and cargo shipping. This designates maritime logistics as an economic sector with favorable perspectives for development. The present study – using as a starting point a forecast of the development of world trade up to the year 2030 – deals with development trends in cargo shipping and the related impact on ports in the European trade areas.

An HWWI forecast model shows an average annual real growth rate for EU foreign trade of 6.6%, while predicting that trade with East Asia and the Pacific region will yield higher growth (+9.2% p.a.) than that with the industrialized countries (+5.9% p.a.) The forecast assumes that, with a 6.6% annual growth rate in trade in the EU, the trade volume determining transport volume will increase by 3.3%. With an unchanged modal split in the movement of goods, this would mean that the overall volume of shipment by sea would increase by approximately 125% between 2005 and 2030. Since the proportion of containerized goods will continue to climb appreciably, ports at which container shipments account for a large share of the total goods handled will profit especially from the growth in maritime transport. By the year 2030, above-average growth in total cargo handling could therefore be recorded, for example, at the ports of Bremen, Felixstowe, Gioia Tauro, Valencia and Hamburg.

# 1. Introduction

Hardly any other development in recent decades has had a greater effect on people's daily life and added more to prosperity in large parts of the world than the rapid intensification of world trade and international division of labor. This dynamic development would not have been possible if significant technical and technological advances in shipping had not been achieved at the same time. The brisk increase in demand for transport by trading nations was met by the availability of appropriate services on the part of shipping lines. Progress in maritime shipping, the primary mode of transport for intraregional and intercontinental trade, should be mentioned especially here. In the year 1600, an estimated 1,000 trading vessels with a load capacity of approximately 90,000 tons (t)\* traversed the Hanseatic region – and that was already 50% more than a century before.\*\* Today the world's largest container ship, the *Emma Maersk*, alone has a capacity of approximately 157,000 t.

As early as the Hanseatic period, from middle of the 12<sup>th</sup> to the 17<sup>th</sup> century, maritime traffic permitted an intensive exchange of goods between regions and nations. During its heyday, the Hanseatic League comprised some 200 ocean and river ports in Northern Europe. Due to the advantages derived through the interregional exchange of goods, being situated on the sea or a river was an important factor in the economic development of a city. This explains why so many major cities on the North Sea and the Baltic were established in such locations. In other parts of Europe, too, as well as on other continents, numerous cities are located at the water, their ports serving as the basis for their economic development.

The harbors in these cities have experienced a remarkable transformation through the centuries. As in maritime shipping, these ports have adapted to changing requirements over time

\* Here and in the following, the term "tons" refer to "metric tons" and will be abbreviated as "t."  
\*\* See Zimmerling (1979).

and have consistently modernized and expanded their facilities and capacities. Complementary industries and service providers have settled in the proximity of the ports, making harbors into an important economic factor in their regions, above and beyond their role in trade. More recently, the volume of world commerce and modern logistical concepts have also lent an economic significance, especially to today's large ports, that extends beyond the borders of the city or region. In the international movement of goods, they function as collection and distribution centers that link the world's trade regions. The expected ongoing expansion in world trade up to the year 2030 will, in its wake, make port economics into one of the business sectors that will maintain healthy development perspectives in the coming decades.

This study deals with the development of cargo shipping and the related effects on ports in the European trade areas up to the year 2030. To begin with, the historical development and the structure of international and maritime trade will be portrayed, whereby the emphasis will be placed on an analysis of trade relations of the EU. This descriptive analysis will be followed by theoretical explanations for international trade. Subsequently, a portrayal of the European shipping areas and the structure of their ports will be presented, as well as an analysis of the most recent developments in the leading ports. In addition, the fundamental determinants of developments in port economics will be discussed. An analysis of EU foreign and maritime trade, as well as of the ports in Europe, will serve as a basis for predicting EU foreign and maritime trade up to the year 2030. Founded on this scenario, a forecast will be made of the potential effects of expanding maritime trade on growth in handling volume at the major European ports up to 2030.

## 2. Development, structure and determinants of international trade

### 2.1 Development and structure of world merchandise trade

The development of international merchandise trade progressed at an exceedingly dynamic rate during the postwar period. Between 1950 and 2000, trade volume increased an average of 6% annually. At 6.8%, the annual growth rate in the 1990s was higher than average. Following a drop in merchandise trade in 2001, this positive trend has continued during the past few years.<sup>1</sup> A comparison with the development in gross domestic product manifests a close association between international trade and gross domestic product, whereby trade in goods has shown a much greater increase over time than production (see Fig. 1). This development has been driven by progressive globalization and the intensification of the international division of labor (see also Box 1).

World merchandise trade is distributed rather disproportionately among the individual countries. In 2004, the ten leading export nations (Germany, USA, China, Japan, France, Netherlands, Italy, UK, Canada and Belgium) accounted for almost 55% of the world merchandise trade (see Fig. 2). In imports, in fact, a share of over 57% fell to these countries. Since the early 1990s, Chinese foreign trade, in particular, has increased appreciably. It has grown twice as rapidly as world trade as a whole. With a share of 6.5% of world exports and 5.9% of world imports, China is now the world's third largest exporting and importing nation. The other nine countries have long been among the leading trading nations. Their cumulative share of world trade has, however, decreased over time. This can be ascribed to the fact that the exchange of goods between the other countries has grown more than trade involving the nine countries.

<sup>1</sup> See WTO (2005a) for the development of trade volume. Please note that trade volume in WTO statistics is measured by a quantity index. See WTO (2005b) for a calculation of trade volume.

#### Annual change in world trade volume and gross domestic product in %

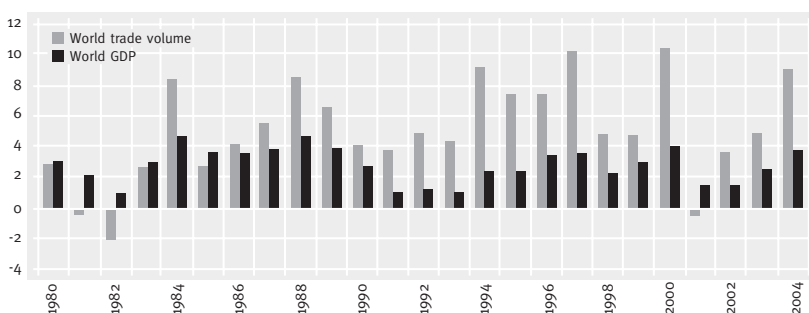


Fig. 1

Source: WTO (2005a).

## The leading exporters and importers in world merchandise trade, 2004

Rank	Exporting Country	Value in US \$ bn	Share in (%)	Rank	Importing Country	Value in US \$ bn	Share in (%)
1	Germany	912.3	10.0	1	USA	1,525.5	16.1
2	USA	818.8	8.9	2	Germany	716.9	7.6
3	China	593.3	6.5	3	China	561.2	5.9
4	Japan	565.8	6.2	4	France	465.5	4.9
5	France	448.7	4.9	5	UK	463.5	4.9
6	Netherlands	358.2	3.9	6	Japan	454.5	4.8
7	Italy	349.2	3.8	7	Italy	351.0	3.7
8	UK	346.9	3.8	8	Netherlands	319.3	3.4
9	Canada	316.5	3.5	9	Belgium	285.5	3.0
10	Belgium	306.5	3.3	10	Canada	279.8	2.9
Exporting countries 1–10		5,016.1	54.8	Importing countries 1–10		5,422.7	57.1
World exports		9,153.0	100.0	World imports		9,495.0	100.0

Fig. 2

Source: WTO (2005b).

Since the 1980s, international trade patterns have become starkly polarized. Trade within the “central” regions (North America, Europe, Asia-Pacific) and the exchange of goods between them have expanded much more than world merchandise trade as a whole. In 2004, the three major regions jointly accounted for more than 85% of world trade (see Fig. 3). With a share of 45.3%, Europe is the world’s largest exporter of goods, followed by Asia-Pacific with 26.8% and North America with 14.9%. The same order applies for imports. Here Europe leads with a 44.4% share of world trade, again before Asia-Pacific (23.2%) and North America (20.8%).

High growth rates were recorded especially in intraregional trade, i.e. trade between countries that belong to certain regions.<sup>2</sup> In the 1950s, this figure only amounted to one third of that of world trade, climbing to more than 40% by 1980 and subsequently to 57% by 2004. At the same time, trade within the three leading regions alone amounted to 55.2% of total world trade in 2004. The share of intra-European trade accounted for 33.4%, clearly exceeding the share of intraregional trade of the North American (8.3%) and the Asia-Pacific (13.5%) economic areas. Trade within North America and the Asia-Pacific region, however, has shown higher growth rates than intra-European trade for the past several years.

<sup>2</sup> The composition of the regions is not always identical in the statistics. In WTO statistics, for example, Mexico, as a participant in the North American Free Trade Agreement (NAFTA), is considered part of North America; in the UNCTAD statistics, however, it is part of Central America.

## Intra- and interregional merchandise trade, 2004

Region of origin	Region of destination							World
	North America	South and Central America	Europe	Commonwealth of Independent States (CIS)	Africa	Middle East	Asia-Pacific	
Value (in US \$ bn)								
North America	<u>742</u>	71	216	5	15	25	249	1,324
South and Central America	93	<u>64</u>	59	3	7	5	39	276
Europe	367	51	<u>2,973</u>	88	98	105	308	4,031
Commonwealth of Independent States (CIS)	18	6	129	<u>55</u>	4	10	35	266
Africa	43	7	99	1	<u>23</u>	3	39	232
Middle East	55	4	64	1	13	<u>22</u>	193	390
Asia-Pacific	533	39	417	25	45	75	<u>1,201</u>	2,388
World	1,852	242	3,957	179	205	245	2,065	<u>8,907</u>
<b>Shares of regional trade flows in total merchandise exports of each region (in %)</b>								
North America	<u>56.0</u>	5.4	16.3	0.4	1.1	1.9	18.8	100.0
South and Central America	33.7	<u>23.2</u>	21.4	1.1	2.5	1.8	14.1	100.0
Europe	9.1	1.3	<u>73.8</u>	2.2	2.4	2.6	7.6	100.0
Commonwealth of Independent States (CIS)	6.8	2.3	48.5	<u>20.7</u>	1.5	3.8	13.2	100.0
Africa	18.5	3.0	42.7	0.4	<u>9.9</u>	1.3	16.8	100.0
Middle East	14.1	1.0	16.4	0.3	3.3	<u>5.6</u>	49.5	100.0
Asia-Pacific	22.3	1.6	17.5	1.0	1.9	3.1	<u>50.3</u>	100.0
World	20.8	2.7	44.4	2.0	2.3	2.8	23.2	<u>100.0</u>
<b>Shares of regional trade flows in total merchandise exports worldwide (in%)</b>								
North America	<u>8.3</u>	0.8	2.4	0.1	0.2	0.3	2.8	14.9
South and Central America	1.0	<u>0.7</u>	0.7	0.0	0.1	0.1	0.4	3.1
Europe	4.1	0.6	<u>33.4</u>	1.0	1.1	1.2	3.5	45.3
Commonwealth of Independent States (CIS)	0.2	0.1	1.4	<u>0.6</u>	0.0	0.1	0.4	3.0
Africa	0.5	0.1	1.1	0.0	<u>0.3</u>	0.0	0.4	2.6
Middle East	0.6	0.0	0.7	0.0	0.1	<u>0.2</u>	2.2	4.4
Asia-Pacific	6.0	0.4	4.7	0.3	0.5	0.8	<u>13.5</u>	26.8
World	20.8	2.7	44.4	2.0	2.3	2.8	23.2	<u>100.0</u>

Fig. 3

Source: WTO (2005b).

The three core regions also play a very important role in interregional trade, as a glance at Fig. 3 will show. Transpacific trade between North America and Asia-Pacific was dominant here in 2004, with a share of approximately 8.8% of total world trade. The share of interregional trade between Europe and Asia-Pacific (8.2%) was somewhat lower. Transatlantic trade between Europe and North America accounted for 6.5%. The exchange of goods with the “central” regions also dominates the foreign trade of the “peripheral” regions. In 2004, Europe was the primary trade partner of the Commonwealth of Independent States (2.4%) and Africa (2.2%). Trade relations on the part of the Middle East concentrated on the Asia-Pacific (3.0%) and European (1.9%) regions. For South and Central America, North America (1.8%) and Europe (1.2%) were the most important trade partners.

Viewed by sector, the high share of trade in industrial goods should be pointed out. It amounted to almost three quarters of total world goods trading in 2004, though the weight has clearly shifted toward information technology and telecommunications. The share of chemical and pharmaceutical products has also increased, whereas other sectors, such as trade in iron and steel, automobiles, and textile and clothing products, have grown more slowly than trade in industrial goods as a whole. Trade in agricultural goods, which had still dominated world trade in the 1950s, slid to an all-time low in 2004 and constituted not even 10% of total goods trading. Trade in mining products, fuels, and other products, which had declined considerably during the first half of the 1980s as a result of the oil price crisis of 1979-80, recorded very high growth rates in recent years and in 2004 attained a share of almost 15%.<sup>3</sup>

## 2.2 Internal and external foreign trade of the European Union

Parallel to the expansion in world merchandise, foreign trade on the part of member states of the European Union also increased substantially. To a considerable extent, this trade is conducted by the six member states that are among the ten leading world trade nations (Germany, France, Netherlands, Italy, UK and Belgium). Combined, these countries accounted for almost 30% of world trade in 2004. The cumulative share of all 25 EU member states was somewhat higher. It rose to 44.3% by 1990, then dipped to 40.4% by 2004 (see Fig. 4). Since the radical changes in the Central and Eastern European countries, export trade on the part of the 25 EU member states seems to be developing somewhat less expansively than world trade.

To draw conclusions regarding the structure of the trade patterns, it is essential to differentiate between the external and internal foreign trade of the European Union. External foreign trade is defined as the exchange of goods between the European Union and the rest

<sup>3</sup> See Koopmann, Franzmeyer (2003) and WTO (2005b).



of the world (extra-EU trade), while the movement of goods among the EU member states is considered internal foreign trade (intra-EU trade). A consideration of the external and internal foreign trade of the EU-25 shows that that extra-EU trade has become less significant since 1980 than intra-EU trade, although this proportion has not shifted much since 1990. In 2004, the internal exchange of goods accounted for approximately two thirds of overall foreign trade on the part of the EU-25 and was thus approximately twice as high as the share of extra-EU trade (see Fig. 4).

#### Shares of intra- and extra-EU trade of the EU-25 in world trade and in total trade of the EU

<b>World trade and EU trade</b>						
	<b>1980</b>	<b>1990</b>	<b>1995</b>	<b>2000</b>	<b>2003</b>	<b>2004</b>
World trade (US \$ mn)	2,033,075	3,493,575	5,168,919	6,435,732	7,490,263	8,975,589
EU-25 trade (US \$ mn)	821,020	1,547,400	2,174,943	2,438,907	3,096,873	3,623,090
Share EU/World (in %)	40.4	44.3	42.1	37.9	41.3	40.4
<b>Intra-EU Trade</b>						
	<b>1980</b>	<b>1990</b>	<b>1995</b>	<b>2000</b>	<b>2003</b>	<b>2004</b>
Intra-EU-25 (US \$ mn)	483,141	1,022,932	1,385,805	1,618,916	2,101,503	2,440,655
Intra-EU/World (in %)	23.8	29.3	26.8	25.2	28.1	27.2
Intra-EU/EU (in %)	58.8	66.1	63.7	66.4	67.9	67.4
<b>Extra-EU Trade</b>						
	<b>1980</b>	<b>1990</b>	<b>1995</b>	<b>2000</b>	<b>2003</b>	<b>2004</b>
Extra-EU-25 (US \$ mn)	337,879	524,468	789,138	819,991	995,370	1,182,435
Extra-EU/World (in %)	16.6	15.0	15.3	12.7	13.3	13.2
Extra-EU/EU (in %)	41.2	33.9	36.3	33.6	32.1	32.6

Fig. 4

Source: UNCTAD (2005a).

The USA continues to be the most important trade partner of the EU-25, whereby the relative significance of this trade relationship has declined in recent years. This pertains particularly to EU imports from the USA, whose share dropped from 22% to 15% between 1999 and 2004, and to a lesser extent to EU exports to the USA, whose share only decreased from 27% to 24% during the same period of time. In contrast, the share of export trade between the EU and China has more than doubled since 1999. China now holds second place in imports into the European Union among the trade partners of the EU-25 and is now in third place, behind Switzerland (see Fig. 5), among exports from the EU. A definite increase has also been noted in recent years in imports from Russia and exports to Turkey.

The EU primarily exports industrial goods. Their share in overall EU exports has remained quite stable at 87% in recent years. In 2004, vehicles and machines made up almost half (45%) of exports from the EU-25. Chemical products accounted for 16% of EU exports. Foodstuffs and animal fodder amounted to 5%. Major changes have, however, been noted on the import side. The share of petroleum products, for example, spiked from 11.2% to 16% between 1999 and 2000 and by 2004 had reached approximately 18%. The main reason for this development was the hike in the price of crude oil, which caused a significant increase in the value of imports of petroleum products. During the same period of time, there was a sharp drop in the share of imports of industrial goods. They fell from 74% in 1999 to 69.2% in 2004, whereby imports of machines and vehicles declined from 38.6% to 34.4%.<sup>4</sup>

<sup>4</sup> See EU (2005a).

### The five most important trade partners of EU-25 in 2004

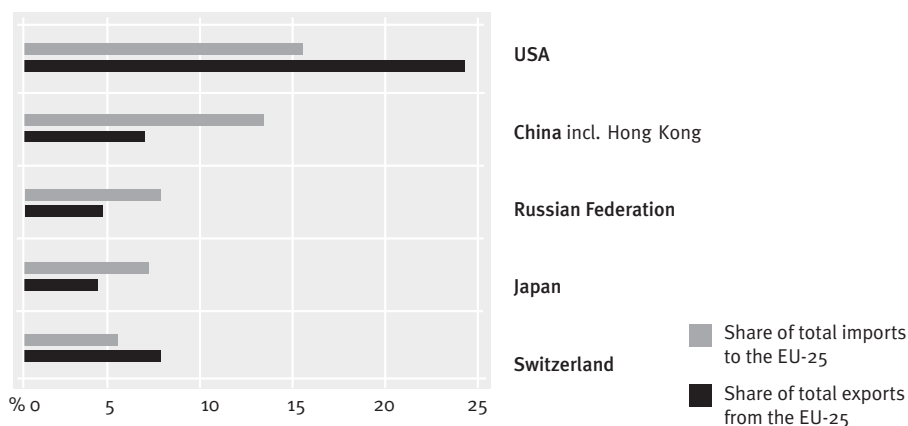


Fig. 5

Source: Eurostat (2006).

## 2.3 Determinants of international trade

### 2.3.1 Main results of international trade theory

The development of international trade is determined by various factors. A strong influence is that of general world economic development. Economic crises in individual regions or specific industries have a negative influence on international trade. The downturn in trading volume in 1981 and 1982, for example, can be largely ascribed to the oil price crisis of 1979-1980, whereas the collapse of the “new economy” was primarily responsible for the decline witnessed in 2001. The terrorist attacks of September 11, 2001, played a role in the drop in international trade during that year.

It can be empirically shown that the growth rates in international trade exceed those of the gross domestic product. The simple models of traditional foreign trade theory, however, are of little assistance in explaining this empirical fact. They primarily prove the beneficial effect of international trade, whereby differences between the countries are the source of gains from trade.<sup>5</sup>

For instance, it is advantageous for a country to import goods which, due to geological or climatic factors, are not available to a sufficient extent in that country and to export goods that are available in abundance. The absolute price or cost advantages enjoyed by countries for various goods at the same time explain the direction taken by the international flows of trade. Countries whose climatic conditions do not permit the cultivation of coffee, tea, bananas or cotton are forced to satisfy the demand for these products through imports. By the same token, countries that have no crude oil deposits are dependent upon supplies from abroad to meet their requirements, if they do not wish to do without crude oil. The same holds true for ore, coal, and other minerals.

The Ricardo model explains patterns of international trade in terms of differing technologies, which reflect the natural differences between countries. Ricardo shows that a country does not have to possess an absolute cost advantage in the production of an item in order to profit from international trade. Essential is only the existence of comparative cost differences and for countries to specialize in the production of goods for which they have comparative advantages. For a country which has higher production costs than foreign countries for all goods, it is thus advantageous to export items for which the cost disadvantage in relation to foreign countries is relatively small, and to import goods for which the cost disadvantage is relatively large. For a country in which production costs for all goods are lower than in foreign countries, it is accordingly profitable to export goods for which the country has a comparative advantage and to import goods for which the country has a comparative disadvantage.

<sup>5</sup> Niehans (1995) provides a good survey of the models of traditional foreign trade theory.

Whereas Ricardian foreign trade theory analyzes the effects of international differences in productivity or cost resulting from different production technologies, the Heckscher-Ohlin model bases international trade on the differing endowments of countries with production factors. According to this theory, it is advantageous for countries to export goods whose production requires especially intensive use of the factors that are in abundance. A country rich in labor, but whose available capital is low in comparison to the available labor potential, will export goods that are correspondingly labor-intensive and will import from other countries goods whose production requires intensive capital input.

According to traditional foreign trade theories, differences between countries lead to inter-industrial trade, meaning an exchange of goods produced by various industries. In the course of increasing globalization, however, these differences are likely to lessen. The occurrence of international movements of capital and migrations in labor are thus associated with a reduction in differences in factor endowments between countries. Foreign direct investments, in addition, often go hand in hand with a transfer of technology, so that technological differences between the countries also become less important. If the validity of traditional foreign trade theory is not questioned, international flows of trade are likely to decrease. This, however, is not confirmed by the empirical evidence.

With the growing impact of the international exchange of similar goods between countries which only differ to a minor degree from one another, it has become increasingly evident that the principle of comparative advantages is not the only cause for trade. More recent treatises on foreign trade theory which, in contrast to traditional foreign trade theory, assume economies of scale in production, make it clear that specialization and trading profits can even be realized if the countries do not differ from one another. This results in intra-industrial trade, which increases product variety to the advantage of the consumer and at the same time permits the company to fully tap the advantages of mass production that have not yet been utilized.

Furthermore, the modern trade theory suggests a connection between the size (e.g. the economic power) of countries and the volume of trade. According to it, in the course of progressive economic development, the volume of trade increases more than proportionately if, and only if, the countries involved converge in terms of their economic power (e.g. income).<sup>6</sup>

<sup>6</sup> See Helpman, Krugman (1985) and Helpman (1987).

### 2.3.2 Liberalization of trade

The dynamic development of world trade is generally seen in relation to the progressive dismantling of national trade barriers which has taken place since the end of World War II. On a multilateral level, liberalization efforts have concentrated on tariff reductions for some time. Considerable successes have been achieved in this regard. In the course of several rounds of negotiations on the General Agreement on Tariffs and Trade (GATT), average tariffs on industrial products has been lowered since the end of the war from almost 50% to less than 5%. The GATT Uruguay Round, which lasted from 1986 to 1993 and led to the establishment of the World Trade Organization (WTO) in 1995, resulted in a comprehensive renewal and extension of international trade regulations. In the process, the agricultural sector, as well as textiles and clothing, which had previously been exempted from the general GATT regulations, had to forfeit their special status.<sup>7</sup>

In regard to agricultural trade, the decision was made to replace all non-tariff trade measures by their tariff equivalents. This established the prerequisites for further liberalization measures. Agreed at the same time was a reduction in tariff protection, domestic support measures, and export subsidies. Considerable potential for liberalization still exists. For trade in textiles and clothing, the decision was made to remove all national import quotas step by step, whereby the final step in quota reduction was to go into effect on January 1, 2005. Decades of regulation of trade in textiles and clothing have thus by now come to an end. The effects of this liberalization are quite noticeable. International trade in textiles and clothing showed double-digit growth rates in 2003 and 2004, while barely an increase had been seen in the years before.

The other GATT agreements that were signed within the scope of the Uruguay Round were designed primarily to safeguard the liberalization that had already been achieved. As a result, quantitative trade relations (for example, “voluntary export restraints”) that massively hindered the international exchange of goods are by now a thing of a past. Tighter limits were also imposed during the Uruguay Round on such practices as anti-dumping measures, subsidies, and countervailing measures. Furthermore, the General Agreement on Trade in Services (GATS) and the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) expanded the scope of world trade regulations to extend beyond trading in goods. Both agreements may have a long-term positive effect on worldwide economic growth and thus indirectly contribute to a broadening of international goods trading.

Along with the efforts to dismantle trade barriers globally, integration efforts at the regional and bilateral levels were also advanced. In effect worldwide at the present time are more than 200 WTO-notified preferential trade agreements. The EU (or the EC) is a signatory to more than one quarter of these agreements. Examples of the more recent integration efforts

<sup>7</sup> Senti (2000) provides a comprehensive survey of world trade regulations.

by the European Union are the Euro-Mediterranean Association Agreements with non-European Mediterranean countries, the planned Economic Partnership Agreements with the ACP countries, the free trade agreements with South Africa, Mexico and Chile, and the planned agreement with the Mercosur countries, which include Argentina, Brazil, Paraguay and Uruguay and, most recently, Venezuela.<sup>8</sup>

The quintessential characteristic of these preferential or free trade agreements is a reciprocal reduction in trade barriers. On the one hand, new trade is created between the trade partners of a regional agreement; on the other hand, existing trade is diverted at the expense of other countries.<sup>9</sup> However, price-induced diversion of trade should be compared long-term with income-induced creation of trade, which results from the fact that internal growth impulses of regional integration also indirectly stimulate trade with other countries. Besides, regional agreements are rarely limited to internal tariff reductions, but often also involve the elimination of trade barriers resulting from various domestic measures and regulations (e.g., the EC single market). All in all, the trade-creating effects of regional integration are likely to predominate so that, at least over time, a decline in interregional trade need not be expected.

### 2.3.3 Impact of transport costs

Through the reduction of state-imposed market access barriers, at the same time, other trade-inhibiting factors have gained in relative importance. Of particular consequence here are transport costs, which may have far-reaching effects on the regional structure of foreign trade.<sup>10</sup> In many cases, transport costs now constitute a far more serious trade barrier than tariffs. A 2001 study by the World Bank concludes that, for 168 U.S. trade partners, transport cost barriers outweighed tariff barriers. For the majority of Sub-Saharan African countries, for example, the share of transport costs in trade value is approximately five times as high as the tariff burden. In the developing countries, transport costs are on average 70% higher than in the industrialized countries.<sup>11</sup>

Transport costs are affected by numerous factors. Predominant is the geographical distance between the trade partners. It is estimated that doubling the distance increases the transport costs by 20 to 30%. This provides an additional explanation (in addition to the formation of free trade areas and customs unions between neighboring countries) for the fact that the intensity of international trade relations tends to be inversely correlated to the distance between the trade partners, and explains why intraregional trade is dominant over interregional

<sup>8</sup> See Koopmann (2006).

<sup>9</sup> A liberalization of trade between the EU and the Central and Eastern European countries in the 1990s, for example, led to a brief decrease in the exchange of goods between these countries and Russia.

<sup>10</sup> We will not go into detail here regarding wholesale and retail distribution costs, which also constitute an important component of trade costs. For this, see Anderson, van Wincoop (2004).

<sup>11</sup> See WTO (2004).

trade. A further important parameter is the location (or the geographical situation) of a country. Limao and Venables (2001), for example, determined in an empirical study that land-locked countries have much higher transport costs than comparable countries with access to the sea. This applies in particular to developing countries that primarily export goods whose value is relatively high in relation to their weight.

In addition to the geographical factors, which are generally invariables, certain determinants of transport costs can be influenced by government and corporate activities. Especially significant in this connection are the construction and maintenance of transportation routes (including seaports, river ports and airports), which are among the components of government infrastructure policy that are most important for trade.

Since, generally speaking, the trade-inhibiting effects of transport costs are comparable with those of government trade barriers, it is not surprising that reductions in transport costs are regarded as a primary determinant in the increase in international trade. An examination of the development of the share of freight costs in import values, however, does not suggest that transport costs continued to decline after 1990 (see Fig. 6), while trade increased appreciably during this period. In this connection, it should be noted that transport costs constitute the price for a service that is determined by supply and demand on the freight markets. If technical progress, for example, lowers the costs of the supplier, this normally leads to a broadening of the services offered and a lowering of freight rates. An increase in the demand for transport services – for example, due to an intensification in the division of labor – will

result, on the other hand, *ceteris paribus*, in a hike in freight rates. The literature often equates the costs that accrue for transport companies in providing their services with transport costs. In fact, however, transport cost is the price that must be paid by the customer for utilization of these transport services.

The price-driving effects of the increased demand for transport has evidently been compensated by the price-lowering technical progress that has clearly been made in the transport sector. Of course, it cannot be ruled out that various carriers have experienced differing developments.

#### Estimated share of total freight costs in world trade

Year	Total freight costs for imports (in US \$ mn)	Import values (c.i.f.) (in US \$ mn)	Freight cost share of import value (in %)
1980	123.2	1,856.8	6.6
1990	173.1	3,314.3	5.2
1994	219.3	4,063.3	5.4
1995	247.3	4,688.6	5.3
1996	259.9	4,954.0	5.2
1997	270.8	5,166.4	5.2
1998	285.8	5,028.6	5.7
1999	284.8	5,280.5	5.4
2000	342.6	6,147.1	5.6
2001	364.0	5,960.5	6.1
2002	337.9	6,097.3	5.5
2003	379.2	7,052.9	5.4

Fig. 6

Source: UNCTAD (2005b).

### **Advantages and disadvantages of globalization**

In economics, the term globalization is understood to mean the process of increasing international economic integration, in which national borders and geographical distances play an increasingly less important role. This is evident, for example, in the expansion of foreign trade, the increase in international capital movements, and the growing importance of multinational enterprises. Increasing globalization should be viewed as a fundamentally positive development, as this means an intensification of the international division of labor and a realization of the associated benefits. The integration of markets, however, also creates additional tension. A company's competitive position in a particular country is to a very great extent also determined by its stance in other countries. Companies that only operate in their domestic markets can easily fall behind, as the comparative advantages are to a diminishing degree the result of unalterable local factors or deviating national factors. There is also a great deal of uncertainty in regard to the effects of the distribution of international trade. It cannot be ruled out, for example, that increased imports from low-wage countries to industrialized countries will squeeze domestic production out of the market. Less-skilled workers in the industrialized countries would have to accept lower wages or would become unemployed if flexibility regarding wages were not forthcoming.

Box 1



### 3. Development, structure and determinants of international seaborne trade

#### 3.1. Development and structure of world seaborne trade

Shipment by sea is the preferred means of transport in world trade. According to estimates, maritime trade accounts for approximately two thirds of total merchandise trade.<sup>12</sup> It is therefore not surprising that the development of maritime world trade has developed as dynamically as has international goods trading as a whole.<sup>13</sup> Since the mid-1980s, the transport volume in metric tons has more than doubled (see Fig. 7). The annual growth rate was 3.7% on average. During the same period of time, total cargo shipments, measured in ton-miles, rose by an average of 3.9% annually, whereby growth in the past decade, at 3.6%, was somewhat weaker.

In 2005, the transport volume of seaborne world trade amounted to 6.78 bn t, an increase of 4.5% over the prior year. Of the total transport volume, crude oil accounted for 1.82 bn t (26.8%), petroleum products 0.49 bn t (7.3%), iron ore 0.65 bn t (9.6%), coal 0.69 bn t (10.2%), grain 0.24 bn t (3.5%), and bauxite and alumina 0.07 bn t (1.1%). The remaining goods, including general cargo shipped in containers, amounted to 2.82 bn t and made up approximately 41.6% of the total volume. The five most important bulk goods (oil, oil products, iron ore, coal and grain) were transported by ship over relatively large distances. Accordingly, they accounted for larger shares in total cargo shipments than in transport volume. For other commodities, the opposite held true.<sup>14</sup>

All of the goods referred to here recorded average annual growth rates of 2% or more (see Fig. 8) in transport volume in the past 20 years. The transport volume rose particularly for coal and iron ore, increasing annually between 1985 and 2005 by 4.9% (coal) and 4.0% (iron ore). The items grouped under “other goods” also grew considerably, at a growth rate of 4% per year. In recent years, a marked increase was shown especially in the growth rates of iron ore transported by sea. Between 2000 and 2005, they amounted to 7.4%, having only

**Development of world seaborne trade**  
(in mn tons)

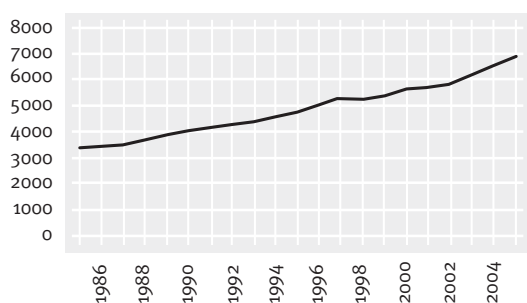


Fig. 7

Source: ISL (2006).

<sup>12</sup> See Kumar, Hoffmann (2002).

<sup>13</sup> It should be noted that world trade statistics are basically recorded in terms of value or volume, whereas those for maritime trade are given in transport volume (in tons) or total cargo shipments (in ton-miles or ton-kilometers).

<sup>14</sup> See: ISL (2006).

reached 1.6% annually between 1985 and 1990. In contrast, growth in the transport volume of crude oil and oil products had weakened over time. However, this only held true up to 2002. Since 2003 – due to demand from China – a definite boost in growth rates has been observed.

Since 2000, iron ore has shown the highest growth rate in total cargo shipments, 8.4% annually (1985-2005: 4% annually). This made it possible to reverse the downward trend in total shipments for iron ore that had persisted since 1985 (see Fig. 9). The same holds true for coal transports by sea. The growth rates for the items grouped under the collective expression “other goods” increased considerably between 1985 and 2000. From 2000 to 2005, however, the expansion was less marked than beforehand. The vigorous growth in container transport was to a great extent responsible for the generally high increase in the transport of other goods. On the other hand, growth in total shipments for crude oil has weakened considerably since 1985. This indicates that crude oil transported by sea in the past 15 years was conveyed over short distances.

A consideration of seagoing world trade by region shows that Asia-Pacific, Europe (even without the Central and Eastern European countries) and North America are the most important destination regions for maritime trade (see Fig. 10). The goods that were unloaded amounted altogether to a share of 87.4%, whereby 42.4% of this fell to the Asia-Pacific trade region alone. For loaded goods, seaborne trade was much more evenly distributed among the individual regions. Here, too, Asia-Pacific led with 31.1%. In second place was Europe at 17.5%, followed by the Middle East (16.0%), Central and South America (13.5%) and Africa (8.6%). In loaded goods, North America only accounted for a share of 7.9%. Behind it was only the Commonwealth of Independent States (including the Central and Eastern European countries) with 5.1%. It is striking that there were great deviations in all regions between the amounts of goods that were loaded and those that were unloaded.

#### Development of maritime world trade by goods and tons

Growth rates per Year in %	1985-1990	1990-1995	1995-2000	2000-2005	1985-2005	1995-2005
Crude oil	6.4	3.5	2.6	2.5	3.8	2.5
Oil products	3.1	2.5	1.9	3.1	2.7	2.5
Iron ore	1.6	3.0	2.5	7.4	3.6	4.9
Coal	4.7	4.3	4.3	5.7	4.8	5.0
Grain	1.2	0.4	3.3	1.0	1.5	2.1
Bauxite and alumina	5.4	- 0.8	1.2	6.6	3.1	3.9
Other goods	2.8	4.0	4.6	4.1	3.9	4.3
Total	3.8	3.4	3.5	3.9	3.7	3.7

Fig. 8

Source: ISL (2006).

## Development of maritime world trade by goods and ton-miles

Growth rates per Year in %	1985-1990	1990-1995	1995-2000	2000-2005	1985-2005	1995-2005
Crude oil	9.3	2.9	2.5	1.9	4.1	2.2
Oil products	6.3	4.5	1.4	3.5	3.9	2.4
Iron ore	3.1	2.9	2.2	8.4	4.1	5.2
Coal	4.7	3.3	2.9	4.3	3.8	3.6
Grain	1.3	1.6	1.4	2.2	1.6	1.8
Bauxite and alumina	4.3	- 1.0	1.3	3.6	2.0	2.4
Other goods	3.2	4.7	5.6	5.1	4.6	5.4
Total	5.5	3.4	3.2	4.0	4.0	3.6

Fig. 9

Source: ISL (2006).

A breakdown of seaborne world trade (in tons) by region and sector shows that crude oil deliveries were primarily unloaded in Asia-Pacific (36.5% in 2004), North America (30%) and Europe (24.4%), while the countries in the Middle East, as expected, exported the largest amounts of crude oil. Approximately 50% of the worldwide crude oil exports came from this region in 2004. Africa accounted for 17.7%, Central and South America for 14.5%, and CIS for 7.0% of the crude oil.<sup>15</sup> Iron ore was primarily shipped from South America (37.0%) and Australia (34.9%) to China (32.1%), Japan (23.8%), and Europe (19.5%). Australia also led in coal exports (33.9%), followed by China (12.8%) and the Commonwealth of Independent States (11.1%). Japan (27.1%) and the other Far Eastern countries (27.8%) were the most im-

<sup>15</sup> See UNCTAD (2005b).

## Maritime world trade by regions and tons, 2004

	Loaded goods		Unloaded goods	
	in mn t	in %	in mn t	in %
Africa	579.3	8.6%	250.2	3.7%
Asia/Pacific	2,116.0	31.3%	2,862.7	42.2%
Europe	1,183.8	17.5%	2,034.3	30.0%
CIS	347.7	5.1%	80.2	1.2%
Central/South America	913.5	13.5%	378.6	5.6%
Middle East	1,083.5	16.0%	147.7	2.2%
North America	534.5	7.9%	1,033.4	15.2%
World	6,758.3	100.0%	6,787.1	100.0%

Fig. 10

Source: UNCTAD (2005b).

portant customers for coal in 2004. The primary suppliers of grain in 2004 were the USA with 45.6%, South America with 22.5%, and Australia with 10.4%. Here, too, the largest amount was shipped to countries in the Far East (41.1%).<sup>16</sup>

The expansion of seaborne trade went hand in hand with a commensurate growth in the world merchant fleet. Both the number of ships and their loading capacity increased notably over time (see Fig. 11). The largest share of the fleet – in regard to both load capacity (gross tonnage, GT) and deadweight tonnage (dwt) – fell to bulk carriers. In addition to special ships (petroleum tankers, natural gas tankers, refrigerated cargo vessels, etc.), ships that can be used for two or three different purposes are becoming increasingly numerous (e.g. combined oil/ore freighters). This also applies to container ships, for which high growth rates have been noted as well.

