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2 The Organization of the Shipping Market

Shipping is an exciting business, surrounded by many false beliefs, misconceptions and even taboos … The facts of the matter are straightforward enough and, when stripped of their emotional and sentimental overtones in clinical analysis, are much less titillating than the popular literature and maritime folklore lead one to expect.

(Helmut Sohmen, 'What bankers always wanted to know about shipping but were afraid to ask', address to the Foreign Banks' Representatives Association, Hong Kong, 27 June 1985. Reprinted in *Fairplay*, London, 1 August 1986)

2.1 INTRODUCTION

Our aim in this chapter is to sketch the economic framework of the shipping industry. Like the street map of a city, it will show how the different parts of the maritime business fit together and where shipping fits into the world economy. We will also try to understand exactly what the industry does and identify the economic mechanisms that make the shipping market place operate.

We start by defining the maritime market and reviewing the businesses that are involved in it. This leads on to a discussion of the demand for international transport and its defining characteristics. Who are its customers, what do they really want and what does transport cost? The overview of the demand is completed with a brief survey of the commodities traded by sea. In the second half of the chapter we introduce the supply of shipping, looking at the transport system and the merchant fleet used to carry trade. We also make some introductory comments about ports and the economics of supply. Finally, we discuss the shipping companies that run the business and the governments that regulate them. The conclusion is that shipping is ultimately a group of people – shippers, shipowners, brokers, shipbuilders, bankers and regulators – who work together on the constantly changing task of transporting cargo by sea. To many of them shipping is not just a business. It is a fascinating way of life.

2.2 OVERVIEW OF THE MARITIME INDUSTRY

In 2005 the shipping industry transported 7.0 billion tons of cargo between 160 countries. It is a truly global industry. Businesses based in Amsterdam, Oslo, Copenhagen, London, Hamburg, Genoa, Piraeus, Dubai, Hong Kong, Singapore, Shanghai, Tokyo, New York, Geneva and many other maritime centres compete on equal terms. English is the common language, which nearly everyone speaks. Ships, the industry's main assets, are physically mobile, and international flags allow shipping companies to choose their legal jurisdiction, and with it their tax and financial environment. It is also ruthlessly competitive, and some parts of the industry still conform to the 'perfect competition' model developed by classical economists in the nineteenth century.

Merchant shipping accounts for roughly a third of the total maritime activity as can be seen from Table 2.1, which divides the maritime business into five groups: vessel operations (i.e. those directly involved with ships); shipbuilding and marine engineering; marine resources, which include offshore oil, gas, renewable energy and minerals; marine fisheries, including aquaculture and seafood processing; and other marine activities, mainly tourism and services. When all these businesses are taken into account the marine industry's annual turnover in 2004 was over $1 trillion. Although these figures contain many estimates, they make a useful starting point because they put the business into context and provide a reminder of the other businesses with which shipping shares the oceans. Many of them use ships too – fishing, offshore, submarine cables, research and ports are examples – providing diversification opportunities for shipping investors.

In 2004 merchant shipping was much the biggest, with a turnover of about $426 billion. The business had grown very rapidly during the previous five years, due to the freight market boom which was just starting in 2004. In 2007 it operated a fleet of 74,398 ships, of which 47,433 were cargo vessels. Another 26,880 non-cargo merchant vessels were engaged in fishing, research, port services, cruise and the offshore industry (see Table 2.5 for details). This makes shipping comparable in size with the airline industry, which has about 15,000 much faster aircraft.

It employs about 1.23 million seafarers, of whom 404,000 are officers and 823,000 are ratings,[1] with smaller numbers employed onshore in the various shipping offices and services. These are relatively small numbers for a global industry.

Naval shipping is worth about $170 billion a year, which includes personnel, equipment and armaments. Although not strictly involved in commerce, navies are responsible for its protection and preserving open lines of commercial navigation on the major waterways of the world.[2] About 9,000 naval vessels, including patrol craft, operate worldwide with annual orders for about 160 new vessels. Cruise and ports complete the vessel operations section. There are over 3,000 major ports and terminals around the world, with many thousands of smaller ones engaged in local trades. So this is a major industry.

Supporting these core activities are the shipbuilding and marine equipment industries. There are over 300 large merchant shipyards building vessels over 5,000 dwt worldwide, and many more small ship- and boatbuilding yards with a turnover of

Table 2.1 Marine activities, 1999–2004

US$ millions	Turnover US$ m.[a] 1999	2004	Growth 99–04 (% p.a.)	Share in 2004%
1. Vessel operations				
Merchant shipping	160,598	426,297	22%	31%
Naval shipping	150,000	173,891	3%	13%
Cruise industry	8,255	14,925	12%	1%
Ports	26,985	31,115	3%	2%
Total	345,838	646,229	13%	47%
2. Shipbuilding				
Shipbuilding (merchant)	33,968	46,948	7%	3%
Shipbuilding (naval)	30,919	35,898	3%	3%
Marine equipment	68,283	90,636	6%	7%
Total	133,170	173,482	5%	13%
3. Marine resources				
Offshore oil and gas	92,831	113,366	4%	8%
Renewable energy	—	159		0%
Minerals and aggregates	2,447	3,409	7%	0%
Total marine resources	95,278	116,933	4%	8%
4. Marine fisheries			–	
Marine fishing	71,903	69,631	–1%	5%
Marine aquaculture	17,575	29,696	11%	2%
Seaweed	6,863	7,448	2%	1%
Seafood processing	89,477	99,327	2%	7%
Total marine fisheries	185,817	206,103	2%	15%
5. Other marine related activities				
Maritime tourism	151,771	209,190	7%	15%
Research and Development	10,868	13,221	4%	1%
Marine services	4,426	8,507	14%	1%
Marine IT	1,390	4,441	26%	0%
Marine biotechnology	1,883	2,724	8%	0%
Ocean survey	2,152	2,504	3%	0%
Education and training	1,846	1,911	1%	0%
Submarine telecoms	5,131	1,401	–23%	0%
Total other activities	179,466	243,898	6%	18%
Total marine activities	939,570	1,386,645	8%	100%

[a] The information in this table is based on many estimates and should be regarded as no more than a rough indication of the relative size of the various segments of the maritime business. The totals include some duplication, for example marine equipment is double-counted.

Source: Douglas-Westwood Ltd

around $67 billion in 2004. In the 1990s the annual investment in new cargo ships was $20 billion, but in 2007 $187 billion's worth of new ships were ordered and shipbuilding capacity was growing rapidly.[3] Another $53 billion was spent on second-hand ships, a very large figure in comparison with previous years.[4] In addition, a network of ship repair yards maintain merchant, naval and offshore ships. The shipyards are supported by the marine equipment manufacturers, paint manufacturers and suppliers of the host of equipment needed to construct and