If the ships are grouped according to the nationality of their owners, the figures reflect the fact that in 2005 the Greek shipping companies had the largest share (14.6%) in capacity (both in GT and DWT) of the world merchant fleet.<sup>17</sup> They were followed by the shipping companies in Japan (13.1%), Germany (7.0%), the USA (6.0%), China (5.9%) and Norway (5.3%). In container ships, the German shipping companies had the largest share (31.4%) of the TEU capacity. They were followed at a distance by the Japanese, Danish and Taiwanese shipping companies. A large proportion of the ships do not go to sea under their home maritime flags, for reasons of cost. More than half of the world merchant fleet tonnage is registered in countries with an open registry (e.g. Panama). This applies to more or less all types of vessels worldwide.

<sup>16</sup> See ISL (2006).

<sup>17</sup> As at January 1, 2005. See VDR (2005) and the sources cited there.

### Development of the world merchant fleet

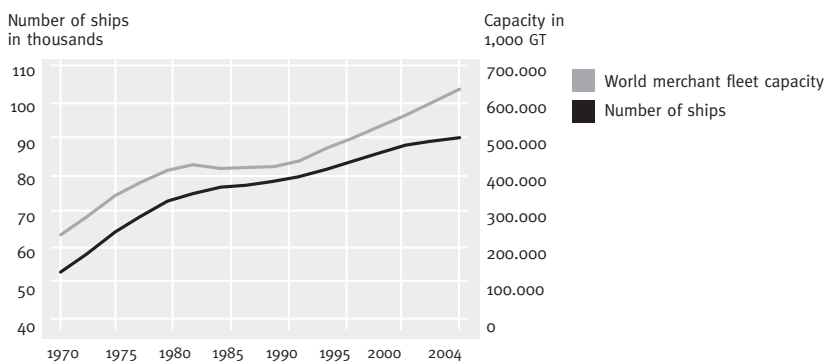


Fig. 11 Source: Lloyd's Register Fairplay, quoted in VSM (2005).

### 3.2. Maritime foreign trade of the European Union

Sea traffic plays a dominant role in the external foreign trade of the European Union (see Fig. 12). Its share of total extra-EU trade (in tons) amounted to 71.7% in 2004. Following at a great distance were pipelines with 14% and road transport with 5.1%, while 4.5% fell to rail transport. The share of air transport, at 0.5%, was very low. If the value of the external foreign trade of the EU (in euros) is analyzed, however, the share of air transport, at 26%, was much higher, while that of sea transport sank to 47.1%.<sup>18</sup> In this analysis, road transport was in third place with 14.2%. Pipelines had a 2.9% share of trade by value in 2004. The figures showing the development of extra-EU trade by mode of transport indicate that maritime transport has increased in significance in recent years in comparison to other types. Care should be taken in interpreting this data, however, as the statistical survey methods have changed along with the admittance of the new EU member states.

The total amount of goods transported by sea in extra-EU trade can be estimated for the year 2005 at just under 1.5 bn tons. The amount that was imported by the EU was considerably greater than the amount exported. More than three quarters of the total volume (77.6%) constituted imports and less than a quarter (22.4%) were exports. If the seagoing trade is analyzed by value, the disparities are much smaller. In this case, imports into the EU account for a share of 54.6% and exports for 45.4%. This leads to the conclusion that the European Union exports goods of far greater value than those it imports. The ratio between value and amount of EU exports in 2005 was almost three times as high as that of the EU imports.

<sup>18</sup> Almost half of the EU's maritime trade is transported in containers. In December 2005, for example, the share of containerized maritime freight in extra-EU trade by value was 43.1%.

#### External foreign trade of the EU by mode of transport, 2004

Extra-EU trade	Value in mn euros	Share in %	Volume in mn tons	Share in %
Sea	859.1	47.1%	1,430.0	71.7%
Road	259.7	14.2%	100.8	5.1%
Rail	25.1	1.4%	89.3	4.5%
Inland waterway	6.5	0.4%	24.9	1.3%
Pipeline	53.4	2.9%	279.1	14.0%
Air	473.7	26.0%	9.8	0.5%
Other	145.4	8.0%	59.7	3.0%
Total	1,822.9	100.0%	1,993.6	100.0%

Fig. 12

Source: EU (2005b).

The various regions of the world are involved in the seaborne trade of the EU to differing degrees. Fig. 13 shows the regional distribution of the extra-EU trade in sea traffic for the year 2002. By volume, Africa – just ahead of the non-EU European countries (including the Russian Federation) – was the most important trade partner of the EU in sea traffic in 2002. The largest amounts of goods (in tons) were imported from these two groups of countries. In regard to exports from the EU, the largest amounts of goods conveyed by sea transport went to North America. In 2002, this was also the only region with which the European Union recorded a surplus in seaborne trade by volume. By value, the Asia-Pacific economic area was the most important trade partner of the EU in sea transport. This was especially due to the high imports of the EU from this region. In exports from the EU, on the other hand, Asia-Pacific only held second place, behind North America. Apart from trade with the Asian countries, the ratio between value and amount for EU exports was considerably higher than that for EU imports.

Among the total imports of the European Union, petroleum products (including crude oil) were, by quantity, the most important category of goods in sea transport in 2005 (see Fig. 14). It accounted for 46.6% of the total import volume and was followed by solid mineral fuels with a share of 15.1%. Ore and scrap metal or metal waste had a 11.8% share. For this group of goods, the ratio between value and amount is very low. By value, for example, petroleum products only made up 30.4% of imports. The largest share here, 41.5%, was accounted for by the commodity group including “vehicles, machines, other semi-finished and finished articles, and special cargo.” For this category, the ratio between value and amount is the highest. 10.9% of the imports were foodstuffs and animal feed (Commodity Groups No. 0 and 1).

### Shares of imports and exports in maritime transport between the EU and the world regions, 2002, in %

	EU imports		EU exports		Total	
	Share of trade volume	Share of trade value	Share of trade volume	Share of trade value	Share of trade volume	Share of trade value
Non-EU European countries (incl. Russia)	23.4	16.5	17.4	12.5	22.0	14.5
Africa	25.0	13.2	17.3	12.1	23.2	12.6
North America	8.3	14.7	32.1	32.3	13.9	23.5
Central and South America	17.2	9.6	7.0	8.8	14.8	9.2
Middle/Near East	13.2	6.8	8.5	9.1	12.1	7.9
Asia	8.1	37.2	16.6	22.2	10.1	29.7
Australia and Oceania	4.8	2.0	1.3	3.1	4.0	2.6

Fig. 13

Source: Pongas, Troner (2004).

Among exports from the EU to other countries in 2004, petroleum products were also the most important category of goods in volume in sea traffic. They amounted to almost one third of goods exported from the EU. Foods and animal fodder (Commodity Groups No. 0 and 1) accounted for a share of 15.3%, chemical products for 11.22%. Foodstuffs and animal fodder, as well as agricultural and forestry products and live animals, each showed export volumes of just under 8%. Another 18.5% fell to vehicles, machines, semi-finished and finished articles, and special cargo, whereby this group was the most significant in exports by value. In interpreting these figures, it should be noted that the total volume serving as a basis for the export shares is much lower than that for the import shares.

Sea traffic is much less important for intra-EU trade than for external EU trade (see Fig. 15). Road traffic dominates in the exchange of goods between the member states. In 2004, it accounted for a share of 31.1% of the transport volume (in tons). Sea and coastal shipping (short sea shipping), with a share of only 18.1%, held only second place. It was followed by pipelines with 7.7% and rail transport with 6.1%. Inland shipping accounted for 4.5% of intra-EU trade. With only 0.1% by volume, air traffic did not play a major role in intra-EU trade. The share of road traffic by trade value, which amounted to 47.6% in 2004, was even larger. This means that higher-value merchandise is transported on the road. The same applies to air traffic, which holds a higher share by value than by amount. Nevertheless, air traffic only accounted for 2.3% of intra-EU trade by value. Goods with a relatively low ratio of value to volume are transported by sea. Accordingly, maritime trade accounted for a very low share of intra-EU trade by value, only 11.2%.

#### Share of various types of goods in extra-EU trade, 2005

NST/R Chapter	Volume in tons		Value in euros	
	Imports	Exports	Imports	Exports
0 Agricultural and forestry products, live animals	3.2	7.6	3.7	1.8
1 Other foodstuffs and animal fodder	6.2	7.7	7.2	7.0
2 Solid mineral fuels	15.1	0.6	2.1	0.1
3 Petroleum products	46.6	30.8	30.4	7.5
4 Ore and metal waste	11.8	5.9	2.7	1.2
5 Iron, steel, and nonferrous metals (incl. semi-finished)	2.8	6.9	4.8	5.7
6 Stones, earth, and building materials	4.5	8.7	0.9	1.4
7 Fertilizers	1.2	2.1	0.3	0.3
8 Chemical products	3.0	11.2	6.4	13.2
9 Vehicles, machines, other semi-finished and finished articles, and special cargo	5.5	18.5	41.5	61.9

Fig. 14

Source: Comext (2006).

## Intra-EU trade by mode of transport, 2004

Intra-EU Trade				
	Values in mn euros	Shares in %	Amounts in mn tons	Shares in %
Sea	225.9	11.2%	284.5	18.1%
Road	957.5	47.6%	489.9	31.1%
Rail	72.7	3.6%	96.7	6.1%
Inland waterway	15.4	0.8%	70.3	4.5%
Pipeline	27.0	1.3%	121.1	7.7%
Air	47.1	2.3%	1.1	0.1%
Other	664.9	33.1%	511.1	32.5%
Total	2,010.5	99.9%	1,574.7	100.0%

Fig. 15

Source: EU (2005b).

If total cargo shipments are measured in ton-kilometers, it becomes evident that sea and coastal shipping are primarily used within the EU when goods must be transported over long distances (see Fig. 16). Sea shipping in 2004 thus amounted to a share of 39% of the total shipments, whereas its share of transport volume in the same year was only 18.1%. If one considers the fact that in Fig. 15 (as opposed to Fig. 16) a residual amount is listed, after adjusting the data, the share of sea shipping in transport volume is calculated at 26.7%, which is still much less than the share of total cargo shipments. Inland waterway transport is also primarily used to convey goods over long distances. In contrast, pipelines are generally used for transport over relatively short distances. Accordingly, their share of the 2004 total shipments was much lower than their share of transport volume.

All told, total cargo shipments for the movement of goods within the EU in the period between 1995 and 2004 increased by 28% and achieved an average annual growth rate of 2.8%. During the same period, road traffic increased by 35% and was thus able to boost its market share from 42.1% in 1995 to 44.3% in 2004. The annual growth rate was 3.4%. The market share of sea traffic was also increased, by 31%, between 1995 and 2004. This was the equivalent of an annual growth rate of 3%. The greatest growth of all modes of transport, however, was recorded by air traffic, which increased by 39% between 1995 and 2004. Despite growth rates of 3.7% per year, however, air traffic was only able to call a market share of 2.5% its own in 2004.

Growth recorded by the other types of carriers (pipelines, inland waterways, and rail traffic) remained below that of transport of goods as a whole. Particularly weak results here were shown by rail traffic, with growth of only 0.6% per year. The market share of inland



## Modal split within the EU, 2004

	Shares in %, transport capacity in ton-kilometers					
	Road	Rail	Inland waterway	Pipeline	Sea	Air
1995	42.1	12.1	4.0	3.6	38.2	0.1
1996	42.3	12.0	3.9	3.7	38.0	0.1
1997	42.1	12.1	4.0	3.5	38.2	0.1
1998	43.0	11.5	3.9	3.6	37.9	0.1
1999	43.5	10.8	3.8	3.5	38.3	0.1
2000	43.0	10.8	3.8	3.4	38.8	0.1
2001	43.2	10.2	3.7	3.5	39.4	0.1
2002	43.7	10.0	3.6	3.4	39.3	0.1
2003	43.5	10.1	3.3	3.4	39.6	0.1
2004	44.3	10.0	3.4	3.3	39.0	0.1

Fig. 16

Source: EU (2005b). Air and Sea: only national and intraregional EU-25 transport  
Road: national and international transport by registered vehicles in the EU-25.

waterways also receded noticeably, but high growth rates were registered between 1995 and 2004 in certain EU member states (50% in Belgium, 30% in France).

If one considers the distribution of shipping traffic by type of ship, it is noted that the “general cargo” category is clearly dominant in extra- and intra-EU trade. Approximately two thirds of the gross tonnage of incoming traffic in 2003 belonged to this category. The share belonging to container ships was about 12.5%, and tankers accounted for about 10%.<sup>19</sup> Special cargo ships only accounted for a substantial share of sea traffic in Belgium, Slovenia and Cyprus. All told, the UK and Italy recorded the most extensive incoming traffic. In most of the member states, trade with non-EU countries dominated in sea traffic. This applies, for example, to Cyprus, Italy, the Netherlands, Slovenia, Spain, France and Belgium. In other member states, such as Estonia, Lithuania, Malta, Finland, Sweden and Ireland, on the other hand, intra-EU trade is of greater significance in sea traffic. The role of domestic sea traffic is also more than negligible in Greece, the UK, Italy, Denmark and Spain.

### 3.3. Determinants of maritime trade

A close relationship exists between the development of maritime transport and world trade. Technological changes in sea shipping have led to considerable increases in capacities in sea transport and have thus vigorously spurred the expansion of world trade. Especially significant here are the introduction of container shipping, the use of new handling and warehousing technologies, and the application of modern information and communication technologies. Conversely, the expansion of international trade has resulted in an increase in demand for transport services, whereby a large share of this demand falls to sea shipping. The development of international trade thus has a considerable influence on seaborne trade. Unclear, however, is to what extent seaborne shipping will profit from this in the future.

How the transport volume is shared by the various carriers depends on numerous factors, whereby competition between the various carriers can only exist if this is permitted by geographical factors. If one considers a country like Japan, for example, which is completely surrounded by water, for all intents and purposes the only types of transport available for foreign trade are by sea and air. The competition between these two carriers is not especially intense, due to the fact that their main emphases are so disparate. Sea shipping has clear advantages over air transport if large amounts of goods are to be transported at relatively low cost. Air transport, on the other hand, is characterized by its ability to deliver the merchandise quickly.

This means that maritime transport is primarily used to ship bulk goods when time is not of the essence, while air transport is employed primarily for lightweight goods for which time is an important factor. This does not mean, however, that there is absolutely no competition between these two carriers. In a comprehensive empirical analysis, Hummels (1999) comes to the conclusion that air transport costs declined substantially in the second half of the last century. On the other hand, technical progress in sea shipping led to a reduction in the time required for the transport rather than to a decrease in freight rates. As an explanation, Hummels suggests the fact that air transport has been able to expand more than cargo shipping. Just the same, no major shifts in the market shares are to be expected in the future. This applies to bulk goods, in any case, but also to a major portion of other goods, in terms of transport volume or transport capacity.

Since approximately 70% of the earth's surface is covered with water, and since maritime shipping offers considerable cost advantages in many sectors, it is not surprising that shipment by sea generally enjoys an outstanding position in interregional trade. In intercontinental trade, especially, opportunities for using land-based carriers are very limited. Competition exists – if at all – among carriers that service the hinterland areas. In contrast, the relationship that exists between ocean shipping and carriers responsible for transport connections in

the hinterland areas is a complementary one. This means that coastal and inland carriers, rail and road traffic and pipelines generally also profit from an expansion in seaborne trade.

On the other hand, it should be assumed that lower quality in the connections with the hinterland and the harbors would have a negative effect on the scope of seaborne trade. In its white paper on transport policy, the European Commission states that it regards the threatened capacity overload of trans-European traffic networks as a serious danger for the competitive ability of European business and the “optimal utilization of globalization of trade.”<sup>20</sup> Excessive use of the roads also means great burdens on the environment. As the European Commission states in its green paper on energy supply in November 2000, approximately 28% of the emissions of CO<sub>2</sub> – the most important greenhouse gas – in 1998 were attributed to energy consumption in the transport sector. Road traffic alone was responsible for 84% of the traffic-related CO<sub>2</sub> emissions.

The overloading of certain traffic routes is, on the one hand, ascribed to the fact that the users very rarely have to pay for all of the costs they cause. On the other hand, this congestion is the result of delays in the construction of infrastructure for the trans-European network. In its white paper, the Commission suggests a series of measures for solving this problem. These include a toll system for road usage, the promotion of other types of carriers, and targeted investments in the trans-European network. Short sea shipping and inland waterway transport are to profit especially from these measures. Plans exist, for example, for the creation of “high-speed seaways“ to more efficiently connect ports to the railroad and inland waterway network and to increase the efficiency of harbor services.

Maritime cargo shipping does not, however, profit at all times and in all locations from public or private infrastructure measures. The expansion of land-based transport routes can – at least partially – also be to the disadvantage of sea shipping. This is exemplified, for example, by the pipeline that connects Baku on the Caspian Sea with the Mediterranean port of Ceyhan in Turkey, which has been completed following a construction period of four years. Beginning in 2008, a million barrels of crude oil are to flow through this pipeline daily. This will disencumber the Strait of Bosphorus of the passage of approximately 350 supertankers per year.<sup>21</sup> Another example is the Øresund Bridge, which was opened on July 1, 2000, and connects Denmark and Sweden. Estimated losses for sea cargo shipping are 10 to 15% of the total transport volume. Farther-reaching effects may result if construction of the Fehmarn Belt Bridge is completed.

As a whole, the development of maritime world trade is likely to be affected less by competition among the various carriers than by the determinants that shape the scope, structure and direction of the international trading of goods. It is to be assumed, for example, that increases in production and income in the individual regions of the world will lead to an increase in seaborne trade. Above average growth rates in countries in which maritime traffic

<sup>20</sup> See EU (2001).

<sup>21</sup> See N.N. (2006b).

### Annual growth rate in seaborne world trade and international merchandise trade in %

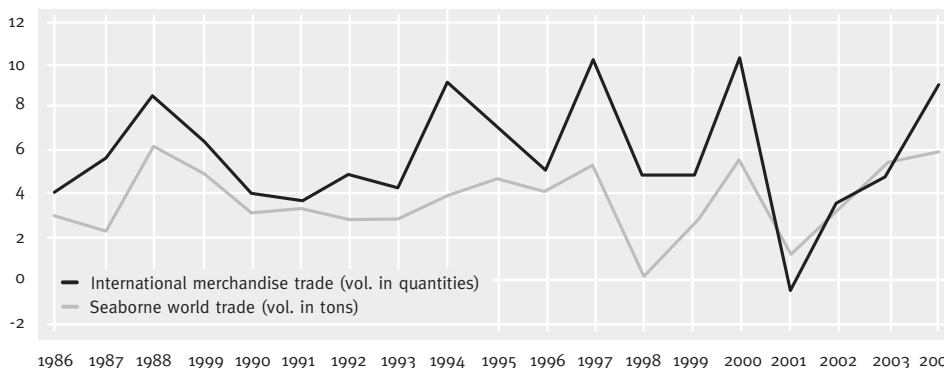


Fig. 17

Source: WTO (2006); ISL (2006).

plays a major role, due to geographical factors, have an accordingly positive effect on worldwide demand for sea transport, while economic crises in such countries and regions seriously weaken seaborne trade. The financial crisis in Asia at the end of the 1990s, for example, led to an especially earnest slump in seaborne world trade (see Fig. 17). In contrast, the economic crash in Central and Eastern European countries in the early 1990s had comparably little effect on seaborne world trade.

Unanticipated events can cause reverberations in the cargo markets, since adjusting capacities to altered circumstances (by expanding a fleet or scrapping ships) takes time. If demand fails to keep up with expectations, capacity utilization of the world merchant fleet will initially drop, as will the freight rates. If the demand for shipment by sea rises more sharply than expected, on the other hand, the result will be a higher capacity utilization of the ships and rising freight rates. Whether and to what extent increasing prices in the case of increasing capacity utilization and declining prices in the case of declining capacity utilization will have a stabilizing effect in the long term depends mainly on the way in which the companies assess future developments. If the owners of the ships or shipping companies, for instance, decide that a drop in freight rates will continue for an indefinite period, they will react by reducing their capacities. If, instead, they assume that the trend could be reversed after a short period of time, they will maintain their capacities and perhaps even expand them. This can cause intense fluctuations in the cargo markets, whereby the stabilizing function of a build-up or liquidation of stock does not apply, as sea transport is a service.

If the structure of merchandise trade changes in the course of world economic development, this may have an especially great influence on sea transport. During the oil price crisis of 1979-80, for example, the seaborne crude oil trade fell off sharply, due to the fact that the price hikes enforced by OPEC in many countries gave rise to the closing down of local energy

sources and to savings in energy consumption. The retrogressive growth of the crude oil trade went hand in hand with increased growth in trade with alternative energy sources. This development is far from over, so that the shares of the various regions in seaborne trade could shift substantially in the future. The strong boost in demand for crude oil and other energy sources by aspiring newly industrialized countries such as China and India is not likely to arrest this development, but to intensify it.

Noticeable effects on maritime trade are also to be expected in the case of a comprehensive liberalization of agricultural trade on a multilateral level. This would lead to a rise in European agricultural imports – especially from North America and Brazil – and a corresponding increase in seaborne trade. A considerable liberalization potential exists, in addition, in numerous developing countries where international trade continues to be hampered by high tariff barriers. It is by no means certain that an accelerated reduction of trade barriers by the developing countries would have a positive effect on seaborne trade, since a rapid opening of domestic markets by the developing countries could impede their economic growth (see Box 2).

### **Liberalization of trade and economic development**

The impact of trade liberalization on economic growth has been the subject of numerous studies. The simple basic models of trade theory emphasize the benefits to be expected for all countries from trade liberalization. To a great extent, however, they neglect the fact that the opening of domestic markets also means adjustment costs. The opening of domestic markets can indeed have a negative influence on a country's economic growth, if the domestic production factors are not sufficiently mobile in moving between the import and export sectors. Another danger is that countries might specialize in economic activities that do not contribute to greater economic growth. Furthermore, reductions in tariffs are indeed associated with a loss of customs revenue. The results of various empirical studies lead to the conclusion that the effects of trade liberalization on the part of developing countries must be viewed in the context of the general institutional framework. Institutions that can establish property rights and ensure adherence to the rule of law are necessary for coping with adjustment problems in the developing countries. Also necessary are institutions that can intervene with corrective actions if the market fails, which can help to stabilize markets and which are able to increase acceptance of the economic system. Liberalization of trade that does not take into consideration the institutional prerequisites of developing countries may therefore constitute a considerable risk for many developing countries.<sup>22</sup>

Box 2

<sup>22</sup> See Borrmann, Großmann, Koopmann. (2005).

## 4. Maritime trade and port economics

### 4.1 The European shipping areas<sup>23</sup>

Official EU statistics differentiate between four European sea areas: the Baltic Sea, North Sea, Atlantic and Mediterranean regions, whereby the term “shipping area” does not refer to the routes taken by the ships, but merely denotes a geographic delimitation. The four European sea areas comprise 471 ports in all, each of which handles a total of more than 1 mn tons of cargo annually, as well as numerous smaller ports. Fig. 19 shows the 10 largest ports in the various shipping areas.

In 2004, 3.5 bn t of goods were handled at the 471 largest ports. This was 7.8% more than in 2003 (see Fig. 18). In comparison with 1997, total cargo handled in the Mediterranean area more than doubled up to the year 2004, and in the Baltic Sea area it had approximately doubled. Total cargo handling in the North Sea area, at 79.1% during this period, grew much more slowly than that in the Baltic Sea and Mediterranean areas. The differences in the increase of port cargo handling in the different regions of the European shipping area are due, in part, to differences in GDP between the EU countries during this period, which led to different degrees of expansion in exports and imports. The high growth rate in cargo handling in the Baltic Sea area was widely influenced by the very pronounced increase in income in the Baltic nations during this period. Between 1997 and 2004, the GDP in Estonia grew by 30.4%, in Latvia by 54.9%, and in Lithuania by 47%, whereas the average growth of the EU-15 during this period amounted to 17.5%.

The largest shares of total cargo handling in the four European shipping areas being considered belonged in 2004 to the North Sea area (43%), followed by the Mediterranean (26%),

<sup>23</sup> The analysis of EU shipping areas and port structures is based on data from Eurostat. The evaluations pertain to the years 1997, 2002, 2003 and 2004, whereby data for the individual ports are available for periods of different lengths. It should also be noted that the handling figures for the ports may include double countings, resulting from transshipment. Transshipment is the transfer or reloading of goods or containers from one ship to another ship within a port. Furthermore, the Eurostat handling figures for container traffic do not contain the container tare weights. This means that the handling figures shown in the present study lie below those published by the ports themselves or in other studies if these contain the container tare weights. The analyses mainly include the Norwegian ports that do not belong to the EU.

#### Total cargo handling\*\* by shipping area, in 1,000 t

	1997	2002	2003	2004	Growth 1997–2004	Growth 2002–2003	Growth 2003–2004
North Sea	847,674	1,430,107	1,445,030	1,518,575	79.1	1.0	5.1
Mediterranean	448,893	850,343	916,383	932,816	107.8	7.7	1.8
Atlantic	n.a.*	603,940	620,674	655,705	n.a.	2.7	5.6
Baltic Sea	208,041	314,736	284,049	413,103	98.6	-9.7	45.4
EU Total	n.a.	3,199,126	3,266,136	3,520,199	n.a.	2.1	7.8

\* n.a.: not available  
\*\* Handling without container tare weight

Fig. 18

Source: Eurostat (2006).

The ten largest ports in the European shipping area, 2004



Fig. 19

Source: HWWI.

### Shares of individual shipping areas in total cargo handling (in t), 2004

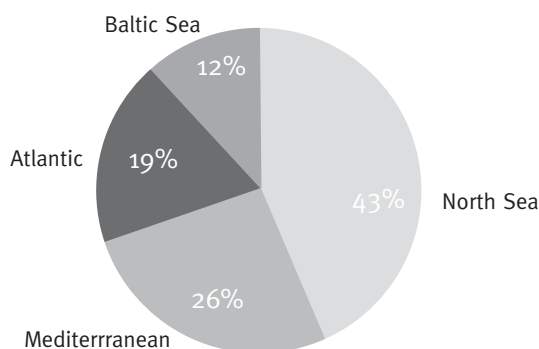


Fig. 20

Source: Eurostat (2006).

the ports on the Atlantic (19%), and the Baltic Sea area (12%) (see Fig. 20). The great importance of the North Sea area stems in part from the fact that the hinterland of the North Range of European seaports, extending from Le Havre to Hamburg, are very densely populated in comparison with the EU average. This means that the North Range offers a comparatively large market, with correspondingly intense trade relations.<sup>24</sup>

#### 4.2 Europe's ports at a glance

The total amount of goods handled in the European shipping area differs considerably among the individual regions and ports. Each of the four European sea areas contains a single dominant port location whose volume of goods handled lies far above that of the others. In 2004, the ten largest ports in the North Sea area accounted for 28% of the total cargo handling amount of the 471 ports reviewed. The ten largest Mediterranean ports accounted for 13%, those in the Atlantic area 10%, and those in the Baltic Sea area 6% of the total amount of cargo handled by the 471 ports reviewed. In 2004, Rotterdam handled 10% of the total cargo handled by the largest European ports and was thus dominant within the European shipping areas.

Half of the top 10 Baltic Sea total cargo handled in 2004 was unloaded in Rotterdam and Antwerp. Rotterdam and Antwerp were the only European ports represented in 2005 among the world's ten largest ports (measured by total cargo handling). With handling amounting to 370 mn t in 2005, Rotterdam was one of the largest ports in the world, holding third place behind Shanghai (annual handling 443 mn t) and Singapore (annual handling 423 mn t). With 160 mn t, Antwerp was 10<sup>th</sup> in the world ranking list.<sup>25</sup> All told, 1.5 bn t of goods were loaded and unloaded at the EU North Sea ports, with 946 mn t handled by the top 10 ports

<sup>24</sup> See Amerini (2005).



and 570 mn t by the other North Sea ports. Three British ports are listed among the top 10 ports in the North Sea region. This is particularly due to the great significance of port economics in the UK resulting from its island position. These three ports were responsible in 2004 for total handling of 164 mn t, equivalent to 17% of the turnover of the top 10 North Sea ports.

An explanation for the large share of the total goods handling assumed by the North Sea ports is – apart from their geographical location in the North Range – the fact that they handle considerable amounts of liquid goods such as petroleum. In the supply of crude oil, Rotterdam is a main hub for northwestern Europe. Furthermore, heating oil deliveries from feeder vessels from Russia for non-European regions are collected here and pumped into larger ships.<sup>26</sup> In addition, Rotterdam’s access to the Maas and the Rhine Rivers facilitates the distribution of goods from Rotterdam to the European hinterland by inland waterway vessels.

Since 1997, growth rates have differed distinctly among the North Sea ports (see Fig. 21). While the rise in total cargo at the port of Rotterdam between 1997 and 2004 amounted to 9%, Hamburg showed an increase of about 43%. Similarly, double-digit growth was recorded during the same period in Wilhelmshaven (23%), Antwerp (29%), and Amsterdam (35%). During this time span, Amsterdam and Wilhelmshaven profited particularly from the expanding trade in oil as liquid cargo. The share of oil as liquid cargo of the total goods handled in

<sup>25</sup> See [www.portofrotterdam.com](http://www.portofrotterdam.com).

<sup>26</sup> See N.N. (2004b).

#### Top 10 of the North Sea region, total goods handling\*\* in 1,000 t

	1997	2002	2003	2004	Growth 1997–2004	Growth 2002–2003	Growth 2003–2004
1 Rotterdam (NL)	303,427	302,744	307,353	330,865	9	1.5	7.6
2 Antwerp (BE)	104,592	113,937	126,098	135,435	29.5	10.7	7.4
3 Hamburg (DE)	69,583	86,724	93,562	99,529	43	7.9	6.4
4 Bergen (NO)	n.a.*	84,803	75,806	74,157	n.a.	-10.6	-2.2
5 Grimsby & Immingham (UK)	n.a.	55,731	55,931	57,616	n.a.	0.4	3.0
6 Tees & Hartlepool (UK)	n.a.	50,447	53,842	53,819	n.a.	6.7	0.0
7 London (UK)	n.a.	51,185	51,028	53,289	n.a.	-0.3	4.4
8 Amsterdam (NL)	36,942	48,460	40,757	49,909	35.1	-15.9	22.5
9 Dunkerque (FR)	n.v.	44,301	45,791	46,448	n.v.	3.4	1.4
10 Wilhelmshaven (DE)	36,443	38,798	39,427	44,956	23.4	1.6	14.0
Total	n.a.	877,130	889,595	946,023	n.v.	1.4	6.3

\* n.a.: not available  
\*\* Handling without container tare weight

Fig. 21

Source: Eurostat (2006).

2004 amounted in Wilhelmshaven to 95%, in Amsterdam to 35%, and in Antwerp to 25%. The specialization of ports is also relevant to the differing growth rates of the port locations, since growth rates in container trade are much higher than those of trade in bulk goods. This explains, for example, the appreciable difference in growth between Rotterdam and Hamburg between 1997 and 2004. Whereas the share of container trade in Hamburg is approximately 60% of total handling, Rotterdam includes a much higher share of bulk goods than Hamburg.

In the Mediterranean area, with the second largest share of seaborne trade of the four trade areas surveyed here, there is also a dominant port, Marseilles (see Fig. 22). The port of Marseilles recorded handling of 90 mn t in 2004, equal to a 21% share of total goods handling in the Mediterranean. Since 2002, however, Marseilles has not been able to further increase its leadership position. Growth in goods handling at this port between 2002 and 2003 was only moderate at 3.6%, and between 2003 and 2004, it showed a downward trend. Part of the reason for this slim growth rate was the high share (86% in 2004) of liquid bulk goods as well as dry bulk goods in the total volume of goods handled. Handling of liquid bulk goods in Marseilles declined, at -4.2%, between 1998 and 2004.

In 2004, Mediterranean ports loaded and unloaded a total of 932 mn t of goods, including 427 mn t at the ten largest ports in the Mediterranean region and 505 mn t at the other Mediterranean ports. Handling in the ten largest ports in 2004 was thus 4.3% higher than in 2003. The differences in growth rates among the ports was pronounced in the period from

#### Top 10 of the Mediterranean area, total goods handling\*\* in 1,000 t

		1997	2002	2003	2004	Growth 1997–2004	Growth 2002–2003	Growth 2003–2004
1	Marseilles (FR)	n.a.*	89,244	92,418	90,810	n.a.	3.6	-1.7
2	Algeciras (ES)	n.a.	41,704	47,711	50,860	n.a.	14.4	6.6
3	Genoa (IT)	43,633	44,408	46,949	45,880	5.1	5.7	-2.3
4	Triest (IT)	46,664	43,717	41,566	41,516	-11.0	-4.9	-0.1
5	Taranto (IT)	36,720	32,462	35,305	39,368	7.2	8.8	11.5
6	Barcelona (ES)	n.a.	24,991	29,931	36,317	n.a.	19.8	21.3
7	Valencia (ES)	n.a.	28,481	30,385	32,297	n.a.	6.7	6.3
8	Augusta (IT)	30,702	29,904	31,803	31,699	3.2	6.4	-0.3
9	Tarragona (ES)	n.a.	29,232	28,638	29,607	n.a.	-2.0	3.4
10	Gioia Tauro (IT)	12,401	25,538	25,284	29,403	137.1	-1.0	16.3
	Total	n.a.	389,681	409,990	427,757	n.a.	5.2	4.3

\* n.a.: not available  
\*\* Handling without container tare weight

Fig. 22

Source: Eurostat (2006).

1997 to 2004. The disparity between the growth rates among the ports with the most dynamic development and those with the poorest amounted to 23.6 percentage points (+21.3% in Barcelona and -2.3% in Genoa). This means that the Mediterranean ports profited to varying degrees from the general expansion in trade.

In the Mediterranean ranking, as in the North Sea ranking, the fact came to bear that countries with a long coastline – such as Italy and Spain – have a comparably large number of important ports. The ten largest ports of the region include five Italian ports, which in 2004 accounted for total goods handling of 187 mn t and thus 44% of the total handling volume of the ten largest Mediterranean ports. The Mediterranean is also the home to four large Spanish ports with total handling volumes of 149 mn t and a 35% share of the total handling volumes of the top 10 Mediterranean ports in 2004. The Italian ports had handled 6.9 mn t more goods in 2004 than in 2003, while the Spanish ports handled 12.4 mn t more goods in 2004 than in 2003.

The top 10 ports in the Atlantic area recorded total goods handling in 2004 of 327 mn t (see Fig. 23). The share of these ports in the total volume of goods (655 mn t) of all EU Atlantic ports was approximately 50%. Gauged by total goods handling, in this region Le Havre is the largest port, clearly ahead of Milford Haven, its growth between 2003 and 2004, at 17.5%, the highest in the Atlantic area. Of the Atlantic ports, only Le Havre is one of the leading port locations in Europe. Following Marseilles, Le Havre is the largest port in France. Liquid cargo, whose annual growth between 1998 and 2004 was only 2.3%, amounted to 66%

#### Top 10 of the Atlantic area, total goods handling\*\* in 1,000 t

	1997	2002	2003	2004	Growth 1997–2004	Growth 2002–2003	Growth 2003–2004
1 Le Havre (FR)	58,207	63,733	67,382	71,878	23.5	5.7	6.7
2 Milford Haven (UK)	n.a.*	34,543	32,737	38,452	n.a.	-5.2	17.5
3 Southampton (UK)	n.a.	34,156	35,773	38,431	n.a.	4.7	7.4
4 Liverpool (UK)	n.a.	30,413	31,684	32,233	n.a.	4.2	1.7
5 Nantes Saint-Nazaire (FR)	n.a.	31,105	30,298	32,008	n.a.	-2.6	5.6
6 Bilbao (ES)	n.a.	24,696	27,475	31,633	n.a.	11.3	15.1
7 Sines (PT)	20,944	19,634	20,863	22,434	7.1	6.3	7.5
8 Dover (UK)	n.a.	20,212	18,796	20,753	n.a.	-7.0	10.4
9 Rouen (FR)	n.a.	19,407	21,688	19,883	n.a.	11.8	-8.3
10 Gijon (FR)	n.a.	20,300	18,801	19,847	n.a.	-7.4	5.6
Total	n.a.	298,199	305,497	327,552	n.a.	2.4	7.2

\* n.a.: not available  
\*\* Handling without container tare weight

Fig. 23

Source: Eurostat (2006).

of total goods handling in Le Havre. On the other hand, growth in container trade between 1998 and 2004 was 80%. This only minimally affected growth in total cargo handling during this period, because container trade only accounts for 25% of overall handling in Le Havre.

In the Atlantic area, as in the North Sea region, the UK ports are highly significant, with a handling volume of 129 mn t in 2004. The French ports, on the other hand, recorded total cargo handling of 143 mn t in 2004. Between 2003 and 2004, growth at the four French ports was 5.2 percentage points lower than that of the four top British ports.

The ports in the new EU countries in the Baltic Sea area – Poland, Estonia, Latvia and Lithuania – only began developing significant trade relationships with Western Europe in the early 1990s. In the course of the expanding trade relations between Eastern and Western Europe, certain port sites in the Baltic Sea region have grown immensely. Today the first five of the largest Baltic Sea ports are among the new EU member states (see Fig. 24). All told, 134 mn t of goods were handled in these ports in 2004. This is equivalent to more than 63% of the total goods handled by the ports in the Baltic Sea region. In all, the Baltic Sea ports account for 12% of the total goods handled by EU ports. Half of the handling in this region falls to the ten largest EU Baltic Sea ports. Here, too, as in the North Sea, just a few ports dominate the region. Approximately 17% of the handling at Baltic Sea ports are accounted for by Tallinn, the capital of Estonia, which is currently one of the most dynamic regions in the Baltic Sea region. The share of liquid goods, especially petroleum and (liquefied) natural gas from Russia, is considerable in the Baltic ports. In 2004, the proportion of liquid cargo handled in Tallinn (Estonia), was 68.5%, in Ventspils (Latvia) about 63%, and in Klaipeda (Lithuania) about 57.3%.

#### Top 10 of the Baltic Sea area, total goods handling\*\* in 1,000 t

	1997	2002	2003	2004	Growth 1997–2004	Growth 2002–2003	Growth 2003–2004
1 Tallinn (EE)	n.a.*	36,480	n.a.	37,116	n.a.	n.a.	n.a.
2 Ventspils (LV)	n.a.	n.a.	n.a.	27,081	n.a.	n.a.	n.a.
3 Klaipeda (LT)	n.a.	n.a.	n.a.	25,842	n.a.	n.a.	n.a.
4 Gdansk (PL)	n.a.	17,166	21,323	22,072	n.a.	24.2	3.5
5 Riga (LV)	n.a.	n.a.	n.a.	22,063	n.a.	n.a.	n.a.
6 Skoeldvik (FI)	9,886	17,581	17,453	19,248	94.7	-0.7	10.3
7 Lübeck	16,847	17,020	17,786	19,168	13.8	4.5	7.8
8 Rostock	16,818	17,347	16,712	16,367	-2.7	-3.7	-2.1
9 Helsinki (FI)	10,091	11,475	11,688	12,252	21.4	1.9	4.8
10 Trelleborg (SE)	8,771	10,336	10,655	10,771	22.8	3.1	1.1
Total	n.a.	n.a.	n.a.	211,980	n.a.	n.a.	n.a.

\* n.a.: not available  
\*\* Handling without container tare weight

Fig. 24

Source: Eurostat (2006).

### Total goods handling\* in 1,000 t, top 40 EU ports, 2004

Position	Port	Shipping areas	
1	Rotterdam (NL)	North Sea	330,865
2	Antwerp (BE)	North Sea	135,435
3	Hamburg (DE)	North Sea	99,529
4	Marseilles (FR)	Mediterranean	90,810
5	Le Havre (FR)	Atlantic	71,878
6	Grimsby & Immingham (UK)	North Sea	57,616
7	Tees & Hartlepool (UK)	North Sea	53,819
8	London (UK)	North Sea	53,289
9	Algeciras (ES)	Mediterranean	50,860
10	Amsterdam (NL)	North Sea	49,909
11	Dunkerque (FR)	North Sea	46,448
12	Genoa (IT)	Mediterranean	45,880
13	Wilhelmshaven (DE)	North Sea	44,956
14	Trieste (IT)	Mediterranean	41,516
15	Taranto (IT)	Mediterranean	39,368
16	Milford Haven (UK)	Atlantic	38,452
17	Southampton (UK)	Atlantic	38,431
18	Tallinn (EE)	Baltic Sea	37,116
19	Göteborg (SW)	North Sea	36,404
20	Barcelona (ES)	Mediterranean	36,317
21	Forth (UK)	North Sea	34,892
22	Valencia (ES)	Mediterranean	32,297
23	Liverpool (UK)	North Sea	32,233
24	Nantes Saint-Nazaire (FR)	Atlantic	32,008
25	Bremerhaven (DE)	North Sea	31,757
26	Augusta (IT)	Mediterranean	31,699
27	Bilbao (ES)	Atlantic	31,633
28	Tarragona (ES)	Mediterranean	29,607
29	Gioia Tauro (IT)	Mediterranean	29,403
30	Venice (IT)	Mediterranean	28,883
31	Ventspils (LV)	Baltic Sea	27,081
32	Klaipeda (LT)	Baltic Sea	25,842
33	Ravenna (IT)	Mediterranean	25,406
34	Porto Foxi (IT)	Mediterranean	25,212
35	Zeebrugge (BE)	North Sea	24,893
36	Sullom Voe (UK)	North Sea	23,939
37	Felixstowe (UK)	North Sea	23,413
38	Cartagena (ES)	Mediterranean	23,234
39	Sines (PT)	Atlantic	22,434
40	Gdansk (PL)	Baltic Sea	22,072
Total			1,956,836

\* Handling without container tare weight

Fig. 25

Source: Eurostat (2006).

**Shares of total goods handling  
of the top 40 ports, 2004**

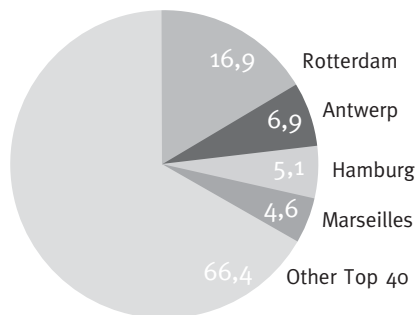


Fig. 26

Source: Eurostat (2006).

As in the individual regions of the European trade area, certain ports in the EU hold a generally dominant position (see Fig. 25). The forty largest EU ports had an approximately 56% share of the total goods handled in the 471 ports that were reviewed. The North Sea ports of Rotterdam, Antwerp and Hamburg held the top positions in 2004 and, along with the Mediterranean port of Marseilles, accounted for about one fifth of the total goods handled at the 471 largest EU ports. The goods handled by these four ports amounted to about one third of that of the top 40 ports (see Fig. 26). Since 2000, the development of the top 40 ports has varied greatly (see Fig. 27). Whereas certain North Sea ports, especially British ports, suffered marked declines, trade in other ports increased immensely: at the Spanish ports of Barcelona (40.8%), Cartagena (35.5%) and Valencia (47.1%), the Italian port of Gioia Tauro (35.9%), and in Hamburg (29.3%). With the exception of Cartagena, these are ports that specialize in container trade. In Cartagena, on the other hand, the handling of liquid cargo increased considerably, by 36.9%, between 2000 and 2004.

Top 40 ports\*, total goods handling\*\* in t, growth 2000 to 2004

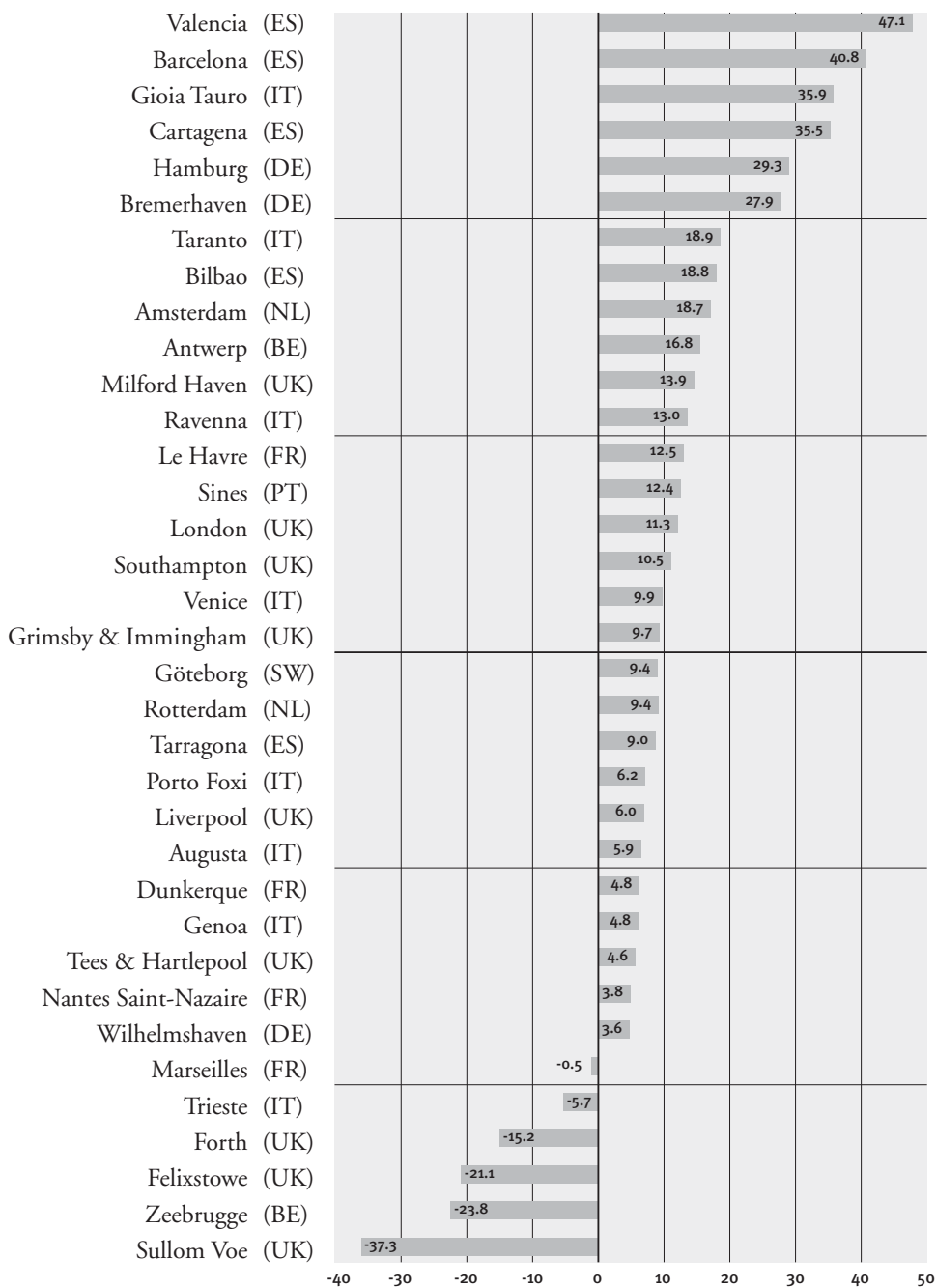


Fig. 27

Source: Eurostat (2006).

\* Without Algeiras (ES), Tallin (EE), Gdansk (PL), Ventspils (LV) and Klaipeda (LT).

\*\* Handling without container tare weight.

### 4.3 Hubs and feeder transport in Europe

Increasing use has been made recently of the “hub and spoke strategy,” in which cargo is transported on feeder ships from smaller ports to larger ports (hubs). Having arrived at the hubs, the cargo is regrouped and then loaded onto larger ships along with goods from other ports. Feeder ships are those that transport goods from the smaller ports, while large seagoing vessels are primarily used for transporting goods over long distances. This makes it possible to take advantage of economies of scale, because large volumes of goods mean lower average transport costs. At the same time, the transport time required by the large ships is reduced, since they do not have to call in at every single port. The hub and spoke strategy is also essential because many of the smaller ports in the European trade area do not have the structures necessary to permit entry by large vessels and container ships. The same strategy is used to distribute arriving goods.

Feeder and ocean-going vessels run on fixed schedules between ports in many places, to regionally distribute the containers that arrive at hubs like Hamburg, Marseilles or Rotterdam. In short sea shipping<sup>27</sup>, on the other hand, not only feeder vessels are used, but other small ships that run between ports in the same geographical region. With the long EU sea coast of 35,000 km and the many inland waterways in the EU, there are numerous ways of utilizing short-distance ships for transporting cargo. These are being used more and more frequently, with growth in short sea shipping between 1990 and 1998 amounting to 27%.<sup>28</sup> This is in part due to the fact that the escalating use of increasingly larger vessels in long-distance shipping, with concurrent growth in cargo handling, means a continuous increase in the cargo volumes that are transported further from the large ports. The European Commission sees considerable potentials in short sea shipping and is implementing measures to foster it. Unfortunately, it is still being hindered to an extent in the EU, e.g. through administrative barriers.<sup>29</sup> New regularly scheduled runs between the hubs and the smaller ports could upgrade certain port locations. In the course of this development, existing ports may develop into new hubs.<sup>30</sup> This assessment applies primarily to ports that are affected by the expansion in container handling.

Intraregional trade accounts for a considerable share of the total cargo handling of individual ports. The share of European intraregional trade (total cargo handling in t) in Antwerp in 2004 was 32%, in Marseilles 45% (2004), in Hamburg 41% (2003), in Rotterdam 47% (2004), and in Tarragona 39,5% (2003). These five ports operate as hubs. In Antwerp and Rotterdam, the largest share of goods that do not originate from inner-European trade originate

<sup>27</sup> The European Commission suggests the following definition [translation]: “Short sea shipping is the conveyance of cargo and passengers between two ports located in the geographical region of Europe or between these ports and ports in non-European countries that have a coastline on inland seas that border on Europe.” This definition thus also includes EU shipping traffic with Norway, Iceland, and states bordering on the Black Sea, the Mediterranean, and the Baltic Sea (see EU 1999).

<sup>28</sup> See EU (2001).

<sup>29</sup> See EU (2001).

<sup>30</sup> European Sea Ports Organisation (2004).



from or are destined for the USA – Antwerp 27% (2004) and Rotterdam 20% (2004). In Marseilles, as in Tarragona (39.1%; 2003), Africa's share in non-European total cargo handling was the highest.<sup>31</sup> In the port of Hamburg, however, the exchange of goods with Asia was the most important in interregional maritime trade (33%, 2003). Each of the five ports mentioned has an intraregional total cargo handling volume of under 50%. In contrast, ports like those of Lübeck, Helsinki and Dublin trade almost solely intraregionally. Generally speaking, as the size of the port increases, the share of intraregional maritime trade decreases while, as a rule, ports with an above-average share of interregional trade serve as hubs. It is only in the large ports that mass advantages can be utilized in transport. Furthermore, it is evident that some of the leading port sites in Europe demonstrate international trade patterns that differ from one another. While Hamburg concentrates on Asia, for example, the trade relations of the major European ports in southern Europe are distinguished by intercontinental maritime trade with Africa.

#### 4.4 Europe's ports in the world economy

Two ports in the North Range, Hamburg and Rotterdam, are listed in the ranking of the world's ten largest container ports. In comparison with world standards, however, most of the European ports are small. The East Asian ports head the list in a ranking of the world's largest container ports in 2005 (see Figs. 28 and 29). The world's six largest ports are located in this region: Singapore, Hong Kong, Shanghai, Shenzhen, Pusan and Kaohsiung. In 2005, a Middle East port, Dubai, joined this list. Of the American ports, only Los Angeles is listed among the ten largest container ports.<sup>32</sup> The six Asian ports account for a share of approximately 75% of the top 10 in container handling.

There are considerable differences in growth in container handling among the world's largest container ports (see Fig. 29). Shenzhen's container handling grew by 219.1% between 2001 and 2005. During the same period, Hamburg recorded a growth rate of 72.5%. Kaohsiung and Hong Kong, on the other hand, with a plus of 25% during this period, showed the lowest growth rate of the studied ports. Particularly striking here is the dynamic development of port locations in Asia, which profit immensely from the increasing integration of the Asian locations in the international division of labor.

Singapore<sup>33</sup> is the world's leader in container handling and, following Shanghai, the world's second largest port in total goods handling. In 2005, it recorded 23.2 mn TEU in container handling.<sup>34</sup> This means that Singapore has ousted Hong Kong from first place among the

<sup>31</sup> The data on hub and feeder traffic come from the Institute of Shipping Economics and Logistics (ISL). Here the definitions of regions are somewhat different than those used by Eurostat. For example, the ISL considers Santa Cruz de Tenerife as part of Africa, while Eurostat sees it as part of Europe. See ISL (2005).

<sup>32</sup> See N.N. (2006a).

<sup>33</sup> See [www.internationalpsa.com](http://www.internationalpsa.com) and [www.singaporepsa.com](http://www.singaporepsa.com).

<sup>34</sup> See N.N. (2006a).

**The top 10 of the world's largest container ports, container handling 2005, in mn TEU<sup>35</sup>**

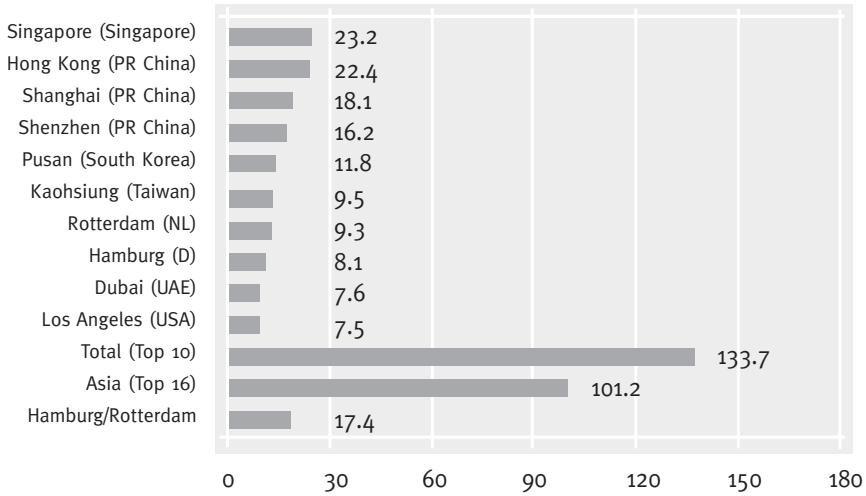


Fig. 28

Source: www.hafen-hamburg.de.

**The top 10 of the world's largest container ports, growth in container handling, 2001–2005**

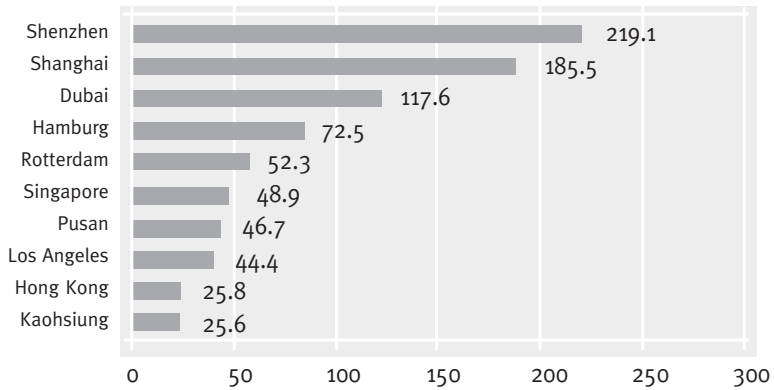


Fig. 29

Source: www.hafen-hamburg.de.

<sup>35</sup> It is common to count double (loading and unloading) in the container transshipment segment. This should be noted in the evaluation of the rankings of the world's largest container ports. For example, in 2005 Singapore recorded handling of 23.2 mn TEU, 80% of which belonged to the transshipment segment, or 18.64 mn TEU of the total container handling. This means that 9.32 mn TEU were unloaded in Singapore. Then 9.32 mn TEU plus the remaining amount of 4.64 mn TEU were again loaded onto ships.

top container ports. Singapore's most important advantage is its location on the Strait of Malakka, which is a key section of the ocean route between Asia and Europe. More than 30% of world trade shipped by sea pass through this straight, more than 2,000 ships daily. The port of Hong Kong is the hub for the South Asian Pacific region. It is connected directly with the hinterland of China and the Guangdong region, one of the world's largest industrial regions. It is, however, expected that Hong Kong will be eclipsed by Shanghai and Shenzhen in container handling by 2010 at the latest, because the basic conditions for development of the port economy of these locations are considered very favorable.

In 2005, Shanghai was ranked third among the world's largest container ports and had grown by 24.2% between 2004 and 2005.<sup>36</sup> This is the greatest change since 2004 among the ten largest container ports. In total goods handling (including inland waterway shipping), Shanghai held first place in 2005, with 443 mn t annually.<sup>37</sup> By 2006, the deepwater port of Yangshan is to be added to the port of Shanghai, although it will only be working to full operational capacity by 2020.<sup>38</sup> The Yangshan port project will increase Shanghai's container capacities by 5 mn TEU, thereby highlighting its importance as a transshipment port.<sup>39</sup>

Shenzhen<sup>40</sup> is located very close to Hong Kong, on the opposite side of the Pearl River Delta, with very good access to the Guangdong region. The growth rates of this Asian port are also immense: 219% in the period between 2001 and 2005. In 2004, Shenzhen was already fourth in the ranking of the world's largest container ports, although in the previous year it hadn't even been one of the top 10 ports.<sup>41</sup> According to a scenario for China's container ports, Shenzhen will surpass the ports of Hong Kong and Shanghai and will have a container handling operation of 33.5 mn TEU by 2010.<sup>42</sup> In line with the concept of the Shenzhen Port Authority, the neighboring port of Hong Kong is to develop complementarily to the port of Shenzhen, so that an international seaport center can be formed. A parallel development of the two ports will be fostered by a bridge over the Pearl River Delta, connecting the two harbor cities of Shenzhen and Hong Kong.

Important port locations in the Asian region have also been established outside of China. The port of Pusan, in the southeastern part of the South Korean Peninsula, is the largest port in South Korea. As a result of the large feeder network, Pusan serves as a hub for the northeast Asian region in intra-Asian trade, as well as trade with the Pacific region. Besides, Pusan is located geographically on the way from China to Japan. The port of Pusan competes particularly with the Japanese ports of Kobe and Osaka. New, more cost-competitive ports in the north of China (Dalian, Qingdao and Tianjin) are currently being developed, aspiring to become the northeast Asian hub.<sup>43</sup>

36 See *ibid.*

37 See [www.portofrotterdam.com](http://www.portofrotterdam.com).

38 See N.N. (2005b).

39 See Junchun, Mao (2004).

40 See [www.sztp.gov](http://www.sztp.gov).

41 See N.N. (2006a).

42 See N.N. (2004c).

43 See [www.busanpa.com](http://www.busanpa.com).

The Taiwanese port of Kaohsiung<sup>44</sup> is the world's sixth largest port. Kaohsiung has a geographically advantageous location on the East Chinese Sea, opposite China and between Shanghai in the north and Hong Kong in the south. Kaohsiung competes particularly with the ports of Hong Kong and Shenzhen for market shares of a regional container hub in the transshipment segment. Most recently, privatization strategies have gained importance.

The port of Dubai<sup>45</sup> in the United Arab Emirates profited from its geographical location between Asia and Europe and held third place in growth in container ports between 2001 and 2005. Due to the immense growth rates, Dubai was able to climb one spot in the container ranking and relegate Los Angeles to tenth place.<sup>46</sup> The total capacity of the port of Dubai is to be increased to 22 mn TEU by 2020. The port profits in part from a special economic zone designed to attract new business.<sup>47</sup>

The port of Los Angeles<sup>48</sup> is the world's tenth largest and the only American port in the ranking of the world's largest container ports.<sup>49</sup> The most important trade partners of this port are Asian countries such as China or Japan. Los Angeles is located on the Pacific and thus has an advantage over the large ports on the American eastern seaboard like New York. The port profits from the super-postpanamax class, that is, oceangoing ships that cannot fit through the Panama Canal, the fastest link between the Pacific and the Atlantic, and therefore cannot directly call at ports on the east coast of America. In addition, Los Angeles is one of the largest metropolitan regions in the world and therefore offers a major selling market. Major problems for harbor development are caused by the limited space, however, since the harbor area can only be expanded by means of additional landfills.

On the whole, the large container ports worldwide show immense growth rates, albeit with considerable regional differences. In the more recent past, Asian port locations have handled the greatest number of containers and shown the highest growth rates. Up to now, it has apparently been possible to increase the port capacities in this region continuously and very rapidly, offering the capacities needed to cover the growing trade in the Asian region. The European ports are relatively small in comparison with global averages, except for Rotterdam, Hamburg and Antwerp. This applies to both container handling and total goods handling. The size of a port, however, does not reveal how competitive it is as a whole, but rather its supraregional importance. For the major European ports with their function as hubs – as well as for the Asian “megaports” – this is considerable.

44 See [www.khb.gov.tw/english](http://www.khb.gov.tw/english); [www.stroudgate.net](http://www.stroudgate.net) and [www.bfai.de](http://www.bfai.de).

45 See [www.dpa.ac](http://www.dpa.ac) and [www.dpworld.com](http://www.dpworld.com).

46 See N.N. (2006a).

47 See N.N. (2000).

48 See [www.portoflosangeles.org](http://www.portoflosangeles.org).

49 N.N. (2006a).

## 4.5 Determinants of port development

As a whole, the prospects for the growth of ports depend on how trade develops in general, the ports' export and import regions, and the general competitiveness of the ports. *Ceteris paribus*, a port location has better perspectives for development if it concentrates more intensely on trade with booming regions.

A port's competitive position is influenced by numerous factors (see Fig. 30). Specific parameters at various port locations determine the advantages and disadvantages of these locations, which have affected their development in the past and will also have an effect on their future growth rates. A special characteristic of ports is that their functions and the related business sectors for the most part cannot be transferred to any arbitrary location. Relocating a port, as is to be accomplished in Helsinki through the Vuosaari Harbor project by 2008, is actually a rarity.<sup>50</sup> At the same time, new competition in the vicinity can cause ports to lose in significance, even making it necessary to relinquish the location.

The intensity of the competition which a port faces is related to the geographic distance from other (potential) port locations and other geographical and biogeographic factors. For example, the geographically determined conditions of Hamburg and Rotterdam differ clearly. The port of Hamburg is approximately 110 km from the sea and is located inland on the Elbe River, which has a positive effect on transport costs for goods destined for the hinterland

50 By 2008, the harbor is to be moved to the eastern part of the city (14 km from the center), to facilitate more efficient land utilization in the center of the Finnish capital, to reduce traffic and noise in the downtown area, and to make space for the expanding economy. See N.N. 2004.

### Determinants of port development

- *Geographic location:* Substitute ports; distance from the open sea; tides and tidal range; proximity to market; (natural) water depth
- *Infrastructure:* Docks; depth of navigation channels and basins; surface area allocation; hinterland links (water, road, rail, pipeline); capacities
- *Suprastructure:* Computer and logistics systems and ICT; ground stabilization and reinforcement (road surface, bollards, etc.); multi-story buildings (warehouses, etc.); handling equipment (tractor units, container gantries, cranes, etc.); supply and waste disposal lines
- *Costs:* Port expansion and planning implementation; port charges and other port dues; human resources capital; ISPS Code and other security measures; salaries; strike frequency; public/private port operators; environmental requirements; free port

Fig. 30

areas. Its location on the Elbe, however, also means that navigation in the port of Hamburg is affected by the tides. Only ships with a maximum draft of 12.5 m can call on the port of Hamburg regardless of the tides. Rotterdam, in contrast, is a deepwater port with a navigable channel of 22.5 meters, which can be navigated by giant vessels with more than 10,000 TEU, independent of the tides, which is not (yet) possible in Hamburg.

Apart from the geographical location, numerous other factors relating to the site (see Fig. 30) influence the competitive position of a port and thus the volume of cargo handled in that port. Key factors here are the infrastructure, suprastructure and costs that are relevant to cargo handling.

A critical site-related factor which is highly significant for the competitiveness of all ports and their economic development are the infrastructure links from the port to the hinterland areas, by pipeline, rail, waterways, road and air. Seaports are intermodal transport junctions in international and domestic trade, and goods are transported from the port to their final destination by various means. Good logistics for the hinterland areas are a prerequisite for ensuring that no bottlenecks arise, preventing traffic jams and thus keeping the time and cost for transporting the goods between the port and the final destinations as low as possible.

The local load volume (the share of cargo being handled that will stay in the area or is generated in the area) is also relevant for the development of ports. A high local load has a stabilizing effect on the handling figures, since companies based in the region generally make regular use of the same port to receive and ship their goods. The local load volumes of port locations vary appreciably, as shown by the comparison between the planned JadeWeserPort (see Box 3) and the port of Hamburg. The Hamburg port has a comparably high local load. Approximately 30% of the merchandise handled via the Hamburg port come from or are heading for a destination in the Hamburg metropolitan region.<sup>51</sup> The JadeWeserPort, on the other hand, is being planned as a pure transshipment port for containers. It will have a comparably low local load volume, as it is located in an economically underdeveloped region.

Depending on the biogeographic and infrastructural situation of a port, the modal split may differ considerably in regard to the shipping of cargo onward to its final destinations. This results in differing costs for further transporting goods to their selling markets in hinterland areas, due to the differing characteristics of road, rail, water and pipelines as modes of transport. Road traffic is clearly dominant in linking ports to hinterland areas, whereby the overloading of certain roads is becoming more and more of a bottleneck. In many cases, due to its very limited flexibility, rail traffic does not constitute a serious alternative to road traffic. Freight trains often have to wait on side tracks during the day because the conveyance of passengers takes precedence in many places and the distances in Europe are too great for a freight train to reach its destination during the night. Another disadvantage of transporting goods by rail is that the EU countries and their neighbors still have different power systems,

51 See Eckhardt (2006).

## Jade-Weser-Port<sup>1</sup>

Germany's first deepwater port, the JadeWeserPort, is currently being built in Wilhelmshaven in Lower Saxony. The JadeWeserPort, whose container terminals are to go into operation by 2010, will be a port of call for future giants of the sea with a length of up to 430 m, a draft of up to 16.5 m, and a capacity of more than 8,000 TEU (post-panamax container ships). Container ships of this new generation will soon be able to call at the JadeWeserPort, only 23 sea miles from the open sea, regardless of the tides. The planned quay length of the terminal is 1,725 m, enough to permit four large container ships to be loaded or unloaded at the same time with up to 17 container bridges. The terminal will cover an area of 120 ha and, at full capacity, will be able to handle 2.7 mn TEU annually. When this complete capacity has been reached in 2020, 1,000 new jobs are expected to have been created right at the port, and an additional 1,000 with other local logistics companies.<sup>2</sup>

Planning for the JadeWeserPort began in 2001, originally as a project to be conducted jointly by the federal states of Hamburg, Bremen and Lower Saxony. In addition to Lower Saxony, where the port is located, Hamburg and Bremen also expect positive economic effects through this port construction in Wilhelmshaven, due to their proximity to it. In 2002, however, Hamburg decided to withdraw from the financing of the new port construction, having decided that its priorities had to be on investments in the Hamburg port as well as the deepening of the Elbe navigation channel, to support development of the Hamburg harbor.<sup>3</sup> Bremen and Lower Saxony are jointly financing the approximately 670 million euros for infrastructure and transport links for the JadeWeserPort. The investments for the suprastructure (container bridges, industrial trucks, ground stabilization and reinforcement, buildings, etc.) amounting to approximately 300 million euros will be made by the operating companies, who will be granted a concession for 40 years. APM Terminals International has a 30% interest in EUROGATE Container Terminal Wilhelmshaven GmbH, to be established for port operations, and will finance the same share of the investments in the suprastructure, while EUROGATE will be responsible for the remaining 70%.

Basic capacity utilization of the new port was not yet certain in 2002. After world trade slumped following the weak economy of 2001, it was feared that the JadeWeserPort could become a "white elephant."<sup>4</sup> Especially in the case of economic slumps, there is reason to fear that the giant container ships, for which the JadeWeserPort was being built, would be the first to be running under capacity. Should this happen, the JadeWeserPort would no longer be the port of call for large vessels, but would be competing with Hamburg for the handling of smaller cargo ships. Slumps in international trade will in all probability be temporary in the future, too, and would therefore only lead to a decline in the volume of handled cargo for a limited period of time. Long-term, in view of the lasting expansion in world trade that is expected, it is assumed that the sea cargo market will continue to expand and that both the JadeWeserPort and Hamburg harbor will profit from this.

1 See [www.jadeweserport.de](http://www.jadeweserport.de).

2 See Geisler (2006).

3 See N.N. (2004a).

4 See Hollmann (2002).

## Modal split in container handling traffic 2005

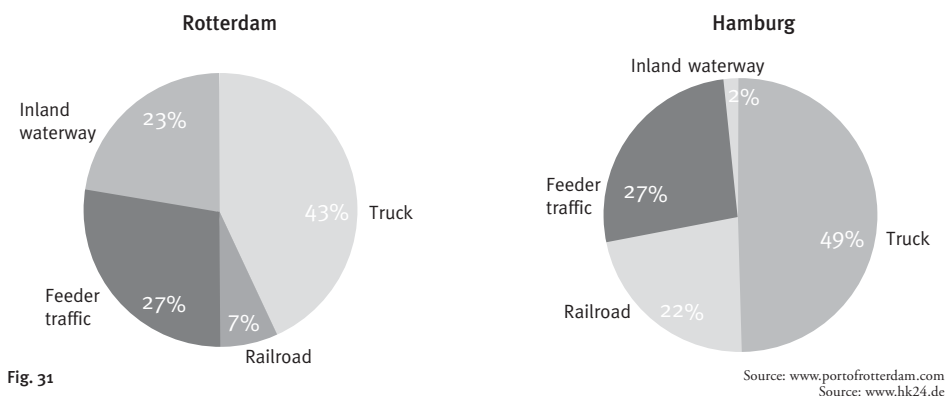


Fig. 31

gauges and signals, making it necessary to change vehicles at a national border, adding to transport costs and time. The EU Commission regards short sea shipping and shipping by inland waterways as the options that may be able to provide solutions to congestion on certain roads and the short-comings of the railroad network. This means that transport by truck would only be indispensable for short distances, and there would be alternative solutions for medium- and long-distance transports.<sup>52</sup> It should, however, be kept in mind that transport by inland waterways also has numerous disadvantages to road traffic. Inland waterway traffic, for example, is highly dependent on seasonal fluctuations in the water level.

Geographical conditions are also responsible for a considerable portion of the marked differences in modal split in the onward transport of goods. Container handling at the ports of Hamburg and Rotterdam (see Fig. 31) is a perfect illustration of this. The port of Rotterdam, even ahead of Hamburg as the largest container port in Europe, has direct access to the North Sea. In 2005, 49% of the further transport of the container ship cargo from Rotterdam was by inland waterway vessel. In contrast, merely 2% of the container volume in Hamburg was further transported by inland waterway vessel. In Rotterdam, the importance of the pipelines and thus Rotterdam's regional significance in regard to handling liquid bulk goods similarly come into play. Some 24% of the crude oil transported from Rotterdam to Germany in 2002 traveled via pipeline.

An additional area that is of great significance in determining the competitive position of ports is the legal provisions, e.g. environmental regulations, that apply to the modernization and expansion of harbor facilities. An example of this is the decision-making process in connection with the planned deepening of the Elbe River near Hamburg, after which ships with a draft of 14.5 m will be able to put into the Hamburg port and put out to sea from there, regardless of the tides.

<sup>52</sup> EU (2001).



The deepening of the Elbe is to cost a total of 320 million euros and to be completed by 2010. The project approval procedure has been in progress since the middle of June 2006, and construction is scheduled to start at the beginning of 2008. Environmentalists are against the expansion of the lower and outer Elbe River.<sup>53</sup> Additional problems stem from the legal stipulations that must be complied with in connection with major infrastructure projects and which in part bring about considerable time lags between the development of a project and its realization. The political approval processes are complicated by the fact that three regional levels (three federal states, the federal government, and the EU), with divergent interests and differing financial responsibilities, are involved in the deepening of the Elbe. Since it is a federal waterway, two planning approval processes are necessary. Actions can be filed against the planning approval process, which would further delay the deepening of the Elbe or even prevent it for the time being.

The example of the work on the Elbe River shows that harbor expansions and improvements in the relevant traffic infrastructure can take a long time, as the result of procedural requirements. This means that the port locations involved cannot react quickly to increased demand. For the Elbe River project, planning and implementation will take approximately five years. The political discussion preceding this took just about the same amount of time. The result is a large time lag between the political decision and the actual realization of a project. This can result in capacity shortages for cargo handling, with a negative effect on the competitive situation of the port, and may temporarily prevent the port from participating in the growth resulting from the continuous expansion of world trade.

The general political and legal framework that influences the cost levels for the loading and unloading of ships may also become increasingly important in the future. One example of this is the implementation in specific countries of the ISPS code (International Ship and Port Facility Code)<sup>54</sup>, engendering different regional cost effects, depending on whether the transport industry or the government bears the costs.

<sup>53</sup> See [www.zukunftelbe.de](http://www.zukunftelbe.de).

<sup>54</sup> The ISPS Code, in force since July 1, 2004, sets forth, among other things, measures for ship security and monitoring (See Eckardt 2006).

### Impacted business sectors

Port/Logistics	Shipbuilding	Shipping and ship-related services	Marine engineering, fishing, aquaculture, tourism
Distribution/Handling	Shipyards	Shipping companies	Energy industry
Transport	Sub-contractors	Ship's agents	Commodities conveyance
Processing		Ship suppliers	Recreation, sports
		Ship insurers and experts	Food/food processing industry
		Shipping banks	

Fig. 32

Source: N.N. (2003).

Generally speaking, it should be assumed that the increasing flow of trade will continue in the future to produce growth impulses for increased value and employment at port locations. It has an influence on the development of the port itself and of the economic sectors linked with it (see Fig. 32), such as logistics and ship-related services. Economic sectors such as the food and food processing industry, refineries, shipyards (see Box 4), and ship-related services of all kinds are also often found in close proximity to a port. In addition, former port areas are being used increasingly all over the world for residential purposes (see Box 5).

The extent to which the future expansion in cargo handling in ports will impact regional income and employment will depend on the specific economic structures of the location that is involved, on the extent to which the port economy is interlaced with other economic sectors in the region, and on the specific determinants of the development of port economics and the accompanying competitive situation.

### Ports and shipyards<sup>1</sup>

As an economic sector, the shipyard industry in Germany, as in Europe as a whole, has traditionally been closely linked with port development, exerting a potent effect on employment. Shipbuilding and maintenance, along with other segments of port economics, have clearly had a positive economic effect in German port cities. Since the 1990s, however, a definite slump has been observed in the shipyard industry. As a result of a rapid decline in employment since the 1990s, only 23,000 people are still at work at German shipyards, 37,000 fewer than fifteen years ago. Eastern Germany was particularly affected by this loss in shipbuilding jobs. Since reunification, some 11,800 jobs have been eliminated in the former state-owned shipyards in Mecklenburg-Western Pomerania (Stralsund and Neptun Stahlbau).<sup>2</sup> Apart from the immense reduction of jobs in Mecklenburg-Western Pomerania, the bankruptcy of Bremer Vulkan AG in 1996 was a critical moment in the history of German shipyards. In Hamburg, the employment decline of 30% as against 1990 was relatively minor when compared with the other shipyard locations in northern Germany.

Even though the significance of shipbuilding has decreased considerably over the years, shipyards continue to strongly influence the structure of parts of Germany and in many places is an important component of the maritime industry. In Lower Saxony, 6,000 people still worked in shipbuilding in 2005. In Mecklenburg-Western Pomerania, this figure was 5,700.<sup>3</sup> In addition to the 120 shipbuilding companies in Germany, there are approximately 400 supplier companies with some 70,000 employees.<sup>4</sup> Many of the

1 See VSM (2005).

2 See Schneider (2005).

3 See N.N. (2005a).

4 See Schwandt (2005).



#### Box 4

suppliers are based in close proximity to the shipyards, although equally important suppliers and special shipbuilders are located in Bavaria and Baden-Württemberg. This means that a total of more than 90,000 employees are directly dependent upon the development of shipbuilding.

To an extent, the shipyard industry is influenced by a new orientation in production. In Mecklenburg-Western Pomerania, the restructuring resulting from the economic transformation process contributed not only to a considerable decline in employment, but also to immense increases in productivity due to the modernization of production processes. Today the formerly state-owned shipyards of eastern Germany (Aker Ostsee Werften, Peene-Werft, Volkswerft Stralsund) are among the world's most modern and productive, in part as a result of their specialization on container shipbuilding.<sup>5</sup> The competitive position of German shipyards on the world market has changed as a result of increasing competition from Asia, including the relatively low labor costs in China. The market position of Asian bidders is also strengthened by high subsidies, such as in South Korean shipbuilding, where they account for up to 30% of the costs of a ship.

Despite massive competition on the world market, there are examples that show that the German shipbuilding industry continues to be competitive, especially in niche and high-tech shipbuilding products. German shipyards are successful with products such as ro-ro vessels, smaller container ships, luxury yachts, cruise ships and naval vessels. German port locations that wish to strengthen their shipbuilding industries should therefore promote innovation, technology and training in the shipbuilding sector through their



**Employment in shipbuilding (1990 = 100)**

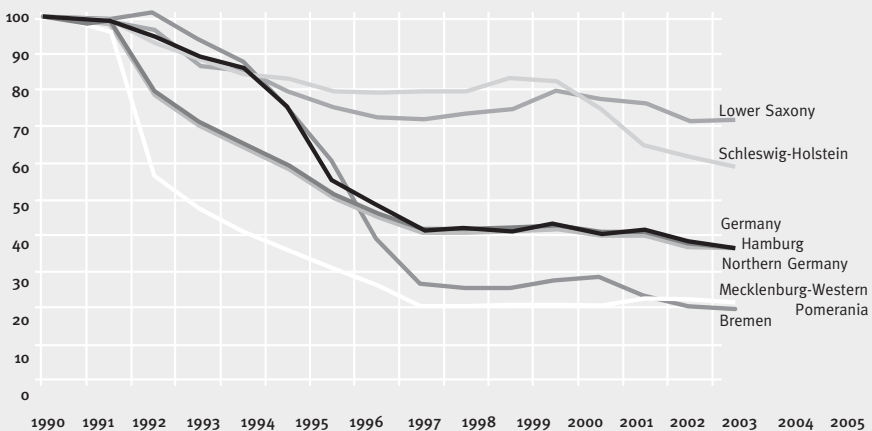


Fig. 33

Sources: Federal and State (Land) Statistical Offices; VSM (2005).  
As of January 2003, the statistical group reporting was expanded.

education and research policies, in order to strengthen their good standing in the high-tech ship sector. An example that points in this direction is that Hamburg will be putting one of the world's most modern ship simulators into operation in 2007. The simulator is to be utilized primarily for the basic and advanced training of navigators. Use by the public will also be possible, however, this being a component of the financing concept and involving tourism at the Hamburg harbor.<sup>5</sup>

<sup>5</sup> See Tiedemann. (2006).

### Living and working at former port sites

As a result of structural changes and relocations, former port sites in many places are becoming available for urban development projects, often in close proximity to the center of the city. New downtown residential areas are now being built in such places in numerous European cities. In Helsinki, for example, where moving the port out of the center of the city and making 100 ha of property available will facilitate the most extensive development project to be conducted by the city of Helsinki in the coming decades. Models for this project are already successful waterfront projects like the London Docklands or Malmö's Västra Hamnen. The construction of HafenCity in Hamburg and Überseestadt in Bremen are examples of the revitalization of old harbor areas that have been integrated into urban development projects.

The creation of HafenCity is one of the measures designed to implement the overall concept of "Hamburg – A Growing City." This plan has been initiated by the Hamburg Senate and is to contribute to above average employment, population, and GDP growth rates in the Hanseatic city in the coming decades. The HafenCity site covers 155 hectares, of which 55 hectares are water, 100 hectares land, and 60 hectares net building land. The existing infrastructure of the port has been integrated into the development concept of HafenCity, and the port basins will be complemented by quays for recreational sports activities, promenades, jetties, and bridges for strolling. The new part of town will be only a short trip from City Hall or the railroad station. HafenCity will be connected to the subway network with a new line, and it will be given a highway exit.



Box 5

If the objectives of the “Growing City” slogan are realized – the goal is for 2025 – 12,000 people will be living here and 40,000 people will be working here in the services industry. Construction of the Überseequartier center of HafenCity is to be completed by 2009. Also planned here are cultural programs centering around the theme of water, adding – along with dining and other entertainment facilities – to the recreational features of HafenCity.

A reurbanization of the partially unused expanses of the overseas and European ports in Bremen has been pursued since 1998. Under construction here is Überseestadt Bremen, which will have a total area of approximately 300 ha and will extend over 3.5 km. This makes Überseestadt twice as large as the HafenCity project in Hamburg. The development period will stretch from 1998 to 2019, with the investment costs estimated at 2 billion euros. Links will be created between Überseestadt and the streetcars and roads of the superordinate municipal transport network. As at HafenCity, service and residential areas are planned. There will also be areas for industrial use, a difference between the “Überseestadt Bremen” urban development project and the HafenCity project. Überseestadt also dedicates space to culture and education, such as Speicher XI, which houses the Academy of Arts.

The fundamental prerequisite for the successful implementation of the “Hamburg HafenCity” and the “Überseestadt Bremen” projects is positive economic development in these cities, resulting in new jobs. The success of both projects will depend upon the extent to which they are successful in attracting people and companies. In this regard, HafenCity Hamburg and Überseestadt Bremen are in competition with other locations in the urban area as well as other cities throughout Germany and Europe. These ambitious harbor projects can only be successful if the advantages they offer exceed those of other locations. A positive factor in this context is the fact that the emerging city quarters are close to the center of the city and connected to the superordinate municipal transport network. The establishment of educational and cultural venues in these parts of the city is also a positive factor, as this affects the city image favorably. A potential danger, however, is that the influx of people to HafenCity and Überseestadt might result in population losses in other parts of the city. This is especially true in view of the demographic changes taking place in Germany. Furthermore, the establishment of companies in the new areas could result in losses in other parts of the city, so that the cities will not be able to meet their overall goals for creating jobs.

1 See Läßle (1995).

2 See [www.hafen-city.info/](http://www.hafen-city.info/)

3 See [www.ueberseestadt-bremen.de/de/daten\\_fakten\\_uestadt](http://www.ueberseestadt-bremen.de/de/daten_fakten_uestadt).

## 5. HWWI forecast

### 5.1 World trade

The development of sea transport up to the year 2030 will be determined primarily by the development of world trade. World trade represents the demand side of the market for international, and thus related national, transport services. The HWWI forecast for world trade is based on an augmented gravity model, a standard model of empirical foreign trade research used to explain bilateral flows of trade. It makes it possible to quantify the influence of geographic, cultural, historic and economic factors on trade between two countries. In addition to income, the most important factor in this projection, there are others, such as the geographical distance between the trade partners, any shared border, access by sea to the trade partners, population size, economic-political alliances like monetary or customs unions, historical components such as colonial relationships, and numerous other factors.

Utilized for this analysis is a data record<sup>55</sup> containing approximately 240,000 observations relating to bilateral trade and the underlying economic, geographical, political and cultural factors in the period between 1948 and 1999. The resulting parameters are used in projecting future flows of trade. Accordingly, a one-percent increase in the gross domestic products of each of two countries involved will increase bilateral trade between these countries by 0.95%.

The gravitation model shows that economic growth also results in an increase in trade relations between the countries. According to a forecast drawn up by the World Bank, substantial increases in production and income are to be expected in all regions of the world by the year 2030. Fig. 34 shows the World Bank forecast of average annual growth rates.

The greatest economic growth, as predicted in this study, is expected in the southern and eastern Asian countries. According to the gravitation model, the highest growth rates in world trade will thus be seen between the Asian regions and the rest of the world. The matrix in Fig. 35 shows the annual growth rates in trade within and between the regions, as determined by linking the gravitation model and the GDP growth forecast.<sup>56</sup> Information regarding trade between EU member states, in which we focus on maritime trade, is shown in Fig. 36.

### 5.2 Maritime trade

The expected trade volume, in tons, is more germane to the transport industry than future trade measured in euros. However, it is not possible to directly induce the trade volume from the real trade in euros. This is because, over the course of years, trade volume has undergone a different development than trade value. In more precise terms, in recent years trade in euros

<sup>55</sup> The data record is found on the homepage of Andrew Rose (<http://faculty.haas.berkeley.edu/arose>) and can be downloaded. For the analysis and simulation, use was also made of the article by Andrew Rose (2004), which is also based on this data.

<sup>56</sup> Numerous variables in geographic, bilateral political or cultural factors, such as access to the sea, colonial relationships, shared language, etc., will not change during the forecast period, or are not expected to change. Since the share of freight costs in trade values has proven constant in recent years, geographic distance does not play a role either as an explanatory variable for transport costs in the simulation.

## Annual GDP growth rates in %

	Up to 2015	Up to 2030
Latin America	4.1	4.4
Middle East/North Africa	3.7	3.9
Sub-Saharan	4.4	4.5
South Asia	5.5	5.4
East Asia/Pacific Region	6.1	6.3
Former European Eastern Bloc and Asian Soviet countries	3.7	4
Industrialized countries	3	3

Fig. 34

Source: FAO (2002).

## Annual growth in bilateral trade p.a. to 2030 (annual growth rates)

	Latin America	South Asia	East Asia + Pacific	Sub-Saharan	Middle East/ North Africa	Transition countries*	Industrial. countries
Latin America	8.5%	9.7%	10.5%	8.7%	8.0%	8.1%	7.2%
South Asia		10.9%	11.8%	9.9%	9.2%	9.3%	8.4%
East Asia/Pacific			12.6%	10.7%	10.1%	10.1%	9.2%
Sub-Saharan				8.9%	8.2%	8.3%	7.4%
Middle East/North Africa					7.6%	7.6%	6.7%
Transition countries*						7.7%	6.8%
Industrialized countries							5.7%

\* Former Eastern European Bloc and Asian Soviet countries

Fig. 35

Source: HWWI forecast.

## Trade between regions and EU-25

	Latin America	South Asia	Sub-Saharan	Transition countries	East Asia + Pacific	Middle East/ North Africa	Industrial. countries	EU-25
EU trade 2005 in bn euros	104.3	55.3	91.3	366.9	420.6	233.7	953.5	2,050.0
Annual real growth rate (forecast)	7.2%	8.4%	7.4%	6.9%	9.2%	6.7%	5.9%	6.0%
EU trade 2030 in bn euros	595.1	416.2	542.6	1,966.6	3,824.0	1,191.4	3,999.1	8,913.4

Fig. 36

Source: Comext (2006), HWWI forecast.

has grown much more than trade volume. The statistical analysis of European trade data shows that a 1% increase in trade in euros corresponds with an increase in volume of approximately 0.5%. Extrapolated, trade growth of 6.6% in Europe would mean a 3.3% increase in trade volume.

The reasons that trade value grows more quickly than trade volume are related to technical progress, the transformation processes of the economies of the EU and its trade partners, and the resulting changes in trade structures. To an increasing extent, on the one hand, many commodity-producing countries carry out the initial processing themselves, so that less of the raw materials are imported to Europe, but, instead, more processed or semi-finished products. On the other hand, the heavy mining and steel-producing industries hardly play a role in Europe any more. Furthermore, the Asian developing countries, in particular, are successfully and increasingly exporting consumer products of all kinds to Europe, and these have greater value than raw materials, but low weight. The boom in container traffic mirrors this development impressively. Assuming an annual growth in trade volume of 3.3%, this will result in an increase in total trade volume of 125% in the next 25 years.

To estimate the volume of sea trade on the basis of the predicted trade volume, it is assumed that the relative shares of cargo conveyed by the various modes of transport will remain constant in the long term. Historical observations substantiate this assumption for the time frame of the forecast. Risks only exist for liquid bulk goods, since pipelines to be built in the future could supersede the sea transport now being used. For all other goods, however, maritime transport is currently expected to remain the dominant means of transport for decades to come. It is also assumed that bottlenecks in fleet capacities will be temporary at most.

Based on this assumption, the volume of shipments by sea will be increasing by 3.3% annually. Growth in individual groups of goods, especially the dry bulk goods, liquid bulk goods, and containerized goods considered here, will naturally show different growth patterns, due to differing trade developments, also in sea shipping.<sup>57</sup>

Fig. 37 shows the predicted development for dry and liquid bulk goods and for containerized goods. Fig. 38 shows the corresponding annual growth rates.<sup>58</sup> Striking is the strong expansion in European container traffic and the stagnation shown in liquid bulk goods. The following considerations serve as a basis for the trade forecast for individual goods: The commodities that currently dominate the trade volume, such as coal, oil, grain, and iron ore, are considered separately. For the large group composed of other goods, like non-ferrous metals and ore, chemicals, or special industrial goods such as vehicles, the trends of the past years are

<sup>57</sup> The classification of individual commodities in the trade statistics into cargo or ship types, which is indispensable for the projection of trade volume to be presented here, is fraught with numerous difficulties and uncertainties. On the one hand, new technologies furnish new transport options. The conventional shipment of piece goods, for example, has been practically displaced by containers in the past three decades, an unusual situation. On the other hand, the decision as to how a commodity should be shipped is dependent upon numerous factors, such as package size or distance, so that the container might be more cost-effective in one case, while in another ro-ro service might be the better option. For the further presentation, agricultural commodities were therefore grouped with dry bulk goods and cooking oil with liquid bulk goods. Processed foods, etc., on the other hand, are calculated with the containerized goods. Industrial raw materials are entered with the dry bulk goods. Gas and oil are considered liquid bulk goods. Industrial products are entered as containerized goods. Only the group consisting of chemicals is considered separately for the simulation, due to its heterogeneity.

<sup>58</sup> Not included is the very heterogeneous commodity group of chemicals, which is grouped with all types of cargo. Road vehicles, machines, etc., for which special ship types exist, are also entered separately.



### Handling growth in Europe's main ports

(Ports handling more than 1 mn t)  
in mn tons

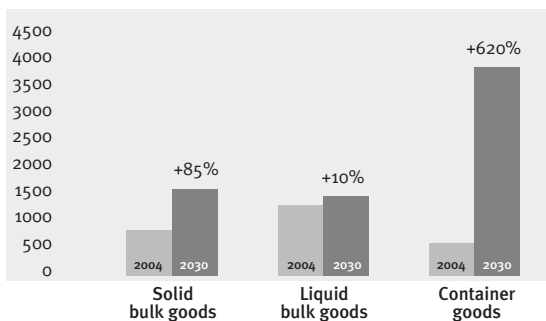


Fig. 37

Source: Eurostat (2006), HWWI forecast.

### Growth rates of European sea transport by type of cargo

	Dry bulk goods	Liquid bulk goods	Containerized goods
Increase by 2030	85.2%	10.5%	620.6%
Annual increase	2.4%	0.4%	7.9%

Fig. 38

extrapolated. Dominant in the group of dry bulk goods are the so-called “five major bulks”: coal, iron ore, bauxite/alumina, natural phosphate and grain, whereby in this subgroup coal, iron ore and grain account for the greatest portion of the weight. The liquid bulk goods comprise primarily crude oil and petroleum products, as well as liquid gas.

The development of oil and coal transports is essentially determined by the demand for energy. In a 2005 HWWI-Berenberg study, various scenarios for long-term development in the markets for energy resources were presented.<sup>59</sup> The basic scenario from this study serves as the grounds for the forecast of transport volume. In this forecast, it is assumed that, as the result of price increases for energy resources and energy-saving technical progress, worldwide demand for energy will grow at a rate that is 2.1% lower than that of production of goods. There are considerable differences in the growth rates of the individual energy resources: The demand for oil and coal grows at a yearly rate of almost 1.7%, much more slowly than that of gas (2.4%) and alternative energy sources (3.3%). Due to the differing growth rates, the share of oil in total primary energy consumption sinks from 37% to 33%, and the share of coal from 26.5% to almost 24%. The share of gas, in contrast, increases from 24% to 26% and that of other energies from over 12% to almost 17%. The demand for energy is not only unequally distributed among the various energy sources, but demonstrates considerable regional diffe-

<sup>59</sup> See Strategy 2030 – Energy commodities.

rences. Whereas the annual growth rate in energy demand in Europe is well under 1%, the average annual increase in energy demand in Asia and South America is over 4%. The rise in demand in North America is somewhere in the middle, at a little over 2%. The minimal increase in overall energy demand in Europe, along with a relatively high growth rate in alternative energies and gas, which is expected to increase by 35% by 2030, leads to a constant demand for oil and a slight decline in the demand for coal (-6% by 2030). Since oil and oil products are clearly dominant in the trade volume of liquid bulk goods, the transport volume of this group of goods is hardly likely to increase in the future.

The expectations regarding the future demand for grain, the most important of the foodstuffs and animal fodders, are based on a HWWI-Berenberg study from 2005 on nutrition and water. Here global trends in worldwide nutrition have been analyzed on the basis of projections of regional calorie consumption. The annual growth rate in grain has clearly declined during the past two decades, to approximately 1% worldwide. Slight increases are expected in the future, but these will primarily affect developing economies. In grains, an annual increase of 0.7% in European demand is predicted.

The marked increase in worldwide iron ore trade in recent years is caused by factors far from Europe. This demand is driven by East Asian countries like Korea, Taiwan and China. The appreciable increase in iron ore demand in China, in particular, has resulted in a boom which has permitted the two largest producers, Brazil and Australia, to considerably expand their production. On the whole, the Raw Material Group<sup>60</sup> assumes an annual jump in demand in the coming years of 12% in China and 3% in the rest of the world. In Europe, trade in iron ore is likely to develop more moderately. For the forecast, based on the development in recent years, an annual growth rate of 1.1% is estimated.

Judging from the trade trends of past decades, on the other hand, there is likely to be a healthy 8% rise in goods transported in containers. Dominant here are industrially produced goods and intermediate products. However, the forecasted growth rate remains behind the development in handling figures of the past years, which lay at an average of 10% annually. This is due to the fact that growth in the container sector in the past was not only fed by the briskly expanding world trade. In addition to this main component, a major role was also played by the hub strategy, in which large ports serve as ports of call and distribution centers, since the thus resulting feeder services between large and smaller ports generated additional handling volume.

Furthermore, the increase in the degree of container use in the general goods sector, that is, the share of general goods shipped in containers, contributed to growth in handling volumes in the container sector. Here, however, a gradual satiation is being observed, so that the contribution to growth is likely to subside. The extent of container use at the port of Hamburg, for example, amounted to just under 97%.

<sup>60</sup> [www.rmg.se/Doc-PDF/reutersfeb05.doc](http://www.rmg.se/Doc-PDF/reutersfeb05.doc)

### 5.3 Port forecast

The objective of the following projection of the development of European seaports, building on the projection for maritime trade, is to develop two scenarios for the development of handling and the potentials of individual European seaports. To do so, the handling volumes of the largest main European ports will be extrapolated using various approaches. The resulting projection of the development of individual port locations is by no means conclusive. In particular, decisions involving economic and structural policy, such as the construction of the JadeWeserPort, which are not taken into account, may have an influence on the development of neighboring ports. Similarly, the development of individual ports can be influenced by decisions regarding strategic and corporate policy on the part of major shipping companies or major port operators who operate several ports. Furthermore, it is also assumed that the port operators will make the technological and investment measures necessary to avoid long-term capacity bottlenecks and to be able to continue to participate in future increases in handling volumes.

#### Basic forecast

Ranking 2030 (2004)	Port	Average annual growth rate in total handling by 2030	Handling* 2030 in 1,000 t
1	(1) Rotterdam	3.5%	805,916
2	(2) Antwerp	5.0%	486,388
3	(3) Hamburg	6.3%	486,115
4	(13) Bremen ports	6.2%	219,065
5	(9) Algeciras	5.7%	217,412
6	(29) Gioia Tauro	7.9%	210,246
7	(5) Le Havre	3.8%	191,321
8	(23) Valencia	6.2%	153,363
9	(4) Marseilles	2.0%	151,187
10	(35) Felixstowe	7.2%	141,398
11	(21) Barcelona	5.1%	133,005
12	(12) Genoa	3.8%	122,077
13	(8) London	3.0%	114,134
14	(18) Southampton	3.3%	89,234
15	(16) Taranto	2.8%	80,682
16	(10) Amsterdam	1.7%	77,475
17	(11) Dunkerque	1.8%	74,179
18	(7) Tees & Hartlepool	1.1%	71,371
19	(6) Grimsby & Immingham	0.7%	69,631
20	(20) Göteborg	2.3%	66,284

\* Handling without container weight

Fig. 39

Source: Eurostat (2006), HWWI forecast.

### 5.3.1 Basic scenario

For the basic scenario, the regional port handling volumes for 2004 are extrapolated with the help of the overall European rates determined through the forecast of maritime trade. Since the development in containerized goods will show especially high relative growth rates, ports with extensive container handling operations are likely to profit from this trend. Ports that primarily handle bulk goods, on the other hand, are expected to be at a disadvantage. Fig. 39 shows the 20 ports with the highest handling volumes in the year 2030, according to the HWWI forecast, with their position in 2004 in parentheses.

The winners in this scenario are for the most part ports with high container handling volumes, such as Gioia Tauro, the largest British port, Felixstowe, or the Bremen ports. The three large universal ports in the North Range, Antwerp, Hamburg and Rotterdam, however, will be strengthening their top positions in absolute terms in this scenario. Hamburg, which ranked behind Antwerp in total handling volume in 2004 as a result of considerably reduced liquid bulk cargo handling, will almost be able to catch up.

### Alternative forecast

Ranking 2030 (2004)	Port	Average annual growth rates		
		Total handling up to 2030	Container handling up to 2030	Handling* 2030 in 1,000 t
1	(1) Rotterdam	3.6%	8.1%	825,871
2	(3) Hamburg	6.6%	8.3%	527,724
3	(2) Antwerp	5.0%	7.9%	485,853
4	(9) Algeciras	5.7%	7.9%	217,903
5	(13) Bremen ports	6.0%	7.6%	205,396
6	(29) Gioia Tauro	7.2%	7.2%	179,703
7	(5) Le Havre	3.3%	7.4%	169,188
8	(35) Felixstowe	7.7%	8.4%	159,496
9	(23) Valencia	6.2%	7.9%	155,303
10	(4) Marseilles	1.5%	7.5%	133,400
11	(21) Barcelona	5.1%	7.9%	132,925
12	(12) Genoa	3.7%	7.7%	118,438
13	(8) London	2.6%	7.3%	104,671
14	(18) Southampton	3.8%	8.8%	102,214
15	(16) Taranto	3.1%	8.4%	86,032
16	(10) Amsterdam	1.6%	7.9%	75,228
17	(11) Dunkerque	1.6%	8.8%	70,436
18	(7) Tees & Hartlepool	1.0%	6.9%	69,851
19	(6) Grimsby & Immingham	0.6%	6.8%	67,645
20	(25) Bilbao	2.3%	7.6%	58,104

\* Handling without container weight

Fig. 40

Source: Eurostat (2006), HWWI forecast.

### 5.3.2 Alternative scenario

As the basic scenario only extrapolates port handling volumes from the overall European growth rates for dry and liquid bulk goods and for containers, it does not permit a differentiation of the handling developments of individual types of goods at the various European ports. Particularly in container handling, however, definite differences in development in recent years have been observed. The alternative scenario presented below thus also reflects the port-specific international trade linkages in container handling. Taken into account are the regions from which the unloaded goods originate, as well as the target destinations to which the goods are to be shipped and the growth rates predicted for trade with these regions. The basic idea of this scenario is that, especially in the container sector, which is strongly characterized by liner services, relationships between individual ports and regions are quite stable.

Econometric tests support the hypothesis that for ports with a high handling share in dynamically growing regions, such as East Asia, growth in the container sector is more pronounced. Fig. 40 shows the 20 ports with the highest handling volume in 2030, according to the HWWI forecast, for the alternative scenario.

It is striking that in this scenario, in some cases, growth in container handling deviates considerably from the average rate of 7.9%. With a rate of 8.8%, ports like Southampton and Dunkerque lie almost one percentage point above the average. Hamburg, Felixstowe and Taranto, at approximately one half of a percentage point above the average, also expand sharply.

In the alternative scenario, as in the basic scenario, ports like Gioia Tauro, Valencia, Felixstowe, and the Bremen ports profit in regard to total handling. The appreciably higher growth rate in container handling may enable the port of Hamburg to surpass Antwerp.



## **Part B**

### **Perspectives of maritime trade and transport logistics – Strategies for companies and investors**

#### **Berenberg Bank**

## Summary

Anyone who invested in ships between 2001 and 2002 – at the height of the stock market crisis – must be delighted now. Enormous profits have accrued. Since the People's Republic of China (PRC) became a signatory of the WTO general Free Trade Agreement – in the same year, 2001 – globalization has become more intense than ever anticipated. Maritime transport capacities are in short supply, as are port facilities and links with hinterland areas. The “Battle of the Quays” broke out some time ago. Long docking times, as well as more stringent security requirements, have led to exploding costs. Doubled energy prices aggravated the situation. How do the individual links in the logistics chain – the producers and manufacturers, the forwarding agencies and shipping companies, and the governmental authorities and supranational organizations – react to these challenges?

What can we expect by the year 2030?

Above all, what opportunities are available to strategic investors?

In our two-volume study entitled *Maritime Trade and Transport Logistics*, we come to the following key conclusions: The speed of globalization has surprised many people. Infrastructural bottlenecks have given rise to a reassessment of strategies throughout the logistics chain – admittedly rather late. In this respect, hardly any consistent, i.e. reliable, forecast models have been developed that go beyond 2015. For the period extending past that year, we are forced to rely on certain assumptions, qualitative statements, and sometimes “creative guesswork.” Just the same, some stable, long-term trends have emerged of which we want to avail ourselves.

- The economic center of gravity is migrating toward Southeast Asia.
- Decisions as to the location of production sites are based increasingly on – in addition to low wages, education and training levels, etc. – a well-functioning transport infrastructure.
- Global seaborne trade will continue to grow more rapidly than the average growth rate, although less quickly than it will after 2015. On the other hand, greater expansion in the intraregional trade flow is expected.



- Among the various modes of transport, ships are and remain by far the most energy-efficient and environmentally-friendly means of conveying goods and passengers. Special ships (feeder vessels, LNG tankers) will attract the greatest demand.
- Coastal and inland waterway shipping will show high expansion rates, as in many cases they are the focus of political subsidy programs. This applies to the expansion of rail traffic, too, albeit in milder form and regionally differentiated.
- Road traffic strategies will continue to lay claim to the greatest share of investment funds. Financing concepts, however, are undergoing fundamental change.
- While Asia will hold a dominant position in the capacity expansion of port facilities and mainstream ship types, Europe will continue to lead in ship and equipment design, in technological applications along the transport chain, and in equipment for special-purpose vessels.
- Software solutions for ICT (Information And Communication Technology) and ITS (Intelligent Transport Solutions) for a transmodal, closed logistics chain have excellent growth potential. The same holds true for telematics applications.
- The mastery of complex, global logistics chains will become much more important as a competitive factor for companies. Cost pressure will be increasing. Vertical and horizontal concentration strategies will be emphasized for some time to come.

Notes:

1. Throughout this study, the term “tons” refers to “metric tons” and is abbreviated as “t.”
2. All dollar amounts (abbreviated “\$”) refer to U.S. currency unless otherwise indicated.

# 1. Sustained changes in the fundamentals of traditional logistics

## 1.1 Status quo: Globalization causes transport bottlenecks

In one of our previous Strategy 2030 studies, entitled Energy Resources, we pointed out the mutually reinforcing aftereffects of the fall of the Iron Curtain – the spread of democracy and Western patterns of consumption, on the one hand, and business activities stemming from Internet-based technological progress, on the other. The gradual opening of trading areas such as the PRC, India and Russia led – very much in line with the findings of Adam Smith (1723–1790) and David Ricardo (1772–1823) regarding the comparative cost benefits and increase of prosperity ensuing from an international division of labor – to a shift of capital and production plants from West to East not witnessed previously. Asia has become the Anglo-American-European extended workbench. The great distances involved have necessitated the growing use of maritime transport to cope with the surge in trade volume. Since ships can be built more quickly than ports or container terminals, this gave rise to serious bottlenecks in port handling, which became ever more visible and palpable. This situation has become aggravated since 2004. Furthermore, what arrives at the port has to leave it again. The links to the hinterland areas of many ports have proven increasingly to be insufficient. Producers, shipping agents, port operators, shipping companies, and state planning authorities were confronted with a totally new perception of what logistics is all about.

## 1.2 A brief look at the history of logistics

For a long time, the term logistics was semantically linked with the art of warfare. The first written references to the concept were found in the writings of the Byzantine Emperor Leontos (886–911 A.D.) He defined logistics in terms of paying and equipping an army and moving and setting it up for battle.

It was only after World War Two that business researchers began using this term. In this context, it meant (from the company's point of view) the cost optimization of materials flow systems. Until the mid-1990s, however, it only extended “from the back door to the front door,” that is, to supply chain management. Despite the integration of just-in-time concepts and the like, many links in the transport chain were externalized, that is, essentially left up to the government. As globalization progressed, macroeconomic aspects finally became more prominent, as part of a transmodal, globally closed transport chain. This change in the perception of logistics suggested that our study would have to go beyond pure maritime port economics. There is good reason to consider seaports to be the heart or nerve center of national and international trade flows. Without well-functioning infrastructure connections on land with sufficient capacities for transporting goods onward, however, they would be largely unable to fulfill their functions.

### 1.3 The symptoms: Delays at ports force up prices

And this is exactly what began happening to an increasing extent in 2004. After the PRC became part of the WTO international trade agreement, the degree of containerization accelerated even more. Involved especially were the Pacific routes from India and China to the west coast of the United States (direction of exports) and the delivery/import routes of basic and raw materials (Australia/Latin America/South Africa – China).

- As early as the summer of 2004, Joni Casey, President of the Intermodal Association of North America, asserted, “The entire cargo transportation system is approaching gridlock.” Los Angeles and Long Beach, which basically function as a double port and handle approximately 40% of U.S. ocean trade, was no longer able to deal with the enormous volume. At times, as many as 90 ships were lying at anchor.
- In India and the PRC, port capacities were generally much too small.
- At the world’s largest coal handling port, in Waratah, Australia, and at Dalrymple (coal, iron ore), the situation hardly differed. The flow of the exports that are vital to the country’s economic well-being was seriously hampered. The balance of payments deficits skyrocketed in 2005 to AU \$55.3 bn, or 6.5% of the gross domestic product (GDP).
- Other shippers of raw materials in South Africa and Brazil found themselves in a similarly tight spot.
- It was only in Europe that port growth more or less sufficed to meet the increase in demand. Here serious bottlenecks were more likely to occur on land, that is, in transporting the merchandise onward. Road and rail links often proved insufficient.

The consequences for the importers and exporters, shipping companies, port handling operations, and forwarding agents that were involved, however, were always the same: Longer transport times and/or routes and competition for the limited cargo and storage space had a powerful cost-inflating effect.

The “normal” rates for container handling generally fluctuated between an average of \$100 (Rotterdam, Hamburg), \$200 (USA), and \$300 (Singapore) per box. Additional loads could easily result in double these prices.

- A turnaround time of eight to ten days (rather than the normal two to three days) can result in additional costs of up to \$360,000. For container ships with slots for 6,000 TEU, this means added charges of \$60 per unit.
- Shipping companies imposed “overload surcharges” of \$200 to 400.
- Interim storage at the port import depots has increased considerably. After the first three to five days, which are gratis, U.S. ports charge up to \$40 per unit for each subsequent day. At this rate, costs of \$300 to 500 per container can easily mount up.

For the container trade volume of 114 mn TEU registered in 2005, companies and/or consumers worldwide would have to bear maximum additional costs of \$34-57 bn. Not taken into account in this figure were other factors, such as reloading onto smaller feeder ships, so that they in turn can call on substitute ports, or the explosion in security costs following September 11, 2001 (see point 3).

Solutions to the most urgent problems are not likely to be found soon, however. After all, by the year 2008, among other things, approximately 140 container ships of the so-called “super post panamax” class, with a capacity of more than 7,500 TEU slots each, will be put into operation. It will not be possible to create the port capacities they will require in time. In view of the de facto emergency situation, everyone involved realizes by now that there is an urgent need for action, even at this late date.

#### Cost factor port bottlenecks

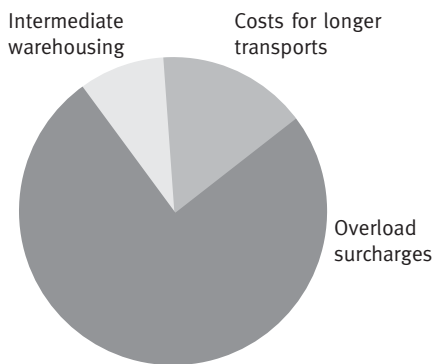


Fig. 1

Source: Berenberg Bank.

## 2. The macroeconomic significance of the transport sector

Providing transport-related infrastructure is still considered one of government's genuine responsibilities. After all, a fully functional port, rail and road system ensures a high degree of productivity, growth and employment for an economy. The situation is similar for the matter of "security," which has assumed an altered, indeed a global dimension, at least since the events that took place in the United States on September 11, 2001.

According to World Bank estimates, depending on the country, as much as 10% of the GDP accrue along the logistics chain. It should be kept in mind that economies without direct access to the sea often incur 50% higher logistics costs than seafaring nations. The absolute figures are therefore not always as significant as a tightly-meshed, well-functioning transportation network.

Closely connected with the added value potential is the effect on employment. Between 2.5% and 11.5% of all employees work in the freight and shipping industry. In Germany, 2.6 million people are employed by 60,000 companies in this sector. Not only was Germany the world champion in exports in 2005, but its logistics sector was the world's largest. On a national level, only the retail trade and the automotive industry were more important (Federal Statistical Office). As an example, the Port of Hamburg provides work directly or indirectly for some 154,000 people. Investments planned up to the year 2015, amounting to up to €1.5 bn, could result in an additional 14,000 jobs.

The relative importance of this sector is also high in the USA. In 2005, according to figures published by the American Association of Port Authorities, the port sector alone provided approximately 4 million jobs. Added value of \$723 bn, or 6.6 % of the GDP, accrued. This means that investments in ports, roads, railroad systems and airports are particularly relevant, generally amounting to 1.5%–2.5% of the GDP. The classic investment multiplier generates additional growth through mushrooming effects. Figures have shown steadily over a long period of time that the demand for transport services increases 1.5 times as quickly as the GDP itself. For many countries, it is therefore of paramount macroeconomic importance to solve the bottleneck problems in their ports and land connections as quickly as possible.

### 3. Reactions and measures at the state level – Various approaches

#### 3.1 Establishing the framework

In 2006, a number of governmental commissions and EU, OECD, UN, ASEAN and ADB (Asean Development Bank) committees were engaged in discussions centering around the future of the global transport and logistics structure. They conferred on the characteristics of a desirable transport system, one which will meet future requirements. Core concerns repeatedly included the elimination of:

- infrastructure overloads,
- environmental pollution (Kyoto Protocol), and
- defense against terrorist threats.

Targeted under the collateral conditions were:

- globalization/increased competitive pressure, and the
- soaring crude oil and energy prices,
- an integrated (also cross-border) transportation network designed for optimal utilization/linkage of oceans, rivers, roads and rail systems (transmodality),
- greater energy efficiency, and
- globally uniform security standards.

#### 3.2 Enormous investment decisions

How much could it cost to create railroad transport corridors from Europe via Central Asia to the East Asian Pacific regions?

How much could it cost to expand the Chinese road network by 400,000 km?

And how much complexity in planning and what software requirements would be necessary to include upstream and downstream transport, to standardize the necessary shipping documents, to incorporate toll collection system billing in the handling of payments, to ensure that transport can at all times be managed/tracked, and to design the entire system so that it is transnational?

##### 3.2.1 Some visions?

###### *Automatic highways*

Roads in Asia could become rather congested. The IMF estimates that automobile density in Asia (except Japan) will amount to 570 mn units (270 cars per 1,000 inhabitants) by the year 2030, increasing from 81 mn cars in 2002.

New transportation concepts will be essential, if only to limit pollution levels. To promote transport efficiency, too, high priority is also being given to the prevention of waiting time and ensuring optimal traffic flow.

Parking aids and cruise controls are familiar to most people. In the future, we will also be seeing a lane for private vehicles – and a second lane equipped with induction loops and numerous sensors that automatically control the headway of a car or truck (even without a human driver) via special radio transmission and reception frequencies. Constant distance measurement, adjustment of speed, prevention of accidents, registration of toll charges, etc., will then be the rule. Japan will be putting the first pilot applications into operation by 2015.

#### *Subterranean pneumatic dispatches*

The use of computer-controlled cargo caps lies in the technological future. This subterranean pneumatic dispatching system may be the answer to the overloading seen in local and regional merchandise transport. The capsules, developed by the Ruhr University in Bochum, move under the earth in a network of transmission tubes at a speed of up to 50 kph and make their way independently to the appropriate station, where their freight is automatically loaded or unloaded (two Euro pallets). The “Ruhrpost” system is currently being tested in a pilot project involving the government of the federal state of North Rhine-Westphalia and RWE Power. There is already a great deal of interest in the new transport system, which is being considered for the new HafenCity in Hamburg, for example.

A number of other research projects, primarily in the USA, center around new pipeline technologies which use hydraulic or pneumatic systems to transport coal and agricultural products, as well as waste materials and hazardous waste, over distances of several thousand kilometers – that is, across the continent.

#### *Ghost train in transit*

Fully automated freight cars are currently also being tested for rail traffic. They constitute a kind of “ghost train,” with no locomotive or conductor, remote-controlled and monitored by radar, laser and video. The Cargo Mover reaches an average speed of 90 kph and uses some 30% less fuel than a truck. Up to now, the Cargo Mover, developed by Siemens in collaboration with the Institut für Schienenfahrzeuge und Fördertechnik, is being used experimentally as a factory railroad. Also in the technological future are cargo vehicles which can be used either “normally” on the road or in a separate lane at a speed of 100 kph (city traffic) or 300 kph, computer- or telematic-controlled.

#### *The Internet for Things*

We are familiar with the Internet of information as we use it in our daily lives. A globally accepted standard, the Internet protocol, permits the multi-network transmission of words, writing, numbers and diagrams. The German Fraunhofer Institut has been working for some time now on an “Internet of Things.” For the logistics sectors, it offers the following perspectives:

Pallets, packages, products can be provided with RFID (Radio Frequency Identification) chips with added functions. The greater storage capacity of the “tags” make it possible to individually specify the destination of the merchandise and the means of transport necessary to get it there. With fully automated supply chains and the appropriate software applications, it would then be conceivable for the packages to independently select and manage the high-bay warehouse, the forwarding and sorting facility, the type of container, and the shipping route. Up to the present, just the opposite has been true, with powerful mainframe computers determining the path the package will take.

### 3.2.2 Tens of trillions of dollars waiting to be invested

One thing must be obvious in regard to these applications: The investments in planning, time, and especially funds necessary to achieve these objectives will be enormous.

It would be extremely difficult to specify amounts for these on a global basis, for they do not exist in aggregative form. Figures are available for individual projects or regions, however, albeit only up to the year 2015. Both will be delineated here, based on HWWI forecasts (see Volume A), projections by the World Bank and OECD, national long-term planning, our own estimates, and the already mentioned “creative guesswork” in the form of qualitative statements.

With this background, as already mentioned, worldwide government expenditures for transport infrastructure projects amount to 1.5%–2.5% of the respective national GDPs. In countries with considerable accumulated need, the figures could go far beyond this over a period of several years. Pertinent investment amounts in 2005 in the PRC and in Thailand, for example, amounted to approximately 4%; in Vietnam, in fact, over 6% of the economic output. On the other hand, according to OECD findings, since the mid-1990s, the leading Western industrialized nations have only been investing barely 1% of their GDP.

#### World GDP 2005 / 2030

in \$ trillions

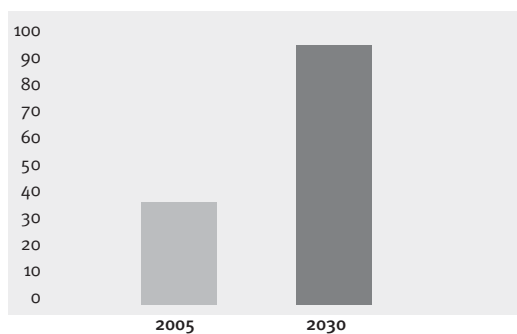


Fig. 2

Source: Berenberg Bank.



Using the findings of the HWWI as a starting point and assuming an annual average growth rate of 3% for world GDP until 2030, we arrive at a target figure of \$93,033 bn, equivalent to a nominal increase of 109% over the original figure (\$44,433 bn for 2005 according to IMF-World Bank data). It follows that annual public spending for programs will presumably amount to \$1,395 bn (1.5% GDP share) to \$2,326 bn (2.5% GDP share), compared with the starting figures of U.S. \$665 bn to \$1,109 bn in 2005. Summing up the amounts over the forecast period of 25 years, one quickly arrives at five-digit billion figures.

### 3.2.2.1 Asia invests in “hardware”

As in the previous volumes in this series, those on Energy Resources and Water and Nutrition, we cannot ignore Asia – especially the overriding China factor – when discussing trends in transport and logistics. As a result of the expected increase in per capita income in many developing countries in Asia, worldwide transport volume there will be rising much more sharply than in Europe. For example, the World Business Council for Sustainable Development<sup>1</sup> expects a 2.5% average annual world growth in total merchandise transport in ton-kilometers up to the year 2030. While increases amounting to 1.9% are forecasted for western Europe (eastern Europe 2.7%), transport volume is expected to accelerate in India by 4.2% and in China by 3.7% annually.

In most of the Asian countries, transport facilities are still much more limited than in the Western industrialized countries. This applies despite – or perhaps because of – the dynamic growth not least in India and China, where there is a huge need for investments in infrastructure. Skeleton data compiled by the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) for Asia up to the year 2015<sup>2</sup> assume annual investment requirements of \$261 bn. The lion’s share, however, will be devoted to road construction (88%).

<sup>1</sup> See World Business Council for Sustainable Development (2004).

<sup>2</sup> See ESCAP (2006).

### Annual investment requirements in Asia

in \$ bn

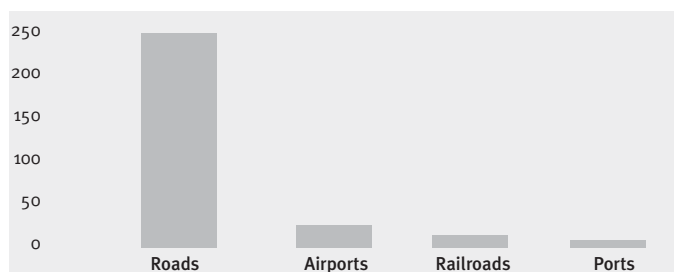


Fig. 3

Source: ESCAP (2006), Berenberg Bank.

In view of the planned expansion of the Chinese road network by 400,000 km, this distribution in the Asia-Pacific region seems absolutely realistic. On the Asian Highway alone – with its 140,000 km, it is the backbone of the Asian road network – some 26,000 km in 16 member states require repairs or improvements. Another 12% are in such poor condition that the minimal requirements for paved roads are not even fulfilled. Otherwise, they are equivalent to the situation in the USA and Europe between 1948 and 1963. On the whole, it is clear that in the Far East the emphasis of government action is on the construction of lacking infrastructure, that is, the “hardware.”

In China, investments in the transport sector, in view of the increasing transport volume and rapidly growing private car ownership, amounted in 2004 alone to \$88 bn. More than two-thirds of this amount were invested in roads. Over 46,000 km of highways were built, and over 150,000 km of main roads and divided highways were overhauled. By 2010, 14 new highways (including Beijing – Hong Kong) are to be built. Planned by the year 2020, in addition, is the construction of 400,000 km of roads in rural districts, so that 80% of all towns will then be connected with one another or with major roads. The OECD estimates the annual volume of investments in infrastructure in this context at \$24 bn. Between 2020 and 2030, an additional increase of \$38 bn annually is expected. This mammoth program can only be compared with the United States, where, between 1948 and 1960, some 32,000 to 53,000 km of highways were built annually.

At present, 73% of PRC transport volume is road traffic, while an additional 15% falls to the railroads. 12% of the transport volume is waterborne, especially when large distances are involved. By ton-kilometers, the share of inland shipping in the modal split increases to 60%.<sup>3</sup> The growing transport amounts are also prompting China, not least in consideration of the environmental burden, to focus its attention during the coming decades on alternative means of transport, such as rail and water networks.

Planned outlays for railroad infrastructure until 2020 amount to approximately \$250 bn (including private investments) for the expansion of the railroad network to 100,000 km. Currently this network totals 75,000 km, equivalent to one-sixth of the world rail transport network. In terms of freight volume, on the other hand, the Chinese railroad network is the world's largest. The freight volume conveyed over the railroad tracks in 2004 amounted to 1,724 bn ton-kilometers.<sup>4</sup> Some 60% of the lines are single-track, so that, in addition to new construction, top priority is being given to investments in the expansion of a two-track network and/or a separation between passenger and freight transport. During the 2006–2010 planning period, the most urgent railroad-related infrastructure projects include the construction of six new long-distance (including Beijing – Shanghai), as well as five new Intercity lines.

<sup>3</sup> See National Bureau of Statistics of China (2006). Data for the first half of 2006.

<sup>4</sup> See ESCAP (2005).

In the PRC, as in Europe, the future of rail transport will involve (partial) privatization to an increasing extent (see Chapter 7). At the end of 2005, 20 joint ventures existed in the railroad sector, attracting funds equivalent to \$5.5 bn, including 310 mn from private investors. This past summer, the first rail operator, Daqin Railway Co., went public on the Shanghai Stock Exchange. The IPO of the largest coal transporter in northern China had a total volume of \$1.75 bn. According to statements made by the Railway Ministry, this example is to be followed by a number of other IPOs. The recent Initial Public Offering of Air China showed that investor expectations are not always met. The number of shares offered had to be reduced immediately, and the initial market price did not meet the price of issue.

Regardless of this, expansion in aviation and airports is becoming progressively important. In 2005, domestic airlines transported 138 mn passengers and 3.4 mn t of freight. The Civil Aviation Administration of China (CAAC) expects annual growth in freight and passenger traffic to average 14% by 2010, followed by a slight slowdown in the growth rate to 11% annually by 2020. In that year, 1.4 bn passengers and 30 mn t of freight will be transported. To meet this demand, 44 new airports are to be built by 2010, with an investment sum of 140 bn yuans. The U.S. logistics company FedEx is currently building the largest air cargo handling center for the Asia-Pacific region in Guangzhou in southern China, investing capital of \$150 mn. The hub is to go into operation at the end of 2008.

A major potential for inland navigation which is still fully untapped is offered by the numerous canals that crisscross the country, particularly in the southern part. The first smaller canals for transporting goods were already built 2500 years ago. The most important such waterway is the Grand Canal, which connected Hangzhou (near Shanghai) with the former capital, Xian, a distance of more than a thousand kilometers. Today the Grand Canal is 1,800 km long. Whereas regional traffic in the north primarily uses roads, in the south more than 120,000 kilometers are considered navigable, so that water transport – especially on the Grand Canal and the Yangtse – is quite significant.

One of the most important infrastructure projects for the shipping sector up to 2010 is the deepening of the canal between Beijing and Hangzhou. Another project involves deepening the Pearl River. The critical significance of the expansion of China's waterway and navigation capacity, however, is demonstrated by the "Millennium Project" for expanding the Yangtse with all of its intermodal facets. At present, merely 15% of its capacities can be navigated. Only after total completion of the Three Gorges Dam – the world's largest dam – including its navigation locks and ship lifts 1,000 km west of Shanghai (end of 2009) and the construction of the new container port in Wanzhou will the Yangtse be navigable for cargo ships over a distance of 660 km. This will amount to a fivefold increase in cargo volume and savings of approximately 35%. Container shipping on the Yangtse, which has already more than quadrupled in the past five years (2006 estimate: 3.1 mn TEU) is expected to increase to 15 mn TEU by 2030. A fur-

ther component of the gigantic infrastructure project is the construction of 26 km of highway (including 34 bridges and five tunnels), a large suspension bridge, and new loading and transshipment equipment for shipping. According to U.S. data, construction costs for this mammoth project will amount to about \$75 bn. It could turn out to be even more.

The potential in the infrastructure sector is also huge in India at present. According to OECD estimates, \$12-14 bn will be invested annually in infrastructure projects. The better part will be devoted to the road network, whose poor condition prevents efficient traffic flows and the necessary expansion in the transport system. Experts assume that India loses 20% of its agricultural revenue simply because of the weaknesses in its transport and logistics system. In concrete terms, during the transport of fruits and vegetables from producer to consumer, 40% are “go astray.”<sup>5</sup> In view of this, by the year 2020, infrastructure expenditures amounting to \$26 bn will be channeled into the construction of weatherproof road links between places not previously connected to the road network (50%).

As in China, Indian air transport is also approaching its capacity limits. Experts estimate that cargo traffic will double every twelve years, passenger traffic in as little as eight years. Against this background, the infrastructure of the 62 national and international airports needs to undergo considerable improvements. The Centre for Asia Pacific Aviation (CAPA) estimates necessary airport investments just in the next six years at approximately \$10 bn.

### 3.2.2.2 Other priorities in the West

In the developed G7 economies – using Germany as an example – the priorities are totally different. To begin with, there are often limitations in space for new seaports or airports. The road and rail networks can hardly be further expanded. Environmental protection aspects generally play a much more significant role. As a result, the share of maintenance expenses in the investment budget is considerably higher. And finally, strained public finances necessitate a change in funding and ownership concepts.

These considerations are clearly reflected in the specifications of the current German Plan for Federal Traffic Routes (2003-2015). The planned federal expenditures of €150 bn are to be almost equally divided, with €77.5 bn for the roads and €77.9 bn for the rails. €7.5 bn is available for the expansion of inland waterways. €82.7 bn is planned for maintenance of the existing network and €66.2 for expansion and new construction.

Though this amount may seem impressive at first, it should not obscure the fact that the planned average annual investments of €12.5 bn are a paltry 0.6% of the 2005 German GDP. The result is a continuation in the depletion of our national transport network, which has already been observed for the past 20 years. We are still praised everywhere for our exemplary infrastructure. In international competition, this is considered one of the few advantages Germany offers as a location. If things continue this way, however, it is likely that we will have

<sup>5</sup> See ESCAP (2005).

slipped down to a lower middle-class rating in a “Pisa for Logistics” study that might conceivably be carried out 20 years from now. Considerable efforts in high-tech logistics are called for, as well as the tapping of alternative funding sources. Here we are lagging far behind, even in a European context.

Of primary importance, therefore, is making our existing transport avenues substantially more efficient. The focus should be on support for transmodal logistics structures, e.g. it must be possible to utilize different means of transport without constantly repacking the goods to be transported. Containerization in its outward form is practically ideal for this purpose.

Clearly indicated is further progress in automation, which would hardly be conceivable without the appropriate development of software applications. The diverse EU simulation games and development plans point in this direction.

### **3.3 Top priority – The “transparent container”**

The establishment and application of government regulations, especially on a coordinated global basis, and with appropriate pressure brought to bear, can serve as an example of how binding security standards can be introduced in the maritime transport sector. Then things can progress very quickly. Following the terrorist attacks of September 11, 2001, in the USA, several laws went into effect. Their common goal was to enable monitoring and tracking throughout the entire logistics chain worldwide. As of 2007, additional EU security guidelines for “Enhancing Port Security” may be added to the guidelines of the “International Ship and Port Facility Security” (ISPS) guidelines to be implemented beginning in July 2004.

The logistics sector fears the possible spiraling costs. It is true that ensuring internal and external security is one of the primary responsibilities of governments. In this case, however, the unavoidable costs will be completely externalized, that is, passed on to the transport service suppliers and, in the final analysis, to each individual citizen.

Will ports become “high security zones”? Shipping agents, shipping companies, and port operator companies that do not meet the requirements of

- assigning an identification number to each ship,
- monitoring loading and unloading, and
- establishing physical access controls for ships and ports by setting up restricted areas (including locking mechanisms on enclosures, gates, doors and windows)

are threatened with very detailed inspections, along with considerable delays in transfer operations from the sea- to the land-based logistics chain.

The cost is enormous. The U.S. Port Authorities estimate the one-time expenses for security installations at its own ports at \$3.6 bn. If the expanded EU stipulations should go

into effect, the German BDI (Federation of German Industries) expects the 25 EU states, with 4.75 mn affected companies, to incur initial costs of up to €48 bn and annual follow-up costs of €36 bn.

Our view of these matters is as follows:

- A 100% protection from terrorist threats will never exist.
- The USA threatens to overreact and to sacrifice the principles of free world trade in its attempts to achieve national security. The effect is isolationist.
- Resistance to the transfer of important U.S. port operations to the management of Dubai Ports World can be understood in this context.
- The Doha free trade agreement also failed in the summer of 2006 not least as a result of the uncompromising position taken by the USA.
- Almost simultaneously, the USA announced that it will review its most-favored-nation agreement with India, Brazil, and eleven other countries.

All things considered, we regard this as a possible turning point ( or point of no return) in general efforts toward globalization. This could amount to the nucleus of an incipient regionalization in world trade. We see this as a convincing argument for attaching especially great weight to growth in intraregional transport after 2015.

## 4. Reorganization of the logistics market

Logistics is, as we have seen, a booming sector. Globalization and containerization constitute one important aspect. The outsourcing of transport and warehousing services in the broader sense is another. This means that value added along the logistics chain is growing more quickly than growth in production volume itself.

Whereas for a long time logistics essentially referred to shipping and storing, the spectrum of services later grew to include activities such as consolidating and labeling shipments or invoicing. Today services have been added which may range from continuous shipment tracking to running call centers for the customer. Companies that operate worldwide expect comprehensive, all-around service packages.

Assembly of the Airbus is an example, albeit an extreme one. The initial wing sections are manufactured in Japan and then transported by air or sea to Hamburg to be further processed. They go on to Italy, then via Augsburg back to Hamburg, where, after they are attached to the fuselage parts from Toulouse, final assembly follows. A small or medium-sized company cannot provide such services.

### 4.1 Global orientation

Suitable for such responsibilities are primarily financially strong, globally operating companies that master the complete intermodal logistics chain. This may involve a single group of companies or alliances. In 2006, there were only a handful of these “big players.” Number 1 worldwide was Deutsche Post, with a market share of 11%, equivalent to approximately €20 bn. It was followed by Nippon Express with 5% (chiefly realized in Asia, thus not really global).

Symptomatic of logisticians who aim at operating globally is an aggressive acquisition strategy. In recent years, for example, among the acquisitions of Deutsche Post were Danzas (Switzerland), DHL (which in turn acquired the U.S. air cargo service company Airborne in 2003 for \$1 bn), and, in 2005, Exel (UK) for an amazing €5.5 bn. The long-term strategy involved in acquisitions of this kind may indicate that considerable initial losses are acceptable. In 2005, the U.S. business still “cost” €400 mn.

The Deutsche Bahn “grew” to include the Schenker Group, has at its disposal Rhenus AG, firmly entrenched in inland waterway transport, and finally made various bids, including those for the Hamburger Hafen- und Lager AG (HHLA) and the Lübeck Regional Port.

In this connection, from the corporate and investor point of view, the establishment of transport software that expands as needed is of particularly great importance. In the long term, two-digit growth rates can generally be expected.

## The future of the RFID

We have already noted that logistical processes may account for 10%–20% of the total costs of a company, and, using the Airbus as an example, we have demonstrated the complexity of transport structures. To ensure a company's success, it is very important to comprehend the importance of logistics as an integral part of the supply chain and to ensure that it can be planned and monitored with end-to-end software solutions. After all, especially in tightly linked supply chains, precision is absolutely indispensable. Even minor errors can have fatal results. Shipments can be misrouted, arrive late, or get lost, because they cannot be located. Entire production processes may come to a standstill. In the future, RFID chips (see points 3.2.1. and 3.3) may prove to be the main monitoring components. As is so often the case, RFID technology has military origins. As a further development of radar equipment, radio frequencies were used for the early detection of friend or foe, and were already in place in airplanes and tanks during World War Two. The first civilian applications were for anti-theft systems for merchandise and animal identification tagging (1980s). Numerous toll systems based on this technology have been in operation in the USA since the 1990s. In the meantime, it is also being used for access controls (on admission tickets during the 2006 Soccer World Cup in Germany), cashless payments, or electronic car immobilizers (as part of the key). Basically needed are:

- transponders/senders (RFID tag, smart label),
- tag reading/scanning equipment, and
- interfaces to servers, services, and other applications such as cash registers or inventory control systems.

The future belongs to the active RFIDs with their own (battery) power source. They have a longer service life (several years), larger memories, and can be reused/reprogrammed numerous times. Data can be exchanged over large distances. This means that chips can contain all the data – supplier, customer, merchandise amount, transporters (whether ship, rail, truck, air) – and assume the necessary control functions. This is extremely useful for container traffic. Lemmi Fashion (children's clothes) was the first company in the world to organize its entire logistics chain on the basis of RFID. Philips chips and Microsoft modules are being used. Lewis Jeans intends to follow suit.

Secondary arena: The U.S. FDA (Food and Drug Administration) approved the Veri-Chip from Applied Digital Solutions in 2004. It is implanted under the surface of the skin to transmit patient data. The major user at present is the U.S. Department of Defense. All told, however, this has only involved 1% of the containers transported in the United States. Problems: Global use is hindered by different regional radio frequencies, a lack of uniform encryption methods, hardly any interfaces to other, complementary applications, and costs that are too high. The simplest type of chip costs about \$200 in 2005.



In the long term, however, the market potential, including the required hardware, will amount to hundreds of billions. Companies involved in this subject area include: Alanco Tech., Allixon International Corporation, Baxter International, Bulldog Technologies, International. Paper, Northstar Electronics, Patni Computer Systems (India), Samsung Techwin (Korea), SAMSys Technologies (Canada), KSW Microtec AG, Ident, and Schreiner LogiData. Chip developers include Philips and Infineon. Among the companies producing transport logistics software are Microsoft, SAP, Oracle, PeopleSoft, and Ryder Systems.

## 4.2 Theme orientation

Minor players seek out regional emphases or concentrate on what is called contract logistics. This entails a contractually fixed, long-term relationship between producing companies and logisticians who, in line with the industry's wish for outsourcing, assume total responsibility for its transport requirements. Here the growth rates are likely to reach 10% to 15% annually in the foreseeable future. Companies like Kühne & Nagel or DSV (Denmark) are well placed. Ultimately, however, they must face the powerful competition of the "really big players," such as Fedex, UPS, TNT, or even DHL.

On the regional level, generally national, the trend is toward individual agreements, such as just-in-time deliveries to large retail chains or disposal of special hospital waste.

Cost advantages which can generally be achieved by logistics service providers if they reach certain economies of scale have recently been challenged, however, by hikes in fuel prices. This is documented by the ongoing profitability problems (even extending to losses that endanger their very existence) of smaller, yet stock exchange listed companies in Germany.

## 4.3 Advancing consolidation process

In view of the fact that there are 60,000 transport service providers in Germany – in the PRC there are close to 2.5 million! – a dynamic consolidation or market adjustment process is foreseeable on all levels. Globally operating companies are likely to be open to attractive business opportunities. As a result of its entry into the WTO, the PRC must open its domestic logistics market completely to foreign investors. Enormous gains in productivity are possible here. On the one hand, after all, current estimates define the share of transport costs, approximately 21% of the GDP, at double the G7 norm. On the other hand, there is market growth of 20%–30% and a gigantic expansion in the infrastructure network. An obvious impetus toward consolidations and acquisitions is already in full swing in the "Battle of the Ports."

## 5. The perspectives for sea-based transport logistics

### 5.1 Port and terminal operations – The most important projects in the coming decades

The bottleneck situation at many ports described above, the resulting immense investment volume, and the high growth rates in container traffic make port-related business extremely lucrative for everyone involved: for construction companies, for terminal operators, for the owners, often still the state, and, finally, for the shipping companies.

As a rule, ports are by nature location-specific; shipping companies and shipping fleets are not. In the era of globalization, this leads to fierce competition among the port and terminal operators, on the one hand, and among the ports and the ship owners, on the other. In view of the great macroeconomic significance involved, entire regions or even nations court the favor of investors. In 2001, for instance, when Maersk and Evergreen relocated their container traffic from Singapore to Malaysia (Tanjung), the city-state had to (temporarily) forfeit its position as the world's number two container port. The following emphases in new port investments emerged in this context.

#### 5.1.1 India

The country has 187 seaworthy ports, but cargo handling at these ports in 2005 amounted to only 423 mn t. In comparison, Shanghai alone handled 443 mn t. The largest container port, Jawaharlal Nehru, had a capacity of nearly 3 mn TEU in 2006. In comparison, Hong Kong already cleared more than 22 mn TEU in 2005.

The government has therefore announced plans to double the country's port capacities by 2009. After that, equally high outlays will be required if this part of the subcontinent earnestly wishes to become an economic superpower by 2050. We anticipate an annual expenditure volume of \$3-5 bn.

Interesting for the investor: Nhava Sheva International, the largest private port operator; Gammon India Ltd., in the infrastructure and port construction sector; Quipo Infrastructure Equipment Ltd. and/or cement and construction groups like Grasim Industries or Gujarat Ambuja Cements (Holcim holding).

#### 5.1.2 People's Republic of China

Here different dimensions are involved. In 2005, with a handling volume of 48 mn TEU, China already ranked number one worldwide, even ahead of the USA. By 2010, capacities are to be expanded to 100 mn TEU, then to be doubled again, reaching 200 mn TEU by 2020.

Parallel to this, disembarkation facilities for general cargo and energy commodities are to be expanded substantially. The entire concept concentrates on five "port clusters":

- Fujian (located opposite Taiwan) for oil/gas
- Hainan/Guandong – Containers
- Shanghai/Yangtse – Containers/coal
- Shenzhen/Pearl River – Containers/ore
- Tianjin/Beijing – Containers

Along with the actual construction or expansion of ports, by 2015 some 270 additional container gantry cranes are to be installed. For Asia as a whole, ESCAP expects an increase of 570 terminals. Average construction costs in 2005 amounted to \$50,000 to 60,000 per unit (Regional Shipping and Port Development Strategies, New York, 2005).

Interesting for the investor: The world leader in equipment of this type, with a share of approximately 50%, is Zhenhua Port Machinery. For mobile port cranes, for example, two German companies are far ahead of the rest: the stock market newcomer of 2006, Demag Cranes, with a world market share of 44%, and family-owned Liebherr Int. AG, with more than 20%. Since December 2005, three major Chinese port operators have also gone public: Xiamen International Port Company, Dalian Port Company, and, in the summer of 2006, the 1,700 times oversubscribed Tianjin Port Development, with a total issue volume of \$1.1 bn. A representative of the port construction and infrastructure sector is China Merchants Holding. One of its 2006 orders was a \$550 bn contract in Qinhuangdao.

It is no wonder: Chinese companies account for a world market share of 90% in the production of hardtop containers. Absolutely leaders are CIMC (50% share, not listed on the stock market) and Singama (20% share, Hong Kong Stock Exchange).

### 5.1.3 Selected OECD nations

The most urgent capacity bottlenecks have plagued Australia. The government and private investors have reacted. They plan to invest AU \$10 bn in port expansion by the end of the decade. The largest private operator of coal and ore shipment locations in Waratah (BHP Billiton) and Dalrymple (Prime Infrastructure) will contribute more than AU \$1 bn and will double their capacities. According to statements by the Australian Council for Infrastructure Development, an additional AU \$8 bn will be required for changes in the railroad network. Australia and Canada are considered the “mother country” of the mixed public-private finance model (see Chapter 7).

Between 2003 and 2007, the USA will have invested close to \$10 bn alone to eliminate the most serious bottlenecks. Striking, however, is the fact that, beyond this “emergency management,” hardly any long-term strategic plans exist on the federal level.

That is, except for security measures of all kinds. One exception is the “Plan for Action,” extending to the year 2030, passed by the Southern California Regional Strategy for Goods Movement in February 2005. As you will remember: California itself, with a GDP of \$1,540 bn,

would be the world's seventh largest economy. Among other things, it is the home of the double port of L.A. and Long Beach. The concept is expressly intermodal., including investment needs for road and rail, with special adherence to stricter environmental stipulations.

Assuming approximately three times the container traffic (from 13.1 mn TEU in 2004 to 44.7 mn TEU in 2030), planners estimate the required investment at \$36 bn. This seems comparatively low. Besides, it could be financed completely by the private sector through tolls of \$0.86 per mile and/or fees of \$160-170 per container. A noteworthy major new plan is the container port project in Port Rupert (investment volume: \$420 mn) on the west coast for an annual capacity of 2 mn TEU. Note: Ports are relatively "cheap." This can be shown by the two new German construction projects. The addition of a fourth terminal in Bremerhaven with a planned annual capacity of 2.6 mn TEU by 2008 is expected to cost €500 mn.

The totally new construction of the JadeWeserPort deepwater seaport in Wilhelmshaven will be much more expensive. The site will be reclaimed, that is, created artificially. The approach channels will be designed for a draft of 18 meters. And finally, it will serve various purposes, including a container port with annual throughput of 3 mn TEU, as well as the first German liquid gas terminal. The financing will also be mixed. The infrastructure will be provided by Bremen and Lower Saxony for an estimated €700 mn. Port equipment will be paid for by the operators: the energy group E.ON (€500 mn) and the Eurogate Container Terminal Wilhelmshaven (€350 mn).

#### **A digression: Dredging and filling**

The dredging, supporting and deepening of approach channels, especially the filling of new seaport and airport sites, is carried out by the dredging industry.

This is a multi-billion-dollar business whose major projects are dominated by European companies. Their world market share is over 50%. The leading representatives are a Dutch company, Boskalis Westminster, and the Deme Group in Belgium. As an example of the magnitude involved, during the planned deepening of the Elbe River from the current 14.5 m to 17 m, 38 mn m<sup>3</sup> of sand and rubble will be moved. This would be enough to build a four-lane highway from Hamburg to Frankfurt. The contract value amounts to approximately €345 mn.

Interestingly, the Eurogate Container Terminal Wilhelmshaven, which made the decision to grant the contract to the "dredgers," is a joint venture involving the leading European container terminal operator, the Eurogate Group (70% share), and the world's largest shipping company, Maersk A/S of Denmark.

Now, surprisingly, we have come full circle to the initial remarks in this section. Natural competitors are turning into cooperators. The bonds between shipping companies and port operators are becoming ever closer. Initially, the vertical consolidation of container ship owners increased considerably: In 1988, the "top five" – Maersk, COSCO (PRC), Evergreen (Taiwan),

Hapag Lloyd, Hanjin (South Korea) – controlled 35% of the world market; in 2005, this figure was already over 80%. Then they ventured on land, where they encountered private terminal owners, also growing through mergers and acquisitions and now also positioned intercontinentally. Their “top five” – Hutchinson, Port Authority of Singapore (PSA), Dubai Ports World, Maersk, COSCO (and Eurogate as the European market leader) – now control slightly more than 50% of global handling capacities.

Some background: Sea transport and especially cargo rates are subject to wide fluctuations due to shipbuilding cycles. The margins have been placed under additional pressure by stricter security and safety requirements and diesel prices that have doubled since 2003. The return on sales is often under 5%, half of what is earned “on land.” The predicted high long-term growth in container transport gives terminal operators a sustainably solid basis for ongoing expansion in revenues and profits, especially if the basic capacity utilization of their operations is practically guaranteed through their joint ventures with shipping companies. In our judgment, we are far from the end of these integration efforts, which can certainly continue to “gain ground.”

## 5.2 Shipbuilding – Types and trends

### 5.2.1 Introduction

The capacity of the world merchant fleet has grown by 34% in the past ten years, more than 5% annually in the last three years alone. Following an extended slump, substantial world economic growth and increasing globalization have given shipbuilding the greatest upswing in 30 years. Prices for new ships have risen noticeably in all segments. The rapid growth in demand for tonnage had led to a situation in which the prices for used ships were in some cases above the prices for new ones.<sup>6</sup> The immediate future looks promising. More than 5,500 ships were

<sup>6</sup> See Clarkson Research Services (2006); Jiafu (2005).

### World market shares of the top five container terminal operators

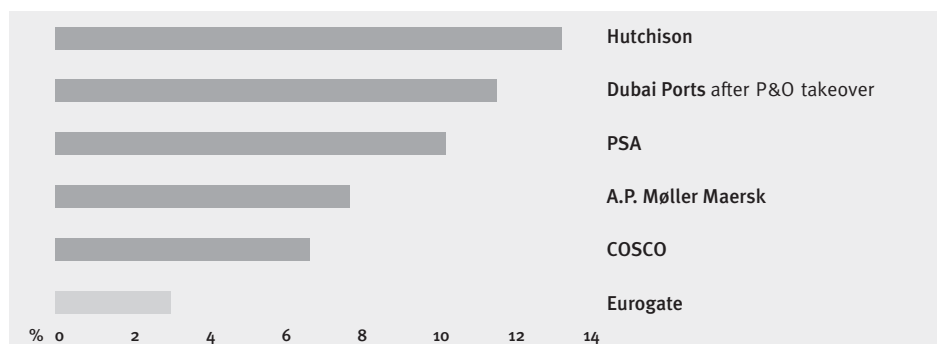


Fig. 4

Source: Company info., Berenberg Bank estimates.

**Breakdown of the world merchant fleet by segment**

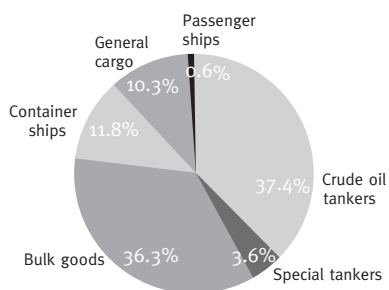
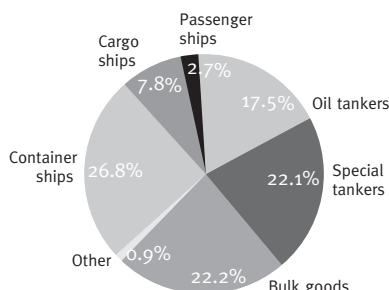


Fig. 5 Source: ISL Bremen (2006a).

**Orders on hand in world shipbuilding by type**



Source: ISL Bremen (2006), VSM Annual Report 2005.

in the shipyard order books at the end of 2005. A doubling of orders on hand in the past three years will ensure shipyard jobs until 2009.<sup>7</sup> These figures alone suggest that there is no reason to worry about the future. Has shipbuilding become a growth industry?

But caution is advised! The current boom is not going to last long. History shows that shipbuilding is a markedly cyclical industry. Boom phases are followed by relatively long slumps. Cycle lengths vary between eight and twelve years – a little longer than the classic economic cycle of six to nine years. In addition to world economics, the reinvestment cycle and charter or cargo rates determine the amplitude and length of the shipbuilding cycle.<sup>8</sup> The tonnage supply follows demand, depending on the type of ship, with a delay of 9-24 months.<sup>9</sup> As ships have a lifespan of 20-30 years, it is easy to predict when they will need to be replaced.<sup>10</sup> This means that the current market situation is basically an echo of the past. At the same time, its echo reverberates far into the future. We are thus likely to experience at least two cycles in the next 25 years.

The cyclical nature of shipbuilding means an extremely variable workload at the shipyards and highly fluctuating prices for new ships, depending on the market situation. At the same time, shipbuilding as a sector lacks flexibility. Developing capacity requires much time and considerable investments. According to the estimates, between three and five non-shipyard jobs depend upon each job at the shipyard (multiplier effect).<sup>11</sup> This sector is of great strategic significance, especially for developing countries. For this reason, there is an inclination to salvage capacities that have been established through state subsidies in crisis periods. Painful adjustments are politicized and implemented very slowly. The bottom line is that capacities are more quickly increased than cut – so utilization under capacity is more likely in the long term than a shortage of capacity.

<sup>7</sup> See VSM (2006).

<sup>8</sup> See Colton/Huntzinger (2002); Klovland (2004); First Marine International (2003).

<sup>9</sup> Bulk freighters are generally the fastest to build, whereas up to two years must be planned for the construction of an LNG tanker. Besides, sea transport generally follows economic development with a time lag, in the following order: Raw materials transports (bulk goods), tanker trade, and finally container trade. See Hansa International Maritime Journal (2002a).

<sup>10</sup> In the case of high cargo or charter rates, more ships are generally ordered; the time needed before delivery then tends to increase. At the same time, there are usually fewer scrappings than would be assumed from the age of the ships. See Klovland (2004).

<sup>11</sup> See First Marine International (2003).

The mood can become significantly overcast even without a serious slump in world economic growth. The current world merchant fleet has become considerably younger in recent years, with average age a little under 12 years.<sup>12</sup> The need for replacements will remain low in many shipping segments. At the same time, an immense capacity build-up is occurring in the Asian region. According to a forecast by the OECD, the world capacity for new shipbuilding will increase by more than 30% by 2012. A surplus will hardly be avoidable in the immediate future. International cutthroat competition will become even fiercer and will change the shipbuilding landscape.

Shipyards are not the right place for the private investor. Ongoing improvements in ship design and equipment offer opportunities to technology leaders in the components industry, whereby the competitive pressure is likely to increase here, too. Regarding interests in vessels: An oversupply will initially have an effect on the spot market. Medium-term, this may also affect long-term charters through renegotiations.

Seaborne merchandise transport today is (primarily) handled by four types of vessels: container ships (12%), tankers (41%), bulk freighters (36%), and special ships (11%). An examination of the trends, demand, and size structure for each type shows that the general increase in size does indeed have a positive effect for small ships.

### 5.2.2 Container ships

The relatively young container shipping sector is the most dynamic market in world merchandise transport. Its importance is climbing quickly and continually. Because they use standardized transport units, container ships can be expedited in much less time and require less manpower than classic general cargo vessels. In the past 10 years, container transport volume has grown, at 10% annually, approximately twice as quickly as world trade. 14% of total maritime trade volume may seem low in comparison with bulk goods. But in the early 1990s, only a mere 4% was transported this way. By value, container shipping already accounts for a little under 50% of transported merchandise.<sup>13</sup>

An end to the boom is not in sight. The forecasts presented in the first part of this study conclude that container traffic will continue to show the most vigorous growth in maritime transport. The relocation of production sites also changes the merchandise structure in favor of this type of transport. The variety in transported goods is growing, with agricultural products, wood products, and construction materials now being shipped in containers. The market for refrigerated containers is growing quickly and outstripping traditional refrigerated cargo vessels.<sup>14</sup> The container is turning into an “all-purpose means of transport.”

<sup>12</sup> See Clarkson Research Services (2006).

<sup>13</sup> See Hansa International Maritime Journal (2003b); Deutsche Bank Research (2006a).

<sup>14</sup> For larger consignments, refrigerated cargo vessels will still have a *raison d'être* in the future. The decreasing significance is evident in the 1.3% annual drop in the capacity of the refrigerated vessel fleet in the past ten years. See Clarkson Research Services (2006).

### Annual capacity growth in the container ship fleet in the past 20 years in %

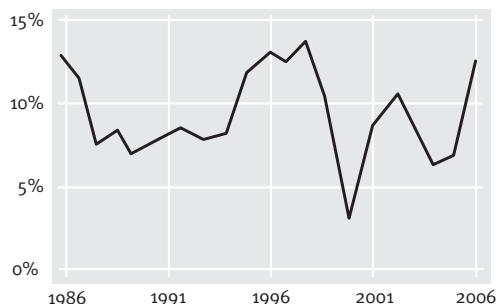


Fig. 6

Source: Clarkson Research Services (2006).

### Breakdown of the world container fleet by capacity (in dwt)

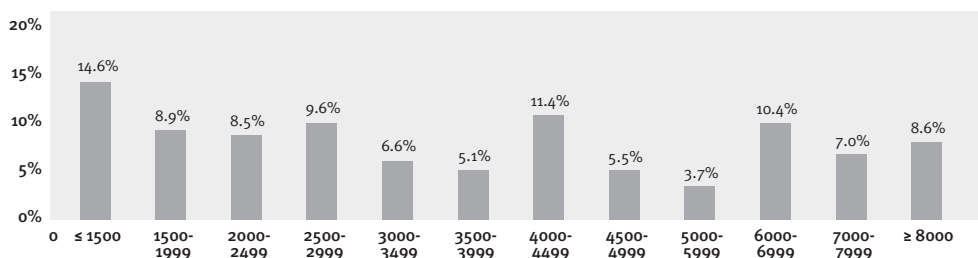


Fig. 7

Source: ISL Bremen (2006b).

In the next three years, the supply of container ships will be increasing even more than demand. At the beginning of 2006, shipyard order books listed 1,230 ships with a container slot capacity of 4.45 mn TEU. The main emphasis was on large tonnage. With orders currently at hand for 3,514 ships with a total capacity of 8.14 mn TEU, this means that worldwide slot capacity will expand by over 50% by 2009. In 2005 alone, the fleet capacity grew by 13.5%. The high rate of new ship construction has led to a decrease in the average age of the fleet, to approximately eleven years. Postpanamax ships, in fact, are on average less than five years old. The number of older ships that are scrapped will remain low. Surplus capacities in global container shipping seems inevitable beginning in 2010.<sup>15</sup>

### Size – Continuous growth

The rising volumes transported in regularly scheduled liner service can be tackled in two ways. Using additional ships with the same capacity can increase the transport frequency. Drawbacks are the very high investment volume, an increased capacity utilization risk for the service, and an only minimal reduction in transport cost per container.

<sup>15</sup> See Clarkson Research Services (2006); ISL Bremen (2006b).



The second method, using larger ships at the same frequency, offers the advantage of appreciable cost savings, especially for longer distances. More efficient fuel consumption, less labor, and a lower capital tie-up make it possible to reduce the costs in reverse ratio to the size of the ships. In comparison with two ships half its size, an 8,000 TEU container ship saves 130 liters of bunker oil per container on the Europe-Asia route.<sup>16</sup>

The structure of the international container fleet has fundamentally changed along with market growth. Increasingly larger container ships are being put into operation at progressively shorter time intervals. During the past 125 years, the fleet has grown by 180%, the slot capacity by 400%. The average size of an all-container ship has nearly doubled. Demand for additional loading space continues. More than half of the capacities that are ordered is for ships that can transport more than 5,000 containers. A year ago, 43 container ships in the over 9,000 TEU class were in the order books. This year, the “*Emma Maersk*” exceeded the 10,000 TEU mark. With this exception, however, taking into account full capacity utilization of the shipyards and supply shortages for large marine engines, regular use of 13,000 TEU ship sizes is only expected in 2010.<sup>17</sup>

Technically speaking, there are hardly any limits to size. A 18,000 TEU vessel is forecasted for 2015. Ships of this size will only travel on two or three main routes. In comparison to current costs on the Asia-Europe route, for example, savings of as much as 16% are expected. Even 21,000 TEU ships are already on the drawing board. In addition to restricted medium-term port and handling capacities, increases in size are limited by other economic factors:<sup>18</sup>

1. *Propulsion units*: They are the greatest problem for future 12,000-15,000 TEU ships. Greater engine power is necessary for speed, or else integration into the existing liner service would be endangered. In the screw propeller, there are limits to weight and material. An alternative would be the installation of two propulsion units. Since the engine and the propeller screw are the most expensive components of a container ship, however, this would increase the capital outlays considerably.
2. *Port charges*: Greater ship sizes mean higher costs for loading and unloading in the port. Besides, the time lost due to longer docking times must be compensated by greater ship speed, with the associated cost.
3. *Operating risk*: The value of the goods transported by a 15,000 TEU container ship can surpass the billion-dollar mark. A breakdown could have serious financial consequences, which would be expensive to insure. The capacity utilization risk of a 10,000 TEU ship is obviously greater than that of a 5,000 TEU ship.
4. *Waterways*: For physical reasons, increases in capacity go hand in hand with increases in width. This makes waterways into limiting factors. On the Europe-Asia route, the Suez Canal limits capacity to about 15,000 TEU. The Strait of Malakka between Indonesia and Malaysia permits a maximum ship capacity of 18,000 TEU on the North America-Asia route.

16 See Reise (2004); Hansa International Maritime Journal (2002b).

17 See Clarkson Research Services (2006), Deutsche Bank Research (2006a).

18 See Hansa International Maritime Journal (2004); Germanischer Lloyd (2004).

### Speed – Prospects for very fast ships

Generally speaking, greater speed is a way of reducing transport time or, through more frequent use of the ship, of handling burgeoning shipment volume. While the time savings play a minor role in feeder services, on longer routes as many as four days at sea could be saved if the speed were increased by 25%. Just the same, faster ships have not become popular. In recent years, the average speed has remained constant at about 25 knots.<sup>19</sup>

The use of faster ships only makes sense on the existing lines if at least one ship can be eliminated through constant frequency of service. Otherwise, the savings in sea days would be compensated by longer container standing time at the ports, since onward transport runs on regular schedules. Besides, a 25% higher speed requires double the propulsion capacity. More powerful engines mean greater investments and higher fuel costs. In the future, ship owners are more likely to attempt to compensate for climbing fuel costs by using less powerful propulsion systems.

As a niche product, express services may in the future become established as a direct competitor to air freight.<sup>20</sup> Japanese shipyards are working on the development of a liner with a speed of 50 knots. In two years, the “FastShip” shipping company intends to begin regularly scheduled service between the USA and France which will guarantee door-to-door delivery of containers between the Midwest in the USA and Western Europe within seven days, at half the price of air freight. The special container ships now being built will be able to cover the distance in less than four days at a speed of 38 knots. The 1,400 TEU capacity is relatively low for a container ship, but corresponds to approximately 60 times the cargo capacity of a Boeing 747.

### Feeder transport – Growth ahead

Despite the current unchecked increase in size, smaller ships with a capacity of up to 2,500 TEU are not likely to disappear. They account for around two-thirds of the container ships and transport just under a third of world container volume. Their use will concentrate more and more on feeder and short sea transport. The trend toward larger units will also be evident in feeder vessels, albeit to a lesser degree. Average capacity is likely to increase from the current 800-1,000 TEU to 1,500 TEU in 2020.<sup>21</sup>

Feeder ships, in contrast to large container ships, are not limited to just a few very long routes or large ports, and they can operate efficiently even with small cargo volumes. As opposed to large tonnage ships, the perspectives for intermediary transport vessels for container shipping are thus good. Transshipment activities (since 1990: +14%) will continue to grow more quickly than container traffic (see Part A).

- Transshipment: For reasons relating to cost and size restrictions, the one-port concept is becoming common for large ships. Only one port of call is used; there the cargo is unloaded

<sup>19</sup> See Reise (2004).

<sup>20</sup> See FastShip (2006).

<sup>21</sup> See ISL Bremen (2006a); Clarkson Research Services (2006); Deutsche Bank Research (2006a).

completely or transferred to smaller ships. These feeder vessels then set course for smaller ports. Such distribution requirements will be increasing in the future.<sup>22</sup>

- With each new large container ship, the demand for feeder vessels will increase even more (multiplier effect), because at each end of a long haul, as many as five feeders will be needed to deliver or distribute the cargo.
- Since the emphasis of ordering is still on large container ships, the smaller the ships, the higher the average age of the container fleet. One in four feeder ships is over 15 years old. The scrapping of tonnage is likely to keep the supply in this class of ships limited in the coming years.
- Experts have calculated that by 2015 approximately 2,100 additional feeder ships will be needed. Since capacities will only be available as of 2010, and because the low profit margins in this segment provide little incentive for shipyards to build small freighters, the supply is likely to remain tight in the immediate future.
- In addition, the demand for small container ships should profit from the focus we predict on intraregional trade beginning in 2015. Short sea shipping in the Baltic is gaining in significance as a result of the eastward enlargement of the EU. Due to its virtually insular location, Asia offers significant opportunities for growth.

A greater number of orders for feeder ships can be expected in the future. Since Asia's shipyards concentrate on large-tonnage vessels, European shipyards could profit especially from this. The Sietas Werft in Hamburg, for example, is the world leader in the design and construction of small container ships.

**Conclusion:** Despite a considerable gain in demand, a surplus of container ships will emerge beginning in 2010. Medium-sized vessels are likely to be affected even more. Postpanamax ships will increasingly dominate the long major routes. Small container ships will be used more and more in feeder service. The gap between large and small ships is likely to widen as of 2015.

### 5.2.3 Bulk freighters

Along with tankers, bulk freighters for dry bulk products are the backbone of worldwide production, as they transport the raw materials that are needed. The so-called major bulks – iron ore, coal, grain, bauxite (feedstock for aluminum) and phosphorus – dominate transport volume, accounting for two-thirds of it.

The emergent Asian economies' hunger for raw materials has fueled the need for bulk freighters. If migration to the cities continues, the long-term perspectives for demand in Asia will be positive. By 2020, China's urbanization will have escalated from 45% to 60%. In comparison with container shipping, however, the growth rates are considerably weaker. The Australian Bureau of Agriculture and Resource Economics (ABARE) expects an annual growth rate

22 Smaller ports still have considerable potential regarding containerization, whereas larger ports like the Port of Hamburg are already at over 95%. See Reise (2004); Deutsche Bank Research (2006a).

of 3.5% for dry bulk goods until 2010, which will level off to 2.1% by 2015. In the more distant future, the authority anticipates annual growth of only 1.2%.<sup>23</sup> Since the main export countries for ore and coal (Australia, Brazil and South Africa) are far away from the consuming countries, transport by ship is the only option, and as the importing countries are successively diversifying their sources, the transport distance may increase slightly in the future.

With a capacity of 342 mn dwt, the 6,631 bulk freighters accounted for the second highest share of the world merchant fleet, with a good 36% of the tonnage, at the beginning of 2006.<sup>24</sup> Beginning in 2004, a reaction to the commodities boom was noted in the form of new ship construction and orders for bulk freighters. This was relatively late – but, in the final analysis, so vigorous that growth in supply was expected to surpass growth in demand in the course of the year. The market’s sensitivity to sinking trade growth is increasing. Due to the high shipping rates, however, hardly any bulk freighters have been scrapped recently, so that almost one in three freighters is overaged. In view of the buoyant demand for replacements and the fact that shipyards are working to capacity, there is little danger of a surplus in the immediate future. Assuming that an additional 70-90 mn t of coal and ore will still have to be transported annually, the gap between growth in cargo volume and tonnage is expected to close more rapidly only as of 2010. However, the slower globalization tempo we predict for the period beginning in 2015 is likely to affect this sector as well.

There are four size categories in bulk shipping vessels. In regard to operating and investment expenses, larger ships are generally more cost-effective than smaller ones, hence ships are becoming progressively larger. The delivery of large freighters increased considerably in recent years, while the number of the smallest bulk carriers fell. The global order book, which at the beginning of 2006, with tonnage of 68.4 mn dwt, accounted for about 20% of the current fleet capacity, points to a continuation of this trend.<sup>25</sup> In contrast to container ships, however, there are no efforts to push up the size limits, set at 365,000 dwt since 1986.

### Annual capacity growth in bulk freighters in % per annum

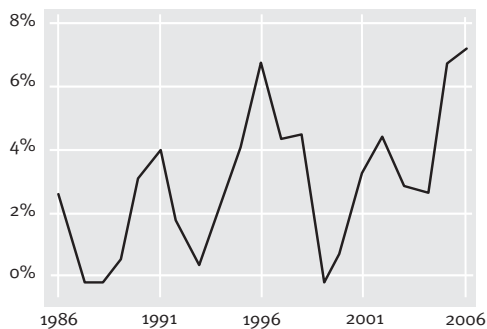


Fig. 8

Source: Clarkson Research Services (2006),  
Berenberg Bank.

<sup>23</sup> See Jiafu (2005), Deutsche Bank  
Research (2006b).

<sup>24</sup> See ISL Bremen (2006a).

<sup>25</sup> See Clarkson Research Services (2006),  
ISL Bremen (2006c).

Since the large capesize freighters (>100,000 dwt) concentrate on the transport of iron ore and coal, the size of this class depends especially on expansion in world steel production and energy demand.<sup>26</sup> The panamax class (60,000-100,000 dwt) is also used for transporting grain, bauxite and phosphate. The small vessels (handymax and handy size) focus on less important dry bulk goods, such as cement, agricultural products, or mineral raw materials. Although trade in these products will increase more slowly in the long term than that with iron ore and coal, container shipping still constitutes competition. Uses for the small bulk carriers are likely to decrease. Opportunities are offered by the high average age, with nearly 70% of the small vessels more than 15 years old. Should demand slump, an increase in scrappings is likely. Besides, a low order volume of just under 7% has a positive effect on current fleet capacity.<sup>27</sup>

As dry bulk goods are generally low-priced goods, the cost of marine transport accounts for a high share of the delivery prices. During the past 50 years, these have risen by a mere 70%. During the same period of time, for the sake of comparison, U.S. retail prices have increased ten times as quickly. Investment costs for bulk freighters therefore play a decisive role. This type of ship is simple in design and technology, and its appearance has changed very little in the past 20 years. The distinct trend toward series production leads to high economies of scale. This has two consequences:

1. China's market share in new vessels (22%) is likely to surge in the future. Japan currently leads, with a share of 64%. Although the more stringent laws in force since July 2006, also requiring bulk freighters to be equipped with double hulls, would tend to increase the price of new ships, keener competition is expected to result in lower prices.
2. Improvements in ship type are likely to be targeted toward a reduction in operating costs. Since higher speeds mean rising fuel costs, bulk freighters remain relatively slow, traveling at about 15 knots. Progress can be expected in automation. Integrated systems for automated loading and unloading could lower personnel costs and reduce docking times.

Since raw materials trade flows in one direction only, pure bulk freighters often make the return trip empty after delivering their cargo. Wider fluctuations in the demand for raw materials also increase the risk that the ships will not be sailing with capacity loads. A greater flexibility in use will be required in the future, favoring freighters that can carry several different types of cargo. Multi-purpose freighters are considered flexible all-rounders since, in addition to dry bulk goods, they can transport liquid bulk goods (OBO freighters), containers (OBC ships), or oversized goods. Temporary bottlenecks in specific market segments can be exploited, and empty runs can be avoided. Many smaller freighters are also able to navigate rivers. Reloading goods in a seaport is then unnecessary, saving time and cost. This greater flexibility must be purchased with higher construction costs, however.

<sup>26</sup> Steel production is expected to expand by 5% annually until 2015, in Asia by 8% annually. China and India have significant iron ore deposits, but China, especially, will continue to be dependent upon rising imports. See Deutsche Bank Research (2005).

<sup>27</sup> See Clarkson Research Services (2006).

Three-quarters of the vessels in the multi-purpose fleet are used for regional or feeder transport, half of these vessels in Asia, the rest especially on north-south routes and in trade with developing countries. Since only few such ships have been built or ordered and the existing fleet already has an average age of 16 years, the segment offers promising perspectives.<sup>28</sup>

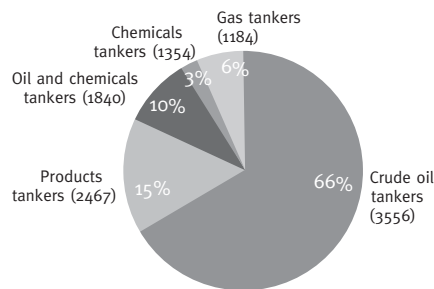
### 5.2.4 Tanker shipping

The tanker fleet includes all types of ships that transport liquid bulk goods. The market is dominated by crude oil tankers, making up two-thirds of the total capacity. The other third is shared by special tankers: pure and combined tankers for oil products and chemicals, as well as gas tankers.

The worldwide transport capacities for liquid bulk goods have grown by an average of 5% annually in the past five years. This segment has the highest transport volume in the world merchant fleet (41%) is outnumbered only by the general cargo ships. At the beginning of 2006, the fleet encompassed more than 10,400 vessels, with a total capacity of 388 mn dwt. Tankers are in first place in world shipbuilding production, too (2005: 37%). The expansion in capacity is likely to accelerate in the medium term. Tankers with a total capacity of 105,5 mn dwt

<sup>28</sup> The multi-purpose freighter fleet currently has a total capacity of 1.05 mn TEU and in the past ten years has increased by an average of 1.4% annually. See Clarkson Research Services (2006).

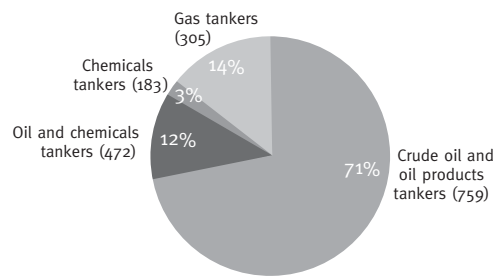
**Breakdown of fleet capacity by tanker type**



**Fig. 9a**

Source: ISL Bremen (2006a).

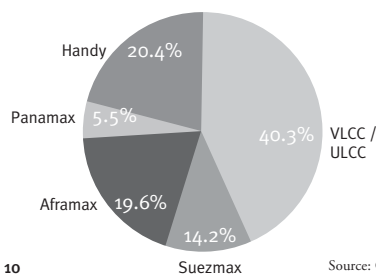
**Breakdown of order book by tanker type**



**Fig. 9b**

Source: ISL Bremen (2006d), VSM Annual Report 2005.

**Breakdown of current capacity by size class**



**Fig. 10**

Source: Clarkson Research Services (2006)

(1,719 ships) were ordered at the beginning of 2006, to be delivered by 2009 – the highest level since the end of the second oil crisis in 1980. In the following year alone, 2007, an increase of more than 12% is expected.<sup>29</sup> A variety of external influences will affect the tanker market in the next 25 years. Safety stipulations will be tightened for reasons connected with environmental protection, thus serving as a basis for replacement and maintenance. Climatic changes and geopolitical questions are likely to endanger capacity utilization.

#### **5.2.4.1 Crude oil, products, and chemicals tankers**

Driven by the closing of the Suez Canal between 1967 and 1975 and for reasons of cost, crude oil shipping became the trailblazer for other shipping segments regarding increase in size. The world's largest ship, the *Jahre Viking*, transported 4 mn barrels of oil in a single load, from the extraction sites on the Persian Gulf to the USA and Japan. This gigantomania came to a sudden end during the oil crises of the 1970s, when capacity utilization problems gave rise to the conversion of several megatankers into crude oil storage facilities. In recent years, however, the average deadweight has risen considerably for crude oil tankers as well, to 163,000 dwt at present. Supertankers (250,000 dwt and more), in particular, experienced an upswing.<sup>30</sup>

Prices for new ships and charter rates for crude oil tankers are very volatile, as they are largely dependent on the world economic situation and the political situation in the Middle East. This applies particularly to supertankers, whose use is limited to oil transport and which handle over 80% of exports from the Persian Gulf. Smaller crude oil tankers are generally equipped with coated and heated steel tanks that can transport various cargos and can thus fall back on other market segments.

#### **Medium-range – Light breeze**

Perspectives for the tanker market are clouded. According to an IEA forecast, crude oil demand until 2030 will increase annually by only 1.7%, the lowest growth rate among the various cargos.<sup>31</sup> The picture is brightened by three trends:

1. Transport distances, which have declined in the past, will increase again. Dependence on the Middle East and Africa to meet world oil need is rising, because production from old oil fields close to the major import countries is sinking at an accelerated rate. By the year 2030, the share of the Gulf states in oil exports will increase from 40% to more than 60%. As increases in distances between production and consumption sites favor transport by ship over pipelines, and since pipeline-bound transport from geopolitical crisis regions can be impacted by failures, this will primarily benefit larger tankers. During the first half of the forecast period, the importance of large tankers will also increase because the greatest growth in oil consumption and imports is expected in the Asian region, and because there are no size limitations on the route between the Persian Gulf and Asia. Momentum in the medium term is ex-

29 See ISL Bremen (2006d), ISL Bremen (2006a).

30 See Hansa Hamburg Shipping (2006), Clarkson Research Services (2006).

31 See IEA (2005).

- pected to be provided for the completion of the Suez Canal expansion scheduled for 2010. Until now, only tankers up to 200,000 dwt are able to pass through the Suez Canal loaded.<sup>32</sup>
2. Security and safety stipulations in the tanker segment are likely to become even more stringent and will necessitate new construction and retrofitting activities. The decision made by the International Maritime Organisation (IMO) to phase out all single-hull tankers by 2015 and tankers without separate ballast tanks as early as 2010 will only generate minimal impulses for new business.<sup>33</sup> Single-hull tankers have not been built since 1996, have been increasingly rejected by the multinational oil corporations due to their image, and tend to command lower charter rates. They are being replaced at an accelerated rate. It is true that almost one-third of the fleet – primarily large tankers – still consists of single-hull ships. But the order books show striking parallels regarding capacity and size structure to the inventory that is being phased out. Clarkson Research expects approximately 15% of the single-hull tankers to still be in service in 2015. Shortages and a significant need for replacements is therefore hardly to be anticipated. The danger of excess capacities does not seem too great in the medium term, however, since the scrapping of old tankers is currently at the lowest rate since 1998 and is likely to appreciably increase by 2010. This will force scrap prices down. Within the context of comprehensive security and safety technology, from which the supplier industry is especially likely to profit, the double hull is only one component. In the future, the requirement for a second, back-up propulsion unit may be added to the list, to improve the maneuverability of the vessel and to maintain its operability in case of engine damage. Since retrofitting is likely to be too expensive, new tanker constructions would profit from this. The trend toward the automated loading and unloading of tankers will increase, reducing the likelihood of human operating errors.
  3. Since significant oil resources are expected in the polar regions and petroleum exports from Russia will be climbing, tankers will be used in frozen waters to an increasing extent. A high ice class necessitates a more powerful propulsion system and a sturdier hull, raising construction costs by 10%-20%. This investment could pay, however, since the demand for ice-strengthened tankers could climb in the medium term by as much as 30%.<sup>34</sup>

### Long-term – Heavy seas

The apex of petroleum production is likely to be approached or even reached during the second half of our forecast period. At this point, the growing demand for oil can no longer be satisfied by an increase in world production, so that supply becomes a limiting factor. Price hikes lead to an adjustment in the demand for oil and a decrease in the amount of crude oil that is traded. Parallel to this, efforts to develop alternatives to oil will be intensified. In addition to the development of alternative drive systems that use natural gas or hydrogen, these include fuel production from biomass, gas or coal.

<sup>32</sup> See Hansa Hamburg Shipping (2006).

<sup>33</sup> See Shipping Intelligence Weekly (2006).

<sup>34</sup> See BMBF (2000); Hansa Hamburg Shipping (2006).



The result: Peak Oil will ultimately threaten the existence of oil tanker shipping. As tankers have a service life of 25 years, anticipated development is taken into account in capacity planning. The number of oil tankers is likely to gradually taper, and the service life of existing ships will be stretched to the limit. Construction activity will collapse, as new vessels will only be required to replace phased-out ships. Large tankers will be more seriously affected than small ones, since they are subjected to greater capacity utilization risks, their focus is solely on crude oil transport, and new propulsion technologies are likely to be implemented initially in the high-consumption industrialized countries. For smaller ships, this may have a positive effect at first. Since the construction of new (transit) pipelines will prove to no longer be profitable, they will be used to a greater extent to fulfill distribution functions.

Tankers will be used for the most part at short notice on the spot market. In the more recent past, a trend toward longer time charter contracts has been observed for larger tankers, and increasingly for smaller ones as well. Deterioration in capacity utilization will first impact the spot market.

### **Oil products and chemicals tankers**

A typical product tanker can transport a variety of oil products (diesel, kerosene, gasoline, etc.), so that charter rates are less likely to be impacted by fluctuations in oil prices. Products tankers are primarily in the medium size segments (panamax, handy size), reach the aframax class at most, and are generally rented short- and medium-term. With full order books concentrating on large products tankers, the fleet capacity and average size are likely to increase appreciably in the next three years. This means that a weaker market situation can be expected medium-term in this segment. China (31%) has now assumed leadership in the construction of products tankers, followed closely by Japan.<sup>35</sup>

We consider the long-term prospects to be somewhat positive, since seaborne trade with oil products could grow more quickly than crude oil trade, a contrast with the past, and the major consumers (USA, China) will be increasingly dependent on imports.

In recent years, the refinery capacities of the industrialized countries have hardly been expanded or modernized for the processing of heavy oils, whose share in oil production will surge. At the same time, the oil exporting countries in the Middle East want to begin expanding local refining operations, to increase their share of the added value. This shifts the focus to the transport of finished products to the importing country. Since in the future the use of crude oil will be concentrated more strongly on the transport sector, the demand for products tankers is expected to rise at the expense of crude oil tankers.

Products tankers will also suffer under the long-term drop in conventional oil production, albeit not to the extent expected for the pure crude oil tanker segment. Whereas biomass is likely to be converted into fuel especially close to the place where it will be consumed, this only

<sup>35</sup> See ISL Bremen (2006a).

holds true to a limited degree for natural gas or coal. Transporting the basic commodities is likely to be more expensive than shipping oil products, with the result that the conversion plants will be built mainly in the production countries (natural gas: Russia, Middle East; coal: Australia, South Africa, USA). Pure chemicals tankers (3%) and combined oil products and chemicals tankers (8%) are the smallest sub-segment of the market, with 11% of tanker tonnage. These are predominantly small ships under 10,000 dwt, which are designed for an approximately 30-year service life, due their high maintenance intensity and construction costs. This ship type has only undergone considerable further technical development to adapt it to the increasingly greater diversification in cargo structure. The number of cargo tanks, pumps and pipelines has been increased considerably, to make it possible to simultaneously transport several individual chemicals parcels (parcel tanker traffic).

#### **5.2.4.2 Gas tankers – Energy policy tailwind**

With the exception of regenerative energies, the demand for natural gas up to 2030, at 2.4% annually, will show the highest growth rate among energy sources. As the result of the growing geographic imbalance between demand and production, international gas trade will increase even more rapidly, tripling by 2030.<sup>36</sup> Gas can basically be transported via pipeline or, in a liquid state of aggregation, in special ships. Liquid petroleum gas (LPG) and liquid natural gas (LNG) tankers are differentiated by their liquefaction temperatures. The current 70% share of pipeline-bound transport is expected to decline in the future, as the shipping of natural gas over long distances is more cost-effective.<sup>37</sup> Besides, ships can be redirected, adding to flexibility in case of regional shortages. The market for liquefied gas shipping can be viewed as a long-term growth market. In view of this positive perspective, the fleet of gas tankers is also growing noticeably.

#### **LPG tankers**

LPG tankers transport petroleum gases (propane, butane) that are recovered during the refining of petroleum and can be liquefied at room temperature with little overpressure. Tankers of this type are generally also able to carry chemicals like ammonia and petrochemical gases. The fleet currently amounts to 4% of world tanker tonnage. Since trade with LPGs is likely to maintain its strong growth rate at least until the end of this decade, orders for this type of tanker have climbed. In the next three years, the fleet capacity is expected to grow by approximately 37%, whereby most of the ordered tankers will be delivered in 2008.<sup>38</sup> Larger ships, in particular, should profit in the future from the growing refinery activities in the Middle East and West Africa, especially as the transport distance will be increasing.

<sup>36</sup> See IEA (2005), BP (2005).

<sup>37</sup> Most of the costs for shipping is related to liquefying and regasifying. These energy costs incur independent of transport distance. See Gasverbund Mittelland (2006).

<sup>38</sup> See Clarkson Research Services (2006).

### LNG tankers – Elite class with potential

Studies predict a rosy future for liquefied natural gas. By 2015, LNG trade should double, growing at an annual rate of up to 10%. In 25 years, half of natural gas trade is likely to be handled by LNGs. The number of LNG exporting and importing countries will rise considerably.<sup>39</sup> The LNG tanker fleet is still of manageable size, but has been growing very quickly recently. In March of 2006, 200 ships of this type – 5% of the total tanker capacity – were sailing the seas. The excess capacity situation that resulted from growth in 2005 has given way due to the opening of new terminals. However, the order books most recently listed 145 ships to be delivered by 2009, which would result in a doubling of the current volume capacity.<sup>40</sup> At the end of the decade, this is likely to cause greater pressure on charter rates, should there be significant delays in putting newly operating terminals into operation.

Drewry estimates that, taking into account the projects currently planned or under construction as well as present fleet development, an additional 79 LNG tankers will still be needed by 2011/2012. By this time, China will have acquired the necessary know-how and developed the construction capacities for the technologically sophisticated tankers. This will result in surplus capacities, which will bring pressure to bear on new construction prices and, with a time lag, charter rates. It should be considered that LNG tankers offer a very long service life of 40 years. In view of the current average fleet age of 13 years, with ongoing expansion of the fleet beginning in 2015, only a limited number of new vessels are likely to be built.

The following trends can be expected in the future:<sup>41</sup>

- *Increase in size:* Whereas three years ago the capacity limit was still 155,000 m<sup>3</sup>, by now ships with a loading volume of up to 250,000 m<sup>3</sup> are being ordered. As the existing terminals are often not able to handle very large tankers, there are limits on such increases in size for the moment. Once terminals have been expanded, the average size is likely to climb, since the key routes are relatively long. Very large tankers require their own liquefaction equipment, since during transport more excess gas is produced than can be used for propulsion. Despite the high cost, a liquefaction plant on board could become widely accepted, because the construction of regasification plants and storage tanks on land has met with resistance from environmentalists. Should this occur, the turbine technology which has been dominant up to now is likely to be rapidly supplanted by the more energy-efficient diesel-electric drive.
- *Tank technologies:* Most widely used and cost-effective in construction is the spherical tank system (called Moss tankers). The modern membrane technology is expensive and complicated. However, a tanker equipped with this technology can load approximately 8% more LNG than a Moss tanker. The future belongs to membrane technology, attractive due to its lower operating costs.
- *Cost depression:* According to the Gas Technology Institute, the costs for gas liquefaction have dropped by 35%-50% in the past ten years. LNG tankers are also less expensive now. A Moss

<sup>39</sup> See EIA (2003), IEA (2005), Gaughan (2005).

<sup>40</sup> See Hansa International Maritime Journal (2005b), Clarkson Research Services (2006).

<sup>41</sup> See Gaughan (2005), Morita et al (2003), Schröder (2006).

tanker with a capacity of 150,000 m<sup>3</sup> costs \$150-180 mn, equivalent to a cost reduction of 40% in the past decade. Economies of scale, growing competition among the shipyards, and improved shipbuilding technology are likely to further cut construction costs for LNG tankers.

- *Spot trade:* Up to the present, almost all tankers are part of special production projects. Spot trade represents only 15% of the global LNG market, and only 12 tankers are available to be booked at this time. Since gas production, liquefaction, ships, and import terminals are very expensive, long-term contracts of over 20 years will continue to predominate in this business. Spot sales and the sale of individual shipments will become more important, however. Especially smaller ships are likely to be increasingly available. Contracts covering price and volume are also becoming more flexible. Since about half of the long-term contracts only end beginning in 2020, newly built vessels are likely to be obtainable to a greater extent for spot trade.

### 5.2.5 Shipyards and shipbuilding nations

The face of the shipbuilding industry has changed considerably in the past 50 years. Whereas Europe initially controlled the market, today the heart of shipbuilding beats in Asia. South Korea (35%), Japan (30%), and China (15%) presently build approximately 80% of all merchant ships, specializing in various segments. The German shipbuilding industry, with a market share of only 4%, holds fourth place.<sup>42</sup>

#### History – Signposts to the future<sup>43</sup>

Until the early 1960s, the European countries were dominant in shipbuilding, responsible for two-thirds of all new ships on the world market. Despite the overpowering British competition, which built almost half of all merchant ships until the mid-1950s, German shipyards were internationally competitive. They had begun building in sections and introducing new production methods at an early date and profited from relatively low material and labor costs.

In the 1950s, Japan began its ascent, needing shipbuilding for the reconstruction of its industrial structure. Its competitive edge was based on more than low wages. Standardization of the construction process, automation, and new management techniques made it possible for Japanese shipyards to quickly become more productive than their European counterparts.<sup>44</sup> In addition, the trend toward the construction of ever larger ships was anticipated in the boom phase that lasted from 1965 to 1975. The shipyards were designed generously from the outset, which proved to be an advantage in comparison with the modernization measures that had to be undertaken in the old shipbuilding nations. Increase in size led to an escalation in capital requirements. State support, closely linked to modern shipbuilding, thus became more important. The fact that, despite its high labor costs, Japan is able to maintain its position as the second largest shipbuilder is due to constant boosts in productivity, investments in mo-

<sup>42</sup> See Clarkson Research Services (2006).

<sup>43</sup> Regarding this chapter, see especially Colton/Huntzinger (2002); First Marine International Limited (2003).

<sup>44</sup> In the 1970s, the production at Japanese shipyards was double that of the European shipyards.

dern technologies, and a productive component supplier industry in the immediate vicinity of the shipyards. Japan has dedicated itself to building bulk freighters for the domestic market, as well as oil and gas tankers. In container ships, it is gradually losing market shares to South Korea. Japan's shipbuilding industry is currently undergoing a transformation process.

The result will be a greater degree of automation in production, lower building capacities, and shipyard mergers. In 1976, following the first oil crisis, the inflated shipbuilding market began to collapse. Within three years, demand and production were cut in half and prices fell steeply. Rationalization, nationalization and subsidies became the buzzwords of the era. At the same time, South Korea developed into a new competitor. In 1970, this country had practically no shipbuilding industry, and 20 years later it had outstripped all of the European countries. While low demand forced Europe and Japan to cut back on capacities in the 1980s, South Korea erected new building berths as the foundations for its world market supremacy. Without massive cash injections by the state and advantageous financing terms, this would not have been possible.

The much desired upswing in the demand for ships began to emerge in the early 1990s. Asia's large shipyards profited especially from this positive impetus. The trend toward series shipbuilding reduced planning and development costs, and it enabled economies of scale and a steep learning curve. Contrary to expectations, the profitability of the shipyards did not improve. Despite rising demand, the prices for new ships sank. The need for replacements for the ships that had been built during the boom of the 1970s had been predicted. South Korea prepared by amassing enormous capacities, Japan reactivated plants that had been shut down, and China entered the market. The Asian crisis of 1998 had dramatic consequences for South Korea's export-oriented shipbuilding sector. Currency effects alter the profitability of shipyards considerably, since ships are priced and invoiced in U.S. dollars. The depreciation of the won thus abruptly doubled profits from delivered ships and permitted the shipyards to substantially reduce their prices for new vessels. The deluge of orders caused Korea's world market share to skyrocket from 25% (1998) to 36% (2000). The downside was the rise in cost for labor and raw materials. Many of the shipyards that were seriously in debt became overextended. To utilize capacities, they began to offer new ships under cost. The resulting legal action filed by the EU with the WTO was rejected last year. It became evident that the WTO regulations do not effectively combat unfair pricing practices. South Korea now specializes in large tonnages, primarily container ships and products tankers, as well as technologically sophisticated LNG tankers. Its goal is to gain market shares in more profitable segments, such as passenger shipping. South Korea's shipbuilding industry is dominated by five major shipyards, which command 72% of the Bloomberg World Shipbuilding Index.<sup>45</sup>

<sup>45</sup> See Nonstop (2005a), Heseler (2000).

### China's path to the top

The transfer of shipbuilding technology has become simpler and faster. At the same time, the degree of automation in the prevailing series production of the most popular ship types has increased and favors large shipyards. These facts indicate that labor costs will remain the most important determinants of competitive capability in the long term. Efforts to limit shipbuilding subsidies internationally are likely to continue to fail. Mercantilistic philosophy will remain highly significant in determining the success of the shipbuilding industry of individual nations. These are good preconditions for China, which has the lowest labor costs among the shipbuilding nations and is setting about to become the world leader in shipbuilding by 2015.

China's metamorphosis into a shipbuilding giant is breathtaking. Its production has more than quadrupled since 1990. In recent years, it has grown by approximately 17% annually. The current 5-year plan includes massive construction projects that will result in a doubling of capacity by 2010. Two large state conglomerates share the shipyards north (CSIC) and south (CSSC) of the Yangtze. By 2015, CSSC intends to expand its capacity to 14 mn dwt. To make this possible, the world's largest shipyard, with an area of 1.8 mn m<sup>2</sup>, has been under construction since 2003 at a price of over \$3 bn on the Yangtze island of Changxing (Shanghai). The sister group CSIC plans to expand its capacity to 8-9 mn dwt. This would mean a tripling of the current 6.5 mn dwt capacity of Chinese shipyards.<sup>46</sup> To ensure capacity utilization, an aggressive price policy has been instituted: New ships are being offered for approximately 20% under the prices set by South Korean competitors. For bulk carriers, the shipyards take their cue from the least expensive Japanese supplier.

Up to now, China's shipyards have primarily concentrated on building large bulk freighters, medium-sized tankers, and small container ships, to generate volume. However, they are very quickly developing the capability of constructing more sophisticated ship types. The first supertankers have already been launched. The goal of the economic planners is to expand the spectrum to include large container ships, RoRo ferries, and LNG tankers, because by value China's shipbuilding industry only ranks sixth.

The construction of the types of vessels that require much labor and little technology and can be produced in series will increasingly shift to low-wage countries in the next 25 years. This trend will be accelerated by rising costs for upstream products (steel, raw materials) and capital. Affected are large oil tankers and bulk freighters, as well as small and medium-sized container ships. China is profiting from this trend. Japan, however, will successively lose market shares. In the second half of the forecast period, nations like Vietnam, Brazil or India could make their way onto the world market, as they can offer lower labor costs and are already building up capacities.<sup>47</sup>

<sup>46</sup> See Nonstop (2005b), VSM (2006), Farnsworth (2006).

<sup>47</sup> See Nonstop (2006).

### Europe's shipbuilding opportunities

Europe's shipbuilding industry will be shrinking and specializing even more in certain niches. This necessity arises from the increasing intensity of competition in the high-technology segment. South Korea and Japan are focusing on high-technology ships, to compensate for losses in other segments. Also included is the construction of cruisers, still firmly under European control. At the same time, shipbuilders will more intensively look for ways of automating labor-intensive tasks. Due to the necessary investments, greater automation will impact smaller companies particularly, so that concentration in this sector is likely to increase.

Europe's chances for survival lie in the tailor-made production of special ships, building highly technological prototypes, and supplying engineering services and equipment for ships (without actual production). Many shipyards will not survive the next recession phase on the meager profits generated by building small tonnages. To support European shipyards, the EU has created the "Leadership 2015" program. Its objective is to bolster its leading position in the markets for technologically sophisticated shipbuilding. In addition to fostering investments in research, development and innovation for products and processes, effective measures are to be taken to prevent the drain of expertise, to ensure competitive financing, and to emphasize security, safety and environmental issues.<sup>48</sup>

#### 5.2.6 The components industry – Opportunities for technology leaders

The maritime components industry produces a broad spectrum of items for shipbuilding. They range from the engine to navigation equipment, deck machinery, and electronic equipment, to cranes, pumps and valves. The share of components in a ship's added value has been consistently increasing and today, depending on the type of vessel, amounts to 60%-85%. Of the global market volume of approximately €61 bn annually, the 400 German companies account for a share of 15% (€9.3 bn) and rank second, behind Japan (20%).<sup>49</sup> Germany plays a leading role in high-tech systems. Since this sector reacts to swings in the shipbuilding market, the high growth in profits noted in recent years is likely to weaken in the medium term. By 2010, we calculate a decline to an average annual growth rate of 2.5%.

Networking between shipyards and components companies will become more closely meshed and increasingly important as a competitive factor. Developing the component supplies sector close to the shipbuilders will permit optimal warehousing and short delivery times for the shipyards. Component suppliers profit from better marketing of their products. The geographical distance is thus an important competitive factor for both sectors. A shift of shipbuilding to Asia offers advantages to companies located there. To succeed competitively, European suppliers will increasingly establish subsidiaries in Asia and transfer production to that region. Since the majority of maritime component suppliers in Europe are not able to operate global-

<sup>48</sup> See EU Commission (2003b). There is also an initiative organized by the industry, called "Waterborne2020," which has similar emphases. See Lloyd's List (2006).

<sup>49</sup> See VDMA (2006a), VDMA (2006b), IHK Emden (2006), BMBF (2000).

ly, due to their size, there will also be more mergers and acquisitions in the future. Three main factors will be of interest to the components supplier industry in the future:

### **Propulsion systems – The energy-efficient and environment-friendly ship**

The world merchant fleet uses about 5% of the produced petroleum annually. Marine engines primarily use heavy fuel oil (bunker oil) with high harmful emissions. Large merchant ships are driven by slow, smaller freighters and chemical tankers by medium-speed diesel engines. Gas tankers generally have a steam propulsion system. In the future, rising fuel costs and more stringent environmental regulations will confront engine manufacturers with considerable challenges. After all, greater size also requires greater propulsive power. This balancing act can hardly be managed with the conventional direct drive.

As an alternative, the diesel-electric, indirect drive, is likely to prevail.<sup>50</sup> The ship's engine drives a generator, which provides energy to an electric engine, which in turn drives the screw propeller. The higher costs of the system are compensated by significant advantages. There is less wear, the ship is easier to maneuver, the screw can be well positioned hydrodynamically, and surplus energy can be used for operation of the vessel. The result is considerable fuel savings over the direct drive. The pod drive is also based on a combination of diesel and electric engines. The screws are housed in rotating gondolas, thus making a rudder unnecessary and the ship extremely maneuverable. Even large container ships can be driven this way. European manufacturers like Siemens, MTU Friedrichshafen, MAN B&W Diesel, and ABB are leaders in this relatively new technology. The next step, standard equipping of merchant ships with fuel cell propulsion systems, is only expected in ten years. Prototypes have existed since 2004. Fuel cells are already being used for the shipboard power supply. Spurred on by environmental legislation, this technology could gain acceptance even earlier in ecologically critical regions.

For fast ships, water-jet propulsion systems have been further developed in recent years. Due to the higher costs and lower efficiency than conventional drives, their use will be limited to high-speed and other special ships.

Wind as a propulsion force is cost-free and environmentally compatible. Ships equipped with auxiliary sail propulsion units can save 10%-70% of fuel, depending on the system and the application area.<sup>51</sup> Wind-powered freighters have proven not viable, due to their high maintenance costs and because the masts hinder the discharging of cargo. Skysails takes a different approach: A huge towing kite tenses in the wind, 100-300 meters in front of the ship, providing additional propulsion. The advantages: A constant, strong wind blows in higher air layers. Besides, the kite takes up hardly any space and does not disturb the operation of the ship. Up to 50% of the cost of €500,000 would be recovered in three years through fuel savings. The system, especially suitable for ships that run at a slow speed, is to be used on a tanker for the

<sup>50</sup> See Siemens (2006).

<sup>51</sup> See Hamburger Abendblatt (2006), Hansa International Maritime Journal (2005a), [www.skysails.de](http://www.skysails.de).



first time in 2007. Series production is planned for 2008. The company is aiming at a market share of 1.5% five years after that.

### **Systems solutions – Modern software in ship operation**

The trend in shipbuilding leans toward the fully electric ship. Modern, computer-controlled systems for navigation, communication and automation enhance safety for the crew, ship and environment, simplify decision-making in case of an accident, and make it possible to reduce the number of crew on board. Integrated systems will become more important in the future. Monitoring, automation, navigation, and engine management systems will be united on a single platform.<sup>52</sup> Important requirements for such systems are:

- The architecture is based on a modular concept that permits standardized hardware, simple maintenance, and easy expansion through sub-processes.
- User-friendliness is a decisive criterion with an increasing number of alarm and monitoring stations.
- The detection and elimination of problems should be enabled by the manufacturer through satellite communication at any time.
- Integration into the logistics chain requires sufficient interfaces to enable communication with the software designed for loading.

### **Services – Greater status**

Services already generate one-fifth of turnover in the component supplier industry. A third of German companies expect the share to rise in their incoming orders. Suppliers will increasingly offer services available worldwide throughout the ship's lifetime. Flexibility and expertise will become more important as competitive factors.

The use of software-based tools such as CAD and CAM systems for the planning, design and production of ships provides considerable potential savings in time and cost.<sup>53</sup> Simulation and virtual reality technology help to optimize production and evaluate the operational behavior and environmental characteristics of a ship at an early stage. Since the early product development phase holds the greatest economic risks for the shipyards, the use of modern software for planning and design will continuously advance.

52 See Siemens (2005), Valkeejärvi (2005), BMBF (2000).

53 See Hansa International Maritime Journal (2003a) und (2002c).

## 6. Perspectives of land-based transport logistics

### 6.1 The modal split – The path leads to the goal: The goods leave the port

#### 6.1.1 Dominance of the road

For years, the movement of goods in Europe has been growing more quickly than the economy as a whole. In view of globalization and the progressive integration of the Eastern European states into the EU, this will not change in the near future. As a result, greater demands will be made on European transport policy in the coming years. The problems surrounding its many facets are mirrored in the development of the individual segments of merchandise transport.

At present, the modal split – that is, a breakdown into the shares of the overall movement of goods performed by individual modes of transport – is dominated by the road. The latter has increased its share by leaps and bounds in the past, while merchandise transport by rail and inland waterways has stagnated or declined. Within the EU-25, the movement of goods has increased an average of 2.8% annually in the past decade.<sup>54</sup> Traffic on waterways rose at about the same rate, principally due to short sea shipping between ports on the Baltic Sea. In contrast, transport volume on inland waterways grew by a mere 9% over the entire ten-year period. Above-average growth was recorded by road transport (35%), while rail transport only expanded by 6%. The largest share of traffic within the EU, about 45%, falls to the roads. The share accounted for by the railroads is around 10%. A further 40% falls to sea transport, but only 3.5% to inland waterways (see also Volume 1, Chapter 3.2).

In Germany, too, the rising volume of merchandise in recent years has led to differing rates of growth for the various modes of transport. Here, unlike the EU, above-average rates were recorded by rail transport, whose share (figures all without sea transport or cabotage)<sup>55</sup> expanded by 14.5% in the past five years. According to the Federal Office for Freight Traffic<sup>56</sup>, this was largely due to the vigorous growth in seaport hinterland traffic. The share of road transport has diminished to 81.6%. Inland waterway transport stagnated at 4%.

**Shares of modes of merchandise transport in the EU (2004)**

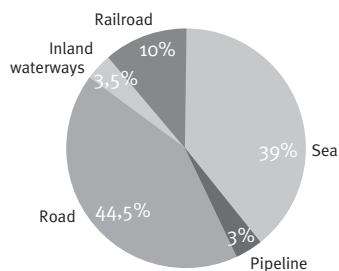


Fig. 11

Source: EU white paper.

<sup>54</sup> See EU Commission (2006a).

<sup>55</sup> Depending on the source, there are sometimes significant differences in the measurement of the modal split. This is due to different definitions – with or without sea transport, with or without cabotage (transport volume of foreign companies) in transport kilometers or transport volumes.

<sup>56</sup> See Bundesamt für Güterverkehr (2005a).

### 6.1.2 Comparing modes of transport: Environmental issues vs. flexibility

Inland waterway transport<sup>57</sup> compares most favorably by far with road and rail transport, considering environmental and cost aspects (see also Volume 1, Chapter 4.5). The economic and ecological advantages are shown by the following comparisons<sup>58</sup>:

- A pusher unit can transport 16,000 t of bulk goods with six pusher tugs. 650 trucks or 400 railroad cars would be needed for this amount.
- A kilogram of fuel can transport 127 tons 1 kilometer by ship, but only 50 tons 1 kilometer by truck and 97 tons 1 kilometer by railroad.
- Whereas a truck needs 4.1 l of diesel per 100 ton-kilometers, inland waterway shipping only requires 1.3 liters, and rail transport 1.7 l.
- While inland waterway shipping shows a specific final energy consumption of 464 kJ/tkm, the comparable figure for road transport is 2,290, and for the railroad a comparably modest 566.
- While inland waterway shipping generates CO<sub>2</sub> emissions of 33.4 g/tkm, this figure for road transport is 164 and for the railroad 48.

Inland waterway shipping is also the absolute winner in regard to noise and safety. This wealth of advantages is, however, countered by a number of disadvantages. In addition to the low network density, these include:

- Dependence on bridge clearance heights and widths, as well as the size and capacities of the locks and canal ship lifts that must be passed through.
- The low transport speed. A motor freighter with 2000 t of cargo needs a good six days to travel from Linz to Antwerp, while a truck traveling at a speed of 80 kph needs only 12 hours.
- The extreme dependence on nature, primarily the water level. An insufficient water level during an extreme summer dry period, for example, can cause considerable delays or even cancellations of transports, as happened recently on the Elbe during the record summer of 2006.

In view of the ongoing climate change, the subject of low water levels is likely to be of increasing concern in the future and will create additional barriers to the expansion of waterborne transport at the latest during the second half of our forecast period. The climate change will not only be characterized by extreme drought, however, but also by flooding, so that inland waterway shipping may forfeit its reliability, or the cost argument per ship may become less convincing. The advantages of the road transport of merchandise lie clearly in its speed and flexibility. Especially in an era characterized by delivery at increasingly shorter notice (just in time) and more “door to door” services, this point will play an ever greater role for reasons of competition and cost in the coming years.

57 In Germany, merchandise volumes of up to 240 mn t, with a transport capacity of 60 to 65 bn ton-kilometers, are currently being transported annually. This is equivalent to almost 90% of the freight volume transported by the railroads or approximately 14 mn truckloads. Over 50% of the goods that are transported are raw materials, primarily stones and earth, as well as construction materials.

58 See Bundesverband der Deutschen Binnenschifffahrt (2006).

However, the problems and risks involved with this mode of transport will also be increasing, especially in relation to environmental problems (air and noise pollution), rising energy costs, and accident risk. In the past decade, the transport sector was by far the industry within the EU-25 in which energy consumption climbed the most (+2% annually as compared with an overall 0.6% annually). About one-third of total energy demand is now absorbed by transport, 25% of this on the road.<sup>59</sup> Experts assume that by 2030 trucks will have replaced cars as the biggest CO<sub>2</sub> polluters.<sup>60</sup>

As these examples show, rail transport may not perform better than inland waterway transport in regard to environmental balance, but considerably better than road transport. On the negative side of the balance sheet is the fact that the fixed costs are much higher. The American railroad company Union Pacific, for example, has to spend over a billion dollars annually on maintaining, expanding and upgrading the railroad infrastructure. In view of this, it is clear that rail transport can only compete with the road on longer distances. As a general rule, however, the truck is only faster than the railroad as of a distance of 400-500 kilometers.

The most serious problems of European rail transport at present lie in the lack of operability across national borders. These include changing locomotives and train conductors and crew, as well as the multiple examination of various forms and credentials. Technical barriers also exist in the form of different power systems, signals and control systems, differing axle and track gauges, and the insufficient networking of the various IT systems. Freight cars have long been able to travel easily between Scandinavia and Sicily. Especially in the dense traffic over the Brenner Pass, however, delays are caused in 50% of all train transfers by the Italian railroad because there are too few locomotives or locomotive engineers.<sup>61</sup> If one considers all of the interruptions caused by the changing of locomotives and train personnel, as well as inspections, checking of papers, etc., the average speed for merchandise transport crossing national borders in Europe is a mere 18 kph. This makes the freight train slower than an icebreaker in the Baltic Sea.

### **Air freight: Low share – High growth**

- Compared with the total volume of goods, the share transported by air freight is relatively small. Only 1% of world merchandise trade is carried by plane. This is also the reason that air transport is not reflected in the modal split. By value, however, this means of transport accounts for 40% of world trade, as it is primarily used for high-quality and expensive items such as computers and machine parts for which the expensive but speedy air transport pays.
- Regardless of the high costs, air transport will be showing sizeable growth rates. The reasons for this can be depicted with the expressions “just in time” and “globalization.”

<sup>59</sup> See EU Commission (2006b).

<sup>60</sup> See ERTRAC (2006).

<sup>61</sup> See Bundesministerium für Verkehr, Bau- und Wohnungswesen (2001).

The highest growth rates in air freight – as in shipping – will be recorded in traffic with Asia. While the International Civil Aviation Organization (ICAO) expects an average annual growth rate of 5.5% by 2015, the world’s largest manufacturer of cargo planes is much more optimistic. In its World Cargo Outlook, Boeing forecasts annual growth rates of 8.5% until 2023. Air transport between China and Europe or the USA, in fact, is expected to show above-average growth rates of 9.3% to 9.5%. Today the air freight volume in Asia already accounts for at least a third of total world air shipments. In 2015, according to predictions by the ICAO, the world share will be more than 40%.

- As the result of intensive competition, according to the Association of European Airlines, profit generated by European air freight carriers has dwindled during the past decade from \$0.30 to less than \$0.20 per sold ton-kilometer. In view of this, strategic alliances – like those in passenger traffic – are expected to also play an increasingly important role in the cargo segment.
- In view of China’s role as a driver of economic growth, Boeing comes to the conclusion in its current “Current Market Outlook” that the world cargo fleet will about double in the next twenty years, from the current 1760 planes to 3530. While Boeing is apparently concentrating more on intraregional traffic in this connection and therefore on smaller, more cost-effective planes, its competitor, Airbus, is currently investing in large ones. The cargo version of the new Airbus A 380 will be able to transport loads as large as 150 t nonstop over distances of up to 10,000 kilometers.
- ESCAP anticipates investments in airport construction and expansion amounting to \$300 bn by 2010. Annual investments up to 2030 are expected to be in the \$30-50 bn range.
- To increase efficiency, competitiveness, and the expansion of regularly scheduled service, greater privatization of airports will be seen in the future – at least in the form of minority holdings. Reasons for this include the strained financial situation of many municipalities, especially as numerous airports are currently only able to remain viable with the help of massive subsidies. Of the 18 international commercial airports in Germany, the majority are publicly owned. Only the Düsseldorf, Hamburg and Frankfurt airports have privately-held minority shares amounting to hundreds of millions of euros each.

#### Growth of air cargo volume up to 2015

Region	Annual change in % per tkm
Europe	4.9
Africa	4.0
Middle East	6.6
Asia-Pacific	6.4
North America	5.0
Latin America/Caribbean	2.5
World	5.5

Fig. 12

Source: International Civil Aviation Organisation

municipalities, especially as numerous airports are currently only able to remain viable with the help of massive subsidies. Of the 18 international commercial airports in Germany, the majority are publicly owned. Only the Düsseldorf, Hamburg and Frankfurt airports have privately-held minority shares amounting to hundreds of millions of euros each.

### 6.1.3 The forecast: No major shift in modal split expected

In view of both the environmental impact and the bottlenecks in road traffic which are already obvious today, a change in modal split is more than desirable. Numerous experts have been dealing with the question of whether and how it will be possible to divert traffic in the coming decades – considering sustainability, cost, and capacity bottlenecks – from the road to the rail and inland waterways. The following summary will provide an overview. The forecasts that are available officially unfortunately only extend as far as 2015 or 2020; everything that goes beyond this should be considered an orientation aid only.

The predictions of transport development in Europe that are most often quoted come from the Basel-based Prognos Institute or, since the spin-off of its transport segment (2003) from Prograns AG.<sup>62</sup> They only go as far as 2015, however, that is, half of the period covered by our forecast. Swiss transport experts expect an escalation in merchandise transport in all modes for Europe (West) by 2015 of 42% (over 2002). Road traffic will persist at its share of approximately 80%. For inland waterway transport, no appreciable shifts in share (6%) are anticipated. Rail traffic will, on the other hand, be able to increase its present market share of about 13.5% by one percentage point. In Eastern Europe, the railroads have traditionally played a much larger role due to the greater role played by heavy industry and agriculture, which are typically dependent on rail transport. In the next ten years, according to Prograns, this is not likely to change. With an increasing transport volume of high-value consumer and capital goods, paired with declining production in primary industry, however, it can be assumed that Eastern Europe will draw increasingly closer to the Western European modal split by the end of our forecast period.

According to the Plan for Federal Transport Routes<sup>63</sup>, merchandise transport in Germany will grow by 64% – compared with 1997 – to 608 bn tkm by 2015. While merchandise transport by road will continue to climb at an above-average rate after that date, rail and inland waterway modes of transport are expected to show under-average growth rates. This means that the modal split is likely to continue to change in favor of the road. Prograns AG comes to similar conclusions in its predictions for Germany.

62 See Prograns AG (2004).

63 See Bundesverkehrswegeplan (2003).

#### Merchandise movement in Germany by transport mode 2005–2015 in bn tkm

	2005	Share in %	2015	Share in %	% 05–15
Road	380.0	72.5	484.9	73.0	27.61
Rail	81.6	15.6	102.3	15.4	25.37
Inland waterway	62.3	11.9	77.1	11.6	23.76
Total	523.9	100.00	664.3	100.00	26.80

Fig. 13

Source: Prograns AG.

**Growth in shares of modes of transport in EU merchandise movement**

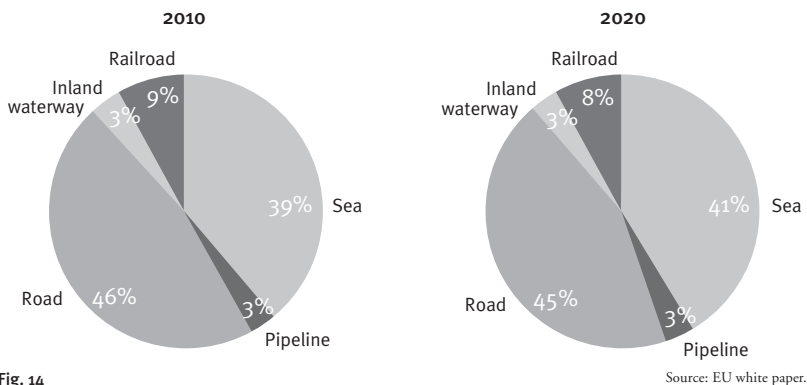


Fig. 14

Source: EU white paper.

In its white paper on transport policy, the EU has also presented forecasts going beyond this and up to 2020 and currently expects merchandise transport to increase by approximately 50% between 2000 and 2020 (including hinterland maritime traffic). Above-average growth is expected in short sea shipping (59%) and in road transport (55%), while inland waterway shipping will only gain by a little under 30% and rail goods transport by 13%. According to the EU forecast, too, the shares accounted for by the various modes of transport will basically remain stable in the long term.

In its overview on energy and transport, which extends to 2030, on the other hand, the EU<sup>64</sup> provides indications regarding the development of the modal split without maritime traffic. Shifts in modes of transport are evident here. However, they do not comply with the EU's ecopolitical aims. Road transport's share, at the expense of the railroad, will probably continue to grow to over 77% (2000: 69%). The rail share – although still increasing at an average

64 See EU Commission (2003a).

**Structure of EU-25 merchandise movement (excl. maritime transport)**

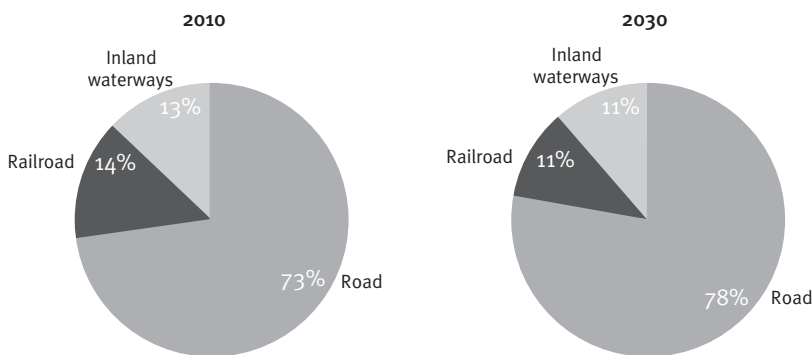


Fig. 15

Source: EU Commission.

rate of 0.9% annually – will fall from 17% to over 11% and that of inland waterway traffic from 14% to 11.3%. Among the EU newcomers, the share of rail traffic, at 24%, will still remain noticeably higher, while inland waterway traffic, at only 1%, will remain an as yet untapped potential.

Quantitative data on the development of merchandise transport in Europe, especially for Germany, up to the year 2025 is provided by the Institute for Mobility Research (ifmo).<sup>65</sup> Among the conclusions of the study entitled “The Future of Mobility – Scenarios for the Year 2025” are:

Assuming that business relations between Germany and the Eastern European countries become more intense, and that Germany increasingly becomes the hub between East and West, East-West merchandise transport will appreciably escalate and, in t, as compared with 2002, will

- double overall, whereby
- in the Oder River corridor it will quadruple to 115 mn t,
- with the Czech Republic, it will triple to 82 mn t,
- in the Balkan corridor, it will double to 107 mn t, and
- with German ports on the North Sea, it will increase (+61%) to 290 mn t.

**Conclusion:** All of the studies and forecasts come to the same conclusion: Attempts to draw merchandise transport away from the road will remain wishful thinking and will only be partially successful. Growth in the merchandise transport sector will continue to take place on the road, while railroad and inland waterway transport will only profit to a lesser degree. Inland waterway and rail transport may be able to increase their growth rates, but they will not succeed in altering the relative significance of the individual modes of transport.

The reverse conclusions that hold true are:

- a) The state will intervene to regulate and guide the development of traffic infrastructure and transport.
- b) Innovations that are environmentally compatible and that conserve resources will be fostered, and companies can be expected to come up with a large number of technological innovations.

<sup>65</sup> See Institut für Mobilitätsforschung (2005). Initiators of the study are: BMW Group, Deutsche Bahn AG, Deutsche Lufthansa AG, and MAN Nutzfahrzeuge AG in collaboration with the Federal Ministry of Education and Research.



## Crossing Paths at the Port of Hamburg

Inland harbors function as intersections between waterways, roads and railroads, and are now developing more and more into regional centers of merchandise transport. Whereas typical bulk and liquid goods such as coal, ore and mineral oils used to be dominant, today high-value bulk and general cargo, as well as containerized goods, are handled to an increasing extent. Although container transport on inland waterways is of relatively low importance in Germany, only 4% of the overall load, growth in this segment is appreciable. The doubling of container transport by inland waterway vessel expected by the Planco Institute<sup>66</sup> between 1997 and 2010 to 2 mn TEU could thus already be achieved by 2008. If this development continues, and with appropriate expansion and support, an increase in this segment to 4-5 mn TEU may be possible by the year 2030.<sup>67</sup>

The most important German inland port is Duisburg, with merchandise handling of over 49 mn t. Thanks to its favorable location in the hinterlands of the ARA (Amsterdam, Rotterdam, Antwerp) ports, 90% of merchandise traded with foreign countries is handled here. The Port of Hamburg, with cargo handling of over 11 mn t, only holds third place in inland waterway transport. Thanks to the noticeable increase in domestic commerce during the past year, however, its cargo volume rose by almost 25%, while the two larger inland ports, Duisburg and Cologne, only recorded increases of 1% and 2%. The advantage of the Port of Hamburg in regard to domestic transport is its geographical location inland, which means that part of the relatively expensive transport to and from the hinterland is eliminated. On the route between Hong Kong and Prague via the Port of Hamburg, for example, 80% of the total transport costs fall to the segment between Hamburg and Prague, although this portion is merely 3.4% of the entire distance.<sup>68</sup>

In the hinterland traffic of the Port of Hamburg, trucks continue to play the dominant role. This applies particularly to container transport, with a share of over 50%. In feeder traffic for short sea shipping to Scandinavia, the Baltic states, and Eastern Europe,

Share of transport modes in hinterland traffic of the Port of Hamburg 2003

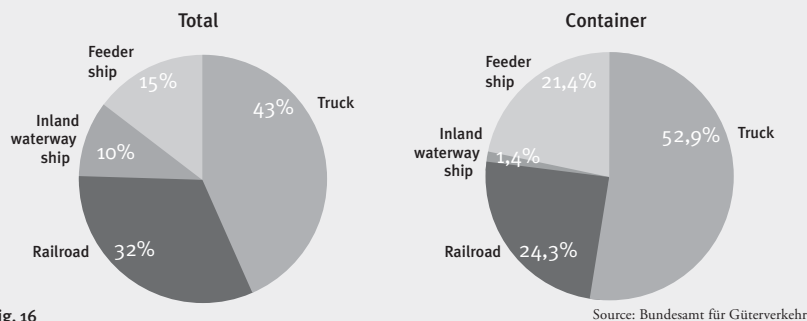


Fig. 16

<sup>66</sup> See Planco Consulting GmbH (2003).

<sup>67</sup> Calculation Berenberg Bank.

<sup>68</sup> See Bundesamt für Güterverkehr (2005b).

as well, the container share of more than 20% lies above the modal split (15%). Approximately one-third of all goods are transported onward by rail. Inland waterway shipping, at 10%, is underrepresented, and the container share in inland waterway traffic, at 1.4%, is much lower still. In view of the climbing volume of merchandise handling, the demands placed on hinterland transport in and around Hamburg will inevitably continue to rise. The Institut für Transportwirtschaft und Logistik, in a study<sup>69</sup> of merchandise handling, traffic forecasts, and planned construction projects, has considered possible bottlenecks for various ports up to the year 2015. Among the conclusions made by experts for the Port of Hamburg are:

- Judging by the current modal split for total merchandise transport, almost 100 mn t would roll over Hamburg's roads by truck. in 2015. This would mean an increase to 20,590 truck tours to or from the Port of Hamburg, compared with the current 9,830 trucks per day.
- The actual figures, however, could even surpass these. The reasons: the rising share of containers that are primarily transported by truck, as well as truck transport to the nearby hinterland (max. 75 km), which exhibit definite economic advantages in this segment over rail and ship. This could, however, change as our forecast period continues – assuming a rise in oil prices to \$150 or more.
- As a result of the expected growth in container traffic, rail transport (over longer distances) will also increase noticeably. In 2015, 170 trains will be in transit daily solely for container transport, so that the total number of train movements will increase to 280, as compared with the present 180.
- Conclusion: The roads in and around Hamburg will increasingly become a limiting factor. Rail transport will also become a priority concern for regional transport policy.
- In traffic on inland waterways, by comparison, bottlenecks are not expected. The reason: As the forecast period progresses, it is container transport that will especially drive growth, which – regardless of its dynamic development – will still remain underrepresented in inland waterway traffic.

In light of the planned “motorways of the sea” and EU eastward enlargement, the share of waterways in the short sea shipping segment, in contrast, will increase. Hamburg is already the most important seaport for Czech foreign trade. This transport is for the most part conducted by land, whereby rail dominates at 75% (truck: 15%, inland waterway vessels: 5%). The situation is similar for hinterland transport involving Slovakia, Hungary and Slovenia. On the other hand, trade with the Baltic countries is predominantly conducted on seagoing ships. In Poland, the land/sea proportion is about even. The Polish government also wants to continue to step up its “from road to sea” approach, which

69 See Frass (2006).

should especially benefit the share of short sea connections via Hamburg. The upturn in handling amounts, especially in the containerized segment, will unavoidably impact the need for bottleneck-free hinterland connections that conserve resources. This will confront regional traffic planning with great challenges, not least in view of Hamburg as a center of business and industry.

The Plan for Federal Traffic Routes, which explores hinterland links for seaports for planning until 2015, classifies the following infrastructure projects for Hamburg as “urgently needed”:

- Widening of A1 between Hamburg-Southeast and Hamburg-Billstedt to six lanes.
- New construction of A14 (Ludwigslust–Magdeburg)
- and A39 (Lüneburg-Braunschweig).
- Widening of the Stelle-Lüneburg railroad line (three-track)
- and the Uelzen-Stendahl line (two-track).

Beyond these, the planned deepening of the Elbe River is considered the largest infrastructure project in northern Germany (€345 mn). Still in the approval phase, the project is to begin implementation in 2008. After 2006, expansion of the Middle Elbe will also be initiated (see also Volume A, Chapter 4.5).

## 6.2 Getting off the road: Establishing a political framework

All forecasts make the same statements about future developments in merchandise transport in the next ten to twenty years: The road will remain the most important mode of transport, but will not be able to cope with the increases in road transport of goods. Transport policy must therefore be redefined as a key component of economic support. Of high priority here are the establishment of environmental policy measures and preparing alternatives for transport policy.

In approaching this, as in considering the modal split, we want to concentrate solely on merchandise transport. Since passenger and goods transports generally use the same infrastructure, whether emissions stem from cars or trucks, pusher units, or cruise ships is not significant in determining transport policy.

### 6.2.1 Need-based expansion of inland waterways

The inland vessel is the best mode of transport not only, but especially, for ecological reasons. Particularly in view of the eastward enlargement of the EU, merchandise transport via inland waterways provides a considerable, but not yet exploited, potential and could develop into a competitive alternative to road and rail. 60% of the expanded outer borders are sea borders,

and the already existent network of rivers and canals has grown through the accession countries from the Danube basin to the Black Sea. In view of this, in its 2001 white paper on European transport policy, the EU Commission already declared intra-Community sea transport and inland waterway transport to be two key components in intermodalism. Establishment of the so-called “motorways of the sea” is therefore essential. By 2010, transnational sea transport connections are to be created that – like conventional highways – function as part of an intermodal transport chain, have high frequency, and can handle large cargo volumes. Obvious examples would be the routes between southern Sweden and Hamburg or between southeast England and Duisburg. Expansion in sea links are expected especially to prevent bottlenecks in the Alps and the Pyrenees. For example, 75% of wood is still transported between Finland and Italy via Germany and the Alps, although transport by sea would be feasible.<sup>70</sup>

The “motorways of the sea” concept was given concrete form through the amendment of the TEN (Trans-European Networks) guidelines in 2004. Three main goals were defined:

- Concentration of the flow of goods on sea-based logistics chains and the improvement in or the creation of new links – that are regular and more frequent and can bear greater loads – for cargo transport between the member states.
- Greater logistical integration of short sea shipping throughout the transport chain.
- Reducing road traffic and/or improving links (e.g. countries at the outskirts of the EU).

Especially for long distances, based on short sea shipping and including rail and inland waterway transport, an efficient combination of infrastructure and service is to be created in the logistical transport chain. Through its quality, efficiency and regularity in regard to transport costs and time, it is to provide a competitive alternative to road transport. The Integrated European Action Programme for Inland Waterway Transport (NAIADES) was established by the EU Commission to foster various plans to expand the waterway network in line with the list of the Trans-European Networks.

Inland waterway transport is also attracting greater attention in Germany again. To develop a waterway network that will meet the needs and will be viable in the future, funds for the maintenance and expansion of public waterways will be augmented for the first time since 2000. For fiscal 2006, an increase in investments in federal waterways by €50 mn to approximately €457 mn is planned. The ports are also to become more competitive internationally. By the end of 2007, therefore, according to the “Master Plan for Merchandise Transport and Logistics,” a national port concept will exist that is designed to improve collaboration among seaports. The recognition that goods do not make their way by themselves from the road to the water, or from the water to the road, resulted at the end of 2005 in the “Initiative for Inland Waterway Shipping and Logistics,” founded jointly by the German industry associations Bundesverband der Deutschen Binnenschifffahrt, Bundesverband Öffentlicher Binnenhäfen, and Deutschen Speditions- und Lagerverband.

<sup>70</sup> Rapid expansion of sea and coastal shipping would depend on the creation of a uniform single market. Due to international regulations – shipping traffic from one member state to another is considered external traffic – this has not yet been tackled.

### 6.2.2 Harmonizing and privatizing the rails

As mentioned above, rail transport offers considerably better options than trucks for the future in regard to both environmental aspects and the growing capacity bottlenecks on the roads. In view of this, it is the stated goal of EU transport policy to foster this mode of transport, too.

An essential prerequisite for this is the EU-wide deregulation and harmonization of rail transport policy. Rail freight markets will therefore be opened as of January 1, 2007, after which all companies in EU member states will be able to offer their freight transport services in the individual national railroad markets, using the respective rail networks. By 2010, cross-border free passage will be ensured for the entire European rail freight transport network (150,000 km). However, there still are numerous obstacles to surmount before the desired complete interoperability among infrastructures, vehicles and crews within the EU can actually be achieved. Not least, there are the financial aspects. The EU will have to meet costs amounting to tens of billions of euros just for the technical coordination.

A model for a uniform European railroad system can – at least in part – be provided by developments in the USA. There rail freight transport accounts for approximately 40% of the modal split. Apart from the totally different geographic realities, two approaches here provide guidance for the future. First, the USA has a separate rail network for freight transport, whereas freight trains on this side of the Atlantic generally have to yield to the faster passenger trains, resulting in delays or a reduced overall speed. Second, the – private – U.S. railroad companies have consciously catered to the interests and needs of industry.

For Europe, this means, first, that the creation of a trans-European rail corridor either solely for merchandise traffic or with precedence for freight trains must be fostered. The second conclusion, especially interesting to investors, is that rail transport companies will for the most part be privatized by the end of our forecast period, thus subject to domestic and international competition. In Germany, plans for the Deutsche Bahn to go public (2008) already indicate a radical change in rail transport. It has not yet been finally decided, however, whether this IPO will include the rail network, or whether the tracks and railroad stations will continue to be publicly owned.

To better integrate railroads in the forwarding agents' transport chain, railroad operators will progressively incorporate shipping or logistics companies through acquisitions and/or alliances. A number of privatizations have already occurred in regional transport, including comprehensive intramodal holdings. In 2001, BASF and two logistics companies, Bertschi Hoyer and VTG-Lehnkering, established rail4chem as the first major rail freight service company alongside the traditional railroads. Since the middle of 2002, IKEA has been delivering goods to its German central warehouse in Duisburg through its subsidiary IKEA Rail AB. In all of the countries they traverse, the trains are operated by private suppliers, which in turn have formed a consortium (Rail Transport Team). In Sweden this is TGOJ Trafik AB, in Denmark

TraXion A/S, and in Germany RAG Ruhrkohle Hafen und Bahn AG. Certain shipping lines and terminal operators already have holdings in railroad companies as well. In Hamburg, for example, HHLA has a stake in Metrans (Czech Republic) and Polzug (Poland), which handle hinterland transport with Central and Eastern Europe.

### 6.2.3 Regulating the roads

Last but not least, EU transport policy will intervene especially to regulate road transport. The primary objectives will be:

- the reduction of conventional emissions caused by traffic as well as of traffic-related greenhouse gas emissions;
- the efficient shaping of the existing infrastructure with the help of modern transport and vehicle technology;
- increased traffic safety.

The results of active, market-oriented domestic transport policy or a harmonized, deregulated EU transport policy<sup>71</sup> can be summarized as follows:

- Environmental regulations will become more stringent, and/or environmental levies will be increased.
- New, optimized methods of transport management will be sought. The registration, prediction and influencing of traffic volume will be decisively improved, for example, through use of the Galileo Satellite System, which will be operational beginning in 2010 and which will transmit appropriate navigation signals.<sup>72</sup>
- Road construction will be increasingly regulated by factors relating to material sustainability and the reduction of energy costs.
- Driver assistance systems (distance and lane holding and driver monitoring systems) will be promoted.
- Traffic control will be managed more and more through infrastructure charges. Electronic road pricing falls in this segment.
- Tolls that are linked to utilization loads and emissions will play an increasingly important role in the coming decades, not only for trucks, but for cars as well. Income thus generated will be channeled into traffic infrastructure projects, so that the expansion in road infrastructure will, in the final analysis, be financed by the users.
- Privatization of highways and federal trunk roads will progress, so that here, too, toll income will basically finance investments in maintenance, expansion and operation.
- Public funds thus made available will be used for the expansion of the rail and inland waterway networks.

<sup>71</sup> See Institut für Mobilitätsforschung (2005).

<sup>72</sup> Not only is the Galileo program the first European infrastructure program of global dimensions, but this is the first time a major project is being funded by several European countries as a public-private partnership model (see Chapter 7). In Germany, the "Program for traffic control on federal highways 2002-2007" is currently being financed with federal funds amounting to €200 mn.

#### 6.2.4 Support for intermodal networking

Whether the accelerated expansion of railroads and inland waterway systems will succeed is questionable. In the past, due to shortages in funds, such ideas have usually remained empty promises. In view of this, the EU Commission is pursuing the goal of encouraging intermodal merchandise transport, that is, the integration of various modes of transport, so that rail and water transport can profit from gains on the road. The linkage of various modes of transport gives logistics a key role (see Chapter 1). The EU fosters intermodal transport through its “Marco Polo” program, which networks the various modes of transport, so that alternatives to classical road transport can be developed. For this program, approximately €450 mn has been earmarked for use until 2013.

To prevent farther-reaching economic consequences though the expected bottleneck in the logistics chain, the German government is also supporting intelligent interplay between road, waterway and railroad in a networked transport system. It is therefore promoting combined transport (CT)<sup>73</sup> by means of regulatory and fiscal policy measures, as well as financial allocations through various government support programs. According to the Plan for Federal Traffic Routes, an increase in CT of 89.7 mn t by 2015 is to be expected, as compared with 46.1 mn t in 2005.

### 6.3 Consequences for companies and investors

The continuing growth in goods and transport will result in a gigantic need for infrastructure investments, especially in Asia (see Chapter 3.2.2). There are many ways an investor can participate in this trend, such as infrastructure funds (see Chapter 7), certificates, or selected specific securities. The transport sector will also be developing successively into a high-tech sector. This will open up new business opportunities and will give the investor a multitude of new ways of sharing in the boom in merchandise transport by investing in transport and logistics companies, as well as construction and technology firms.

#### 6.3.1 The path is the goal: Infrastructure investments

The OECD estimates that between 2010 and 2030 annual worldwide infrastructure investments in road transport will amount to \$220-290 mn, the lion's share for the maintenance, expansion and upgrading of existing links. An annual investment volume of \$50-60 bn will be channeled into the rail sector (see Chapter 7). Specifically, capital expenditures and potential investments appear to center around the following:

*In the road sector*, in view of environmental concerns, in addition to expansion, upgrading and maintenance, the focus will be especially on infrastructure measures. These include noise and wind protection barriers, sound insulation walls, and low-noise paving.

73 Combined transport is the transport of goods in trucks or in individual shipping units (especially swap bodies, containers, or semi-trailers), whereby transport over most of the total distance is carried out by rail, inland waterway ships, or seagoing ships, and over the rest, the shortest possible portion, by motor vehicle. During the transfer from one mode of transport to another, it is not the goods themselves, but the packed transport units, that are reloaded, or else the packed trucks are transported on railroad cars (rolling road) or ships.

- The anticipated use of larger and heavier trucks<sup>74</sup> will also lead to new requirements in road infrastructure to suit these dimensions. In Germany, for example, weight may cause problems on numerous bridges and overpasses. One-third of the approximately 36,000 overpasses, in fact, date from the 1950s.

Focuses in the *rail sector* will be:

- Capacity expansion in rail transport (upgrading of lines, line improvements, parallel tracks for passenger and freight trains, lengthening of holding or side tracks).
- Electrification of the rail networks. Experts expect increases in efficiency of more than 40% from complete electrification, which is to be concluded by 2020 within the EU-15, but will go beyond our forecast period for the newcomer nations. Research for Germany has shown that the electrification of a line which permits a higher speed than the old traction system can increase its capacity by about 10%.

There will also be a definite boost in the demand for locomotives and rolling stock, as well as for special freight cars needed for the expansion of combined transport. Appreciable investments in handling equipment are also expected in connection with CT.

Focuses in *shipping* will be:

- The expansion of existing waterways (deepening, straightening, canalization), as well as inland waterways that are no longer used and the creation of new river connections.
- Investments in bridge heights,<sup>75</sup> operation of locks, and ship hoists.
- Links between the ports and the rail network, expansion of handling and loading equipment.
- Modernization of the inland waterway fleet (some vessels over 40 years old).
- Construction of safer, faster, and lower-emission ships, also to comply with the expected more stringent environmental standards.
- The growing demand for smaller, shallow-draft ships for inland shipping, in view of climate change.

For the investor, the major construction companies like Bilfinger Berger und Hochtief should be mentioned, but also Cemex, Heidelberg, Hochtief and Lafarge. Germany's largest construction group, Strabag, recently re-positioned itself in the European railroad construction sector by purchasing sector specialist Eichholz. Family-owned up to now, the Eichholz Group is known as one of the leading railroad construction specialists in Germany. Companies active in the rail vehicle and technology segments include Alstom, Bombardier, Siemens and Vossloh. It is the Dutch companies, such as BAM and Heijmans (see also Chapter 5.1, A digression: Dredging and filling), that traditionally have experience in the waterways construction segment.

<sup>74</sup> The so-called gigaliners will be 20 t heavier and 6.5 m longer than the 40-tonners currently permitted on German roads. Even though their use is still disputed, experts believe that they would reduce the number of trucks on the highways by one-third, at the same time considerably cutting fuel consumption. Two megatrucks can transport as much as three 40-tonners, but use up to 30% less fuel per t of payload.

<sup>75</sup> In container transport between Magdeburg and Berlin, for example, since vertical clearance is too low, containers can only be transported in a single layer, although transport of up to six containers side by side and five high is possible.



### 6.3.2 Many roads lead to Rome: New technologies in the transport sector

Parallel to the increase in merchandise transport, the conflict between traffic and the environment will become even greater. The EU Commission believes that the energy balance in the next fifteen years will worsen by an additional 7.5% on balance. To counteract this, the consistent use of technologies that are environmentally compatible and conserve resources is absolutely mandatory for all transport sectors. In view of this, the topic of sustainability will be of constantly growing significance for politicians, companies and investors.

The wealth of technological innovations – some already tested or implemented, some, as described in Chapter 3.2.1, still seemingly futuristic – seems practically inexhaustible. Let us mention a few examples here.

It will undoubtedly become more and more important, particularly in road freight transport, to optimize the total transport volume, in order to avoid unnecessary costs and environmental impact.<sup>76</sup> In our study Strategy 2030 – Energy Resources, we have already discussed in detail the long-term changes – more in regard to cost than environmental aspects – to be expected in the automotive industry. Rising gas prices will provide an impetus for accelerating the development of new drive systems (hybrid, electric) and the use of alternative fuels (bio-diesel, synthetic additives, natural gas, hydrogen). This applies to both passenger and freight transport. Trucks are already using – if only sporadically – natural gas, methanol or ethanol. New technologies for drive systems such as hybrid engines and fuel cells are currently being tested in trucks as well. This trend is likely to intensify in the coming decades. Technologies to reduce vehicle weight (lighter materials) will also become more important in road transport. The use of alternative drive technologies will gain in significance not only on the road, however, but also on the rails (locomotives) and in ocean and inland waterway shipping (see Chapter 5.2.6).

The World Business Council for Sustainable Development sees a particular challenge in this connection in air transport. It goes so far as to predict that, with regard to sustainability in the transport sector, by 2030 a complete break with today's drive technologies and the associated fuels may be necessary.

As already suggested several times, new technologies for collecting and transmitting transport data will be key. These Intelligent Transport Systems (ITS) technologies – also subsumed under the term telematics – comprise a broad spectrum of information, control and electronic technologies for monitoring and management in the traffic and transport sector. Microelectronics, satellite navigation, mobile communication, and sensor technology are already helping to monitor and control the flow of traffic. The further development of electronic toll collection and dynamic road pricing systems are also part of this subject area. On the rails, the use of new electronic control systems can enable less distance between the individual trains and thus a higher average speed.

<sup>76</sup> See Acatech (2006).

The development and use of new telematic services or the implementation of new navigation and communication technologies will also play an ever greater role in enhancing reliability and safety in ports and on inland waterways. As described above, the motorways of the sea constitute a major EU innovation and research focus in the shipping sector. Goals entail the establishment of an innovation fund for inland waterway transport amounting to approximately €120 mn.

Among the companies involved in this subject area are Höft & Wessel and OHB Teledata GmbH – a subsidiary of OHB Technology AG – as well as Siemens, Tele Atlas and TomTom. Particular attention will be paid to road surfaces, as well tires designed to lower road resistance. Noise-reducing, heat-resistant, abrasion-resistant surfaces will be preferred. The topic of climate change (softening of asphalt by high heat) will also play an ever greater role in future considerations. Lower rolling resistance resulting from new types of surfaces, as well as the elimination of bumps and uneven spots, could reduce fuel consumption by about 10%. A 20-30% reduction in specific noise emissions may be achieved through the simultaneous optimization of road surfaces and tires. A reduction in road resistance is already being achieved today by the use of so-called “green” tires, which produce fuel savings of 3% to 8%. The next generation could bring about additional savings of up to 9%.

**Conclusion:** The continuing high growth in traffic will develop into a growing challenge for infrastructure policy in the coming decades. In addition to the elimination of bottlenecks, environmental aspects will draw more and more attention from policy makers and companies. The privately- and publicly-funded expansion of traffic infrastructure and the promotion of new technologies that are more environmentally compatible and better conserve resources impact a broad spectrum of industrial sectors and service-providing companies. Especially due to their long-term nature, they offer an outstanding opportunity for investors to play a role in the megatrend of transport logistics.

## 7. Financing transport infrastructure

Infrastructure is often viewed as a public asset, one whose construction, maintenance and operation is the responsibility of government. Even though this perception is partially justified in the case of social infrastructure, the economically oriented transport infrastructure examined here is generally regarded as a mixed asset.<sup>77</sup>

Since well-developed transport routes that facilitate economic growth are in the interest of society, the state should indeed ensure the general conditions necessary for sufficient and safe logistics operations. The construction, maintenance and operation of roads, railroads, airports, seaports, and inland ports, however, can be managed completely or partially by private-sector companies. Privately financed and operated infrastructure will become considerably more important in the future. After all, the immense outlays required to ensure well-functioning infrastructure cannot be met with the notoriously limited public funds.

This section will delineate the investment volume that will have to be funded in the next 25 years and the financial sources available for this purpose. Governments will (need to) concentrate on their core responsibilities in the future and institute usage-dependent financing of public projects or allocate these to private operators. Partnerships are likely in which the risks and returns of a project are shared by the state and private investors, giving rise to new opportunities for the investor. With the increasing variety of investment forms and advantageous risk-return combinations, investments in infrastructure will continue to gain in importance.

### 7.1 Investment potential – How much must be financed?

#### 7.1.1 Global investment potential

According to studies by the OECD and the World Bank, \$250-350 bn will have to be provided annually worldwide until 2030 to maintain and expand land transport infrastructure – road and rail.<sup>78</sup> Investments in roads take up the lion's share, 78%. Of this sum, \$50-70 bn is subject to intervention on the part of policymakers (fiscal constraints, sustainable development, modal shifts toward the railroads). Land transport requires widely branching, well-developed networks. The funding requirements are therefore relatively higher than for air and ship transport, in which investments concentrate on the construction and operation of airport and seaport infrastructure.<sup>79</sup> A record sum of \$36 bn was invested in airports in 2005.<sup>80</sup> Projecting the figures from the Asia-Pacific region to the world, this would mean that, until 2015, \$30-50 bn will be required annually for airports and \$10-20 bn for container ports.<sup>81</sup> Conclusion: In the future, up to \$420 bn will be available annually for productive use in transport infrastructure.

<sup>77</sup> Both principles of public assets – nonrivalry in consumption and nonexclusion – are infringed upon at least to an extent. Rivalry in the consumption of transport infrastructure is evident in traffic jams on the roads, handling of ships or planes in airports and seaports, and the fact that only one freight train can travel on a specific line at one time. Users can also be excluded from consumption: tolls and port and airport charges as well as fees for the use of the rails are common practice.

<sup>78</sup> See OECD (2006a), World Bank (2003). The World Bank study only covers the period until 2010 and bases its calculations on average annual world economic growth of 2.7%. The results harmonize well with those of the OECD study, which forecasts development until 2030.

<sup>79</sup> For shipping traffic, the expansion of important canals and inland waterways should be mentioned as exceptions. Global figures are not available here.

<sup>80</sup> See Airports Council International (2005). The ICAO estimates that between 2000 and 2010 global expenditure for airport and air navigation services will amount to more than \$300 bn. See ESCAP (2005).

<sup>81</sup> Average figures for the so-called ESCAP region from ESCAP (2006) were extrapolated on the basis of the 28% share of the region in the world gross domestic product (2005, World Bank Statistical Database).

This may seem like a large amount, considering a capital stock only for roads and rails which was estimated in 2000 at \$6,000 bn. However, replacement investments of 2% annually and the states' longstanding substantial underinvestment in maintenance and servicing should also be kept in mind. According to the OECD, world investments in road and rail, currently amounting to almost 0.5% of world economic output, will decrease continuously over the entire period to 0.35% (2030).<sup>82</sup>

**Conclusion:** Whether the average expansion in transport infrastructure of almost 1.2% annually will be sufficient to meet the rapidly surging demand is questionable. With a rapid globalization pace (until 2015) and the perspective of burgeoning private funding of economic infrastructure, a high investment potential is likely in the medium term.

### 7.1.2 Regional breakdown

**Breakdown of annual investments**  
(Road + rail) by region (in \$ bn)

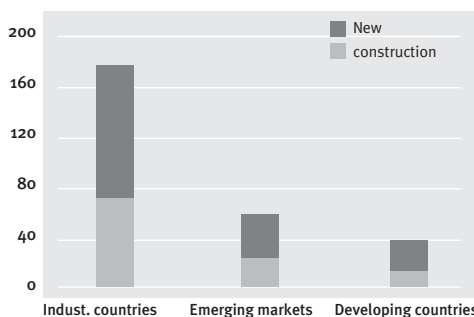


Fig. 17 Source: WTO, OECD, Berenberg.

**Breakdown of annual investments**  
(Road + rail) in \$ bn 2005–2010

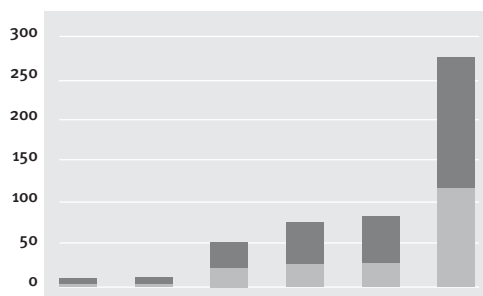


Fig. 18 Source: WTO, OECD, Berenberg.

#### 7.1.2.1 Industrialized countries – The biggest piece of the cake

Until 2030, investments will continue to focus on the G7 nations of Western Europe and North America. Measured by their economic output, the industrialized countries spend considerably less for transport infrastructure than the emerging and developing nations. Their appreciably higher capital stock will grow at a below-average annual rate, 1.6%, since they focus on the maintenance and servicing of the existing infrastructure.

Furthermore, there is a certain amount of catching up to do. In the USA, the value of transport infrastructure diminished by more than 13% between 1950 and 1990. Standard & Poor's estimates that at least \$92 bn will be required annually for the maintenance and servicing of the road network. Improvements cost an additional \$34 bn annually.<sup>83</sup> A study by the Hudson Institute cites a figure of \$48 bn per annum until 2025 to eliminate the accrued underinvestments and \$168 bn for maintenance. The American highway network is expected to develop annual financing needs of \$212 bn.<sup>84</sup> Similarly, elsewhere in the OECD, a shrinkage of transport in-

<sup>82</sup> See World Bank (2003), OECD (2006a).

<sup>83</sup> See Standard & Poor's (2005).

<sup>84</sup> See Giglio (2005).

infrastructure spending to 1.4% of the GDP has accelerated the aging of such infrastructure. In Europe, driven by the enlargement of the EU and the common currency, €600 bn has been assessed just for the expansion of the trans-European traffic network up to 2020.<sup>85</sup>

### 7.1.2.2 Asia – Growth engine for infrastructure

The Asian emerging nations constitute the growth center for the construction of new transport infrastructure. With investment quotas averaging 3% of the GDP, ratios are created that go far beyond those of the industrialized nations. Growth will remain brisk in the medium term. Annual investment requirements of \$211 bn are expected for Asia until 2010, to escalate to \$262 bn by 2015. These figures make the estimates of global investment volumes appear too low. The World Bank envisions the emergence of a financing gap of \$180-220 bn for Asia.<sup>86</sup>

The emphasis will be placed on investments in rail and road that, alone, account for 90% of the total amount. Although two-thirds of all investments in container ports worldwide are expected to be made in Asia, these only amount to 1% of the investment needs. A greater potential, 7%, will be devoted to airport expansion. These low shares in the investment volume by no means indicate stagnation. In the next 10 years, in fact, investments in airports and container ports will double.<sup>87</sup>

The bulk of the predicted investments in land and port infrastructure for Asia falls to China, India, South Korea and Japan. With 60% of the investments, China holds a special position. The capital stock for road and rail is expected to increase by over 10% annually until 2030 – more than twice as rapidly as in the rest of Asia. The potential becomes evident when one considers the fact that the USA, with the same area, has a railroad network that is three times as long and a road network that is four times as long, and that, in 2002, less than 25% of the

85 See OECD (2006a), European Investment Bank (2001).

86 See ESCAP (2006).

87 See ESCAP (2005).

### Breakdown between Asian emerging markets and industrialized nations 1990–2015 in \$ bn

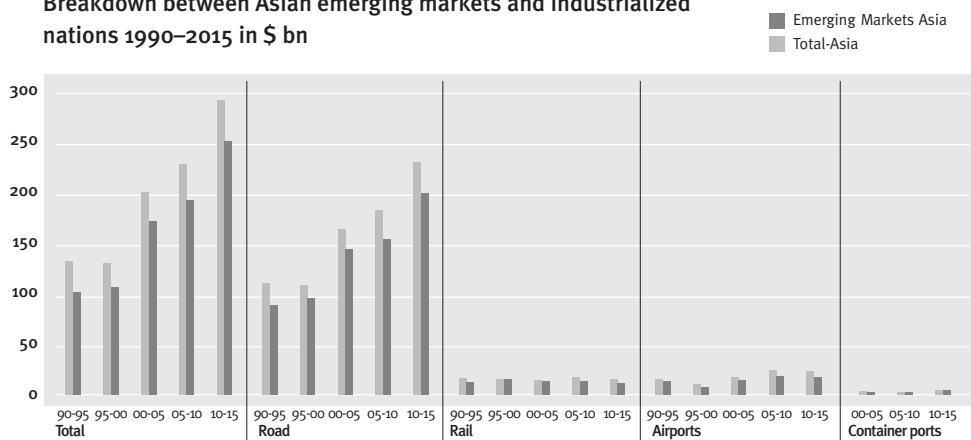


Fig. 19

Source: ESCAP (2006).

roads in China were paved (see Chapter 3.2.2.1).<sup>88</sup> Until 2010, India will need \$20 bn annually for roads and rail.<sup>89</sup> Replacement investments will be increasing as well. To begin with, there is still some accumulated need to take care of after – as the result of budget consolidations in the aftermath of the Asian crisis of 1997-98 – the GDP share of investments had stagnated at a low level. Furthermore, countries in Asia more often have to struggle with natural disasters. The extreme strain to which the infrastructure is subjected results in higher costs for repairs and maintenance of the quickly growing network. Until 2010, for example, southern Asia will have to spend twice as much for the maintenance of its existing transport infrastructure as for the construction of new facilities.<sup>90</sup>

## 7.2 Who funds and how? – Forms and sources of financing

Infrastructure funding has changed appreciably in the past 15 years. In the early 1990s, 78% of transport infrastructure was made possible by the government or through development aid. By now, state funding only accounts for 54%.<sup>91</sup> The gap created by the withdrawal of state and supranational funds is increasingly being filled by private sources. This process is supported by a broad spectrum of private investment opportunities.

### 7.2.1 Supranational funding

In the foreseeable future, developing nations will continue to be dependent upon monetary aid from the community of states. Their burden in comparison with their economic output is considerably higher if the transport infrastructure is inadequate.<sup>92</sup> At the same time, due to the more limited financial resources of these countries and poorly developed capital markets, government funding sources are generally not able to build and maintain an adequate structure. Three-quarters of the money for transport infrastructure thus comes from official development agencies, 25% from private sources. Most of the aid monies is used for road construction projects.<sup>93</sup> Generally speaking, however, the focus of development aid is moving toward economic infrastructure. The share in bilateral development aid sank in the past 20 years from 19% to 13%. In 2004, only 6% of bilateral subsidies were channeled into transport infrastructure. In the portfolio of the international organizations (World Bank, local development banks), these investments, at an average 20%, continue to constitute a focus of appropriations. The absolute amount, however, is decreasing, thus making it essential to tap other funding sources to a greater extent.<sup>94</sup>

88 In India, less than 60%, in South Korea, 80% of the roads were paved in 2002. By way of comparison, 99% of all roads in Germany are paved. See ESCAP (2006).

89 See Chatterton/Puerto (2005).

90 See ESCAP (2005).

91 See ESCAP (2006).

92 Countries with low income will have to invest an average of 6.9% of their GDP in economic infrastructure until 2015 to keep up. In line with this evaluation, 1.3% of the GDP would have to be put aside alone for the maintenance and expansion of the road network. See World Bank (2003).

93 See Menendez (1998), World Bank (2003). 80% of development aid from the World Bank for transport infrastructure flows into road construction, 70% of that from the Asian Development Bank.

94 See OECD (2006b); World Bank (2004).

The traditional chronology according to which a country, once it has boosted its financial capability, resorts first to development aid and then to government financing is likely to change over the next 25 years. Private monies will then be filling part of the gap. International organizations are already trying to attract private investors, a difficult undertaking. Initiatives like this only bear fruit once the general political and economic conditions have improved substantially.

### 7.2.2 Government funding

Government will continue to play a dominant role in the funding of transport infrastructure. New construction entailing high risks, projects with very high investment costs, and those strongly in the interest of society as such will continue to be state-financed. Control instruments will not be placed completely in private hands, so that action can be taken quickly in crisis situations and to maintain political leeway. Several sources are available for financing:<sup>95</sup>

1. **Borrowing:** The state can borrow from private-sector banks, grant loan guarantees to municipalities, or issue bonds (some tax-privileged). The main advantage lies in just-in-time financing: The project can be built when it is needed and be paid off while it is being used. The long-term adverse effects of increasing public debt are, however, sufficiently wellknown. Emerging nations have chosen other paths. Through its direct credit policy, China has financed almost a third of all infrastructure investments through corporate bonds from banks. This path is barred to countries with stronger market-based financial systems and lower domestic savings. Following the opening of its banking sector, China will also have to make greater use of more innovative forms of financing. For several years, special state capital access programs have been gaining in popularity. India, for example, has established a financing company for supporting selected projects in key sectors such as roads, seaports and airports through long-term loans outside of the national budget. Both paths lead to hidden deficits and rising latent government debt. The Asian crisis has shown that vehicles like this must often be backed up by state guarantees, which would also (have to) be discharged when called upon.
2. **Trust funds:** They are funded by user fees or government revenues that are directly allocated to a special investment sector. Long-term public loan costs are avoided. This source of financing has proven efficient in the USA. All five federal trust funds for infrastructure, including ports, highways, and inland waterways, produce net cash inflows.
3. **Currency reserves:** At the moment, Asia's economies combine approximately 40% of world savings and almost \$3 trillion in currency reserves. In comparison with the low return on American government bonds in the face of uncertain currency prospects, use for filling infrastructure gaps appears attractive. However, potential consequences of inflation through resulting surplus liquidity should be considered. Inflationary pressure will continue throughout the project's completion period. To limit the negative effects, the raw materials and machines needed to complete the infrastructure facility should be imported.

<sup>95</sup> See Infrastructure Canada (2004), ESCAP (2005), ESCAP (2006).

### 7.2.3 Private funding

Although the Anglo-Saxon countries have been using private funds since the 1970s to finance infrastructure, these sources have only begun to gain acceptance worldwide very recently. Thanks to networked capital markets, it will be possible for international private investors to hold greater shares in the future.

Partnerships between the state and private investors should not be considered the panacea for revitalizing the public purse, however. They are a fund-raising alternative that can distribute financing burdens and tap new sources of revenue. A rule of thumb says that each euro invested by the state attracts three euros in private capital. As compared with conventional funding, private involvement has several advantages:<sup>96</sup>

- Studies have shown that the inclusion of private project partners in the operation of infrastructure can reduce costs by 10%-20%.
- Operator and infrastructure companies find themselves in situations that lead to oligopolies or geographically limited monopolies. Such structures are more efficient than state monopolies. Increasing competition drives up the range of transport infrastructure – new regions are developed, and the economic output of the country profits (see Chapter 2 on mushrooming effects).
- Transferring design and construction responsibilities, along with remuneration for private services, provides significant stimuli for the private sector to complete infrastructure projects within a shorter period of time.
- International experience indicates that the quality of service provided by private sources is often better than that offered by the state. Contributing to this are a better integration of services with the project, economies of scale, innovations, and performance incentives and penalties in contracts between the government and its private partners.

Private investments in infrastructure are concentrated in the energy sector and telecommunications. The transport sector has been somewhat neglected. In the past 20 years, transport infrastructure projects amounting to approximately \$730 bn have been planned and funded with private investments (see Fig. 20).<sup>97</sup> Only about half of these projects had been successfully completed by the end of 2004. The dominance of road and rail in merchandise transport is reflected in the extent of private financing (see Chapter 6.1). Worldwide, the most money was channeled into roads, followed by the railroad network. This order applied to all regions of the world, with the exception of Africa and the Middle East.<sup>98</sup> The preponderance of land infrastructure, however, is less pronounced than in the distribution of overall investments in the transport segments. This may mean that participation in a port infrastructure is more attractive to private investors and can be more easily translated into practice than one in land infrastructure. The use of private funding for infrastructure is widespread all over the world. Slightly ahead of the Asia-Pacific region, Europe offers the most comprehensive transport in-

<sup>96</sup> See RREEF (2005), Berenberg Private Capital (2006).

<sup>97</sup> Regarding the following section, see AECOM Consult (2005).

<sup>98</sup> In Africa and the Middle East, due to the low development level, water projects dominate the infrastructure portfolio.



infrastructure program involving private equity involvement. North America holds third place. This ranking also applies to the road and rail modes of transport. Half of the value of all of the railroad projects implemented with the help of private sources are located in Europe. Among the completed airport and seaport projects, on the other hand, the Asia-Pacific region dominates with a volume of \$46.3 bn (77%).

Over the past twenty years, the transport infrastructure previously funded by private sources, amounting to \$36 bn annually, seems modest when compared to the future requirements of as much as \$420 bn per annum. The current financing structure offers enormous development opportunities for private equity involvement, which have been taken advantage of increasingly in recent years. The Macquarie Investment Bank estimates that between 2000 and 2004 at least \$180 bn was invested by the private sector in (all) infrastructure projects of the OECD countries.<sup>99</sup> Worldwide private enterprise currently finances 10%-15% of the transport infrastructure, whereby this percentage varies considerably among the various countries. Australia leads with a share of 55%, while in Europe only 4% is privately funded.<sup>100</sup> The World Bank assesses the potential for worldwide private-sector participation in transport infrastructure until 2010 at \$817 bn. Of this sum, a good 80% falls to road and rail, and the remaining 20% to airports and ports. In the next three years, privately funded toll roads with a volume of approximately €45 bn will be put out to tender – 150-200 new projects alone.<sup>101</sup>

A key position is held by the Asia-Pacific region, leading by far with a potential of \$681 bn and, up to the present, only 28% of implemented investment decisions. The focus is on Japan, China and India. Japan is a young market for private interests in the infrastructure sector. Public-private partnerships (PPPs) were only introduced five years ago, cover barely 15% of total investments, and up to now involve smaller projects. China has had a longer history, but intends to expand the role of private capital in the infrastructure sector, as does India.

<sup>99</sup> See Macquarie (2005).

<sup>100</sup> Great Britain, with a share of 20%, raises the European average considerably.  
For Germany, shares of 4%-9% are estimated.

<sup>101</sup> See BMWA (2004).

### World transport infrastructure projects with private equity involvement, planned or completed since 1985 by project type

Segment	Number of projects		Value in \$ bn		Share of value in %	Average cost of completed project in US\$
	Planned	Completed	Planned	Completed		
Road	656	359 (55%)	324.7	157.3 (48%)	44.3%	438.2 Mio.
Rail	247	107 (43%)	280.6	143.7 (51%)	38.3%	1.343.0 Mio.
Airports	182	67 (37%)	88.0	49.5 (56%)	12.0%	738.8 Mio.
Seaports	142	44 (31%)	39.5	10.6 (27%)	5.4%	240.9 Mio.
Total	1.227	577 (47%)	732.8	361.1 (49%)	100%	625.8 Mio.

Fig. 20

Source: AECOM Consult (2005).

## Regional transport infrastructure projects with private equity involvement, planned or completed since 1985

Region	Number of projects		Value in \$ bn		% share of world	
	Planned	Completed	Planned	Completed	Planned	Completed
Europe	334	159 (48%)	268.9	139.0 (52%)	36.7%	38.5%
Asia / Far East	338	140 (41%)	265.5	138.8 (52%)	36.2%	38.4%
North America	252	142 (56%)	123.0	51.5 (42%)	16.8%	14.3%
Latin America / Caribbean	253	124 (49%)	58.5	27.8 (48%)	8.0%	7.7%
Africa / Middle East	50	12 (24%)	17.1	4.3 (25%)	2.3%	1.1%

Fig. 21

Source: AECOM Consult (2005).

Europe holds second place. Large-scale projects, supported by legislative changes intended to foster PPPs, are planned in Spain, Portugal, Italy and Germany. In Germany alone, toll road projects worth \$6 bn are to be completed by 2009. Five to ten network operator companies are conceivable, to manage the road infrastructure in Germany.<sup>102</sup> The focus of growth, however, lies on the EU newcomer countries and candidates, in which there is great potential, but where very few projects have as yet been realized.

A broad spectrum of forms of cooperation between the state and private investors generally exists for infrastructure. They range from the formation of public-private enterprises with majority state holdings, to operator and franchise models, to privatization. Under complete privatization, the state assigns 100% of its responsibility and authority to private-sector companies and only uses regulatory measures to ensure competition. This form is rarer in the transport sector. Public-private partnerships have become popular in recent years. In this type of cooperation, the planning, construction, financing and operation of an infrastructure facility are transferred totally or partially to a private partner for a predetermined period of time. After this period has elapsed, the infrastructure object is returned to the state.<sup>103</sup>

Such partnerships may take various forms in regard to the scope of services provided and the sharing of risk. As a rule, the lower the investment volume, the weaker the influence by the state. In the worldwide transport sector, operator and franchise models predominate in two-thirds of the contracts that have been made.<sup>104</sup> In this form, financing is managed completely by the private partner. On the basis of the partnership, the private operator's credit standing is often upgraded, making it possible to profit from lower financing costs.

<sup>102</sup> See Hochtief (2006). In many countries, however, the legal framework still has to be created or improved and political objections removed, to enable country-wide and border-crossing holdings by private investors. An example here is the resistance by the Italian government to the merger between Autostrade (Italy) and Abertis (Spain) into the world's largest toll road operator. See BMWA (2004).

<sup>103</sup> See Berenberg Private Capital (2006).

<sup>104</sup> Road infrastructures worldwide are transferred to private partners 39% through franchise agreements, 26% through so-called build-operate-transfer (BOT) contracts. See AECOM Consult (2005).

## World potential for private participations until 2010 by region

Region	Estimated investment potential in \$ bn	Investment decisions reached in \$ bn	in %
EU-Europe, thereof	376	137.8	36.6%
Germany	50	12.5	25.0%
Rest of Europe (single market)	166	117.5	70.8%
EU newcomer countries (certain)	120	7	5.8%
EU newcomer candidates	40	0.8	2.0%
CIS-countries (excl. newcomers/candidates)	137	2.6	1.9%
North America	45	31	68.9%
Latin America	92	59	64.1%
Southeast Asia, South Asia and China	681	192	28.2%
Middle / Near East and North Africa	23	4.7	20.4%
Africa (excl. North Africa)	8	1.2	15.0%
World	1362	440.8	32.4%

Fig. 22

Source: BMWA (2004).

## 7.3 Investing in transport infrastructure

### 7.3.1 Characteristics of infrastructure investments<sup>105</sup>

Investments in infrastructure have specific characteristics that make them especially attractive to long-term investors:

- **Limited competition:** Infrastructure projects are natural monopolies that are limited geographically and timewise. Market entrance by potential competitors is also impeded by high development and construction costs, as well as extensive rules and limitations. The resulting pronounced market muscle has a positive impact on pricing policy.
- **Long service life:** Infrastructure has a service life of at least ten, and generally 30-50 years. Franchises are granted for a period of more than 30 years. This facilitates stability in long-term planning.
- **Low-elasticity demand:** Consumers are dependent on the use of infrastructure. Managing without such essential services is only possible to a limited extent, and the same applies to substitutions. Demand is therefore relatively insensitive to price and income. Similarly to real estate, cash flows are generated that are stable and predictable in the long term, irrespective of economic cycles. This also applies somewhat to transport infrastructure as, depending on the mode of transport, it reacts more sensitively to general economic developments.
- **Due to their specific features and special risk-return profiles,** infrastructure investments are a separate category, one whose performance is independent of that of other investments. Funds placed in infrastructure are thus generally suited for fulfilling risk reduction and portfolio stabilization functions.

<sup>105</sup> Regarding this chapter, see Berenberg Private Capital (2006), RREEF (2005), BMWA (2004).

Infrastructure investments are regarded as relatively secure long-range and demonstrate a distinctive risk profile:

- Market risks are extremely limited due to government regulations, long-term exclusive public supply agreements, and market entrance barriers. Risk regarding demand is generally limited by government guarantees and inelastic demand.
- Business risks are greatest during the development and construction phase of an infrastructure facility, as a result of completion and quality risks and highly uncertain predictions of demand development. This applies especially to new construction projects for which experience is not available from other comparable projects elsewhere. Examples like the Euro-tunnel or the Herren Tunnel in Lübeck show that significant risk of loss may be lurking.<sup>106</sup> The greater risks involved in new construction projects are, however, rewarded with greater rates of return.
- Since the operating costs are relatively low as a rule, the reliability of demand predictions increases in the course of time, and the value of the facility rises after installation and commissioning, the risks in a typical infrastructure facility decrease during its life cycle.
- The private operator is subject to political influence, especially in regard to decisions regarding terms and conditions and range of services. In countries with unstable political environments, corruption and changes in the “rules of the game” by the government can threaten the profitability of the investment.
- Infrastructure facility funding is generally leveraged at 30%-90%. Changes in real interest rates represent a risk that should not be underestimated.<sup>107</sup> They can, however, be limited by means of hedges and sound financial management. The degree of leverage is determined by the life cycle phase, risks, operating costs, and evaluation of expected future cash flows.

The following table provides an overview of the risk-return profiles of various transport infrastructure investments:

#### Returns and risks of infrastructure facilities

Infrastructure facility	Risk	Expected annual return
Airports and ports	low to moderate	13% – 25%
Toll roads		
Early phase		
Growth phase	high	13% – 20%
	low	8% – 12%
Railhigh	12% – 15%	

Fig. 23

Source: Mercer Investment Consulting (2006).

<sup>106</sup> The privately funded Channel Tunnel between France and Great Britain has lost billions so far. A doubling of the construction costs and user figures that are 25% lower than expected have led to debts amounting to almost 9 billion euros. Other German pilot projects, the Herren Tunnel (Lübeck) and the Warnow Tunnel (Rostock), also threaten to lose millions as well, due to inflated user predictions. See Seidel (2006).

<sup>107</sup> If user fees are inflation-dependent, they balance the risks of inflation and thus of nominal rates of interest. There is no protection from changes in real interest rates. See RREEF (2005).

### 7.3.2 Investment opportunities

Financial and wholesale institutional investors deal increasingly with the infrastructure market. Pension funds, insurance companies, and fund managers are looking for new investment opportunities. With the growing number of private investors worldwide, new products are being created that are also suitable for small investors. The range of products will be expanded to include bonds, certificates, or other derivatives. Infrastructure funds are likely to profit especially from the increasing market volume.

#### 7.3.2.1 Equities and derivatives

The MGII Global Transport Services Index of the Macquarie Investment Bank includes, with a market capitalization of \$80 bn, 44 companies that deal with the building, ownership and management of transport infrastructure.<sup>108</sup> BAA/Grupo Ferrovial (UK/Spain), Abertis (Spain), Autostrade (Italy), MIG and Transurban (Australia) are the top 5 in the Index. Its history provides a good overview of the volatility and performance of the sector and at the same time reflects worldwide sector growth (see Fig. 24). The chart shows that companies active in the transport infrastructure sector have performed much better in the past six years (+16.7% annually) than the total infrastructure index (+8.9% annually) and the general market (-0.3% annually). Whereas the infrastructure sector has attained average annual returns of 9% since 1990, the road and rail sector recorded 10% per annum. Airports achieved annual growth in value of 12%. The sector proved especially profitable, at over 27% annually, at the beginning of the new century. Long-term returns of 8%-10% appear realistic in the coming years.<sup>109</sup>

As defensive investments, and due to their relatively economy-independent income, infrastructure securities react more moderately to falling stock prices, dropping less than the overall market. They thus offer outstanding diversification characteristics within a stock portfolio.

<sup>108</sup> See Macquarie (2006).

<sup>109</sup> See Berenberg Private Capital (2006).

#### Infrastructure indexes vs. MSCI World in %

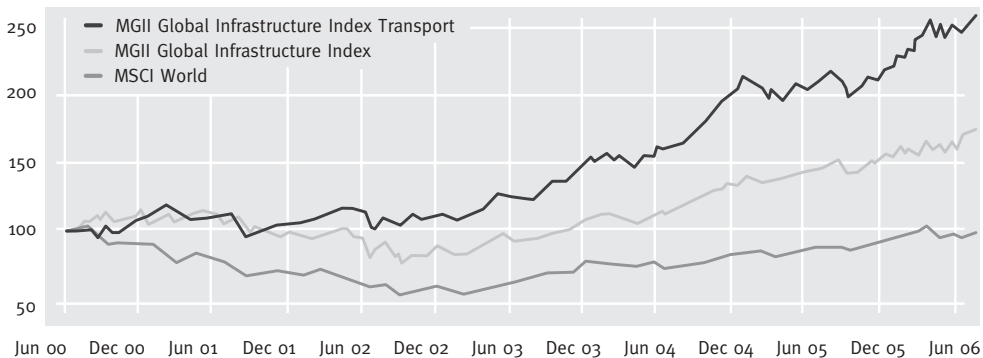


Fig. 24

Source: Bloomberg.

In the long term, however, these securities are sensitive to trends in the capital market and general market fluctuations. There is also a risk that the company management may decide on a policy dictated by short-term share prices, thus ignoring the long-term character of infrastructure investments.<sup>110</sup> The following table lists fields associated with the transport infrastructure sector: It is possible to participate in the positive market development not only through stock purchases, but through certificate holdings in infrastructure companies, indexes, and infrastructure objects. Investors can participate through small-denomination certificates, thus profiting from reduced risk levels. Foreseeable is the more frequent issuance of special bonds and debt securities by governments, supranational organizations, or infrastructure organizations. Such bonds may be issued for a single project or for several that are grouped together.

### 7.3.2.2 Infrastructure funds<sup>111</sup>

Infrastructure funds were introduced at the end of the 1980s, to open the market to private and institutional investors. Due to a lack of public interest and spectacular transactions, the players acted in the background for a long time. In the meanwhile, interest in suitable investment projects has grown, and the few market operators are more aggressive in securing their share of the market of the future. Experience has been gained with this class of investments in Australia and Canada, where they have long been standard practice. In Europe, the development of suitable products and structures is just beginning. Australian pension funds currently invest up to 7% of assets under management in infrastructure funds, in Canada as much as 10%. In Germany, this share is still negligibly small. Demographic developments will cause this sector to develop dynamically. Fund savings concepts with moderate monthly installments for several years are also conceivable for infrastructure funds in the future. At the same time, changes in legislation will increasingly permit nontraditional, alternative investments.

Due to the enormous capital expenditures, lack of diversification opportunities and fungibility, as well the need for special experience and expertise in the analysis, monitoring, support, control and review of a project, direct investments in infrastructure projects by private investors do not appear advisable.

Infrastructure funds eliminate these drawbacks. They invest very long-term in several different infrastructure facilities in various sectors and in different developmental phases, either directly or through unlisted operator companies. Combining differing risk-return profiles facilitates an optimally diversified fund portfolio. The result is a combination of risk and return that a private investor cannot achieve through direct investments. This vehicle is also suitable for limited investment amounts. Infrastructure funds are managed by specially trained portfolio managers. The investor therefore does not need to have any expertise in evaluating the profitability and future prospects of the projects. Since the company that sets up the fund generally invests its own funds as well, it has an ongoing interest in its financial success, which in turn

<sup>110</sup> See Berenberg Private Capital (2006). Infrastructure indexes vs. MSCI World in %  
<sup>111</sup> Regarding this chapter, see: RREEF (2005), Berenberg Private Capital (2006),  
Mercer Investment Consulting (2006).

## Transport infrastructure sectors

<b>Building companies</b> (road, rail, port facilities, etc.)	<b>Logistics companies</b> (shipping lines, airlines, transport companies, railroad comp., etc.)	<b>Financial services providers</b> (banks, infrastructure funds, bonds, etc.)
<b>Port operators</b> (airplane, ship, etc.)	<b>Transport vehicle manufacturers</b> (train, truck, plane, ship)	<b>Equipment producers</b> (traffic lights, cranes, pumps)
<b>Software</b> (logistics, navigation, etc.)	<b>Energy suppliers</b> (fuel, electricity, etc.)	<b>Infrastructure operators</b> (toll roads, tunnels, ports, etc.)

Fig. 25

Source: Berenberg Bank.

increases investor confidence in the fund. To safeguard this interest, its own experts often join or replace the existing management of the infrastructure project.

The return on infrastructure funds is a combination of the net cash inflow and the capital growth from their investments during the fund life. In the past, with moderate risk, they have generated two-digit returns on average. The long-term and very predictable cash flow demonstrates parallels to fixed-rate bonds. The acquisition of real assets appears to justify a comparison with real estate investments. In the past, infrastructure funds have performed better than both of these investment classes.

Infrastructure funds that are tradable on the exchange offer the advantage of greater liquidity and smaller denominations. They do, however, react to general stock market fluctuations. This means that the investor does not share directly in the earnings and appreciation of the investments involved and must therefore accept a potentially greater volatility. Infrastructure funds that are not listed offer the best diversification for an investment portfolio. Up to now, they have been principally reserved for institutional investors. It was only very recently that the Macquarie Investment Bank made it possible for private investors to hold shares in an unlisted fund. Shareholdings are also basically possible through a very few private equity funds that specialize solely in infrastructure.

However, they pursue a short-term and more venturesome investment philosophy aimed at higher returns. Realizing fast capital gains profits is not compatible with the long-term planning horizon of investments in infrastructure. Furthermore, managers of private equity funds may not have the specialized knowledge necessary to evaluate infrastructure projects. It is just this, however, that is of paramount importance for the success of a project.

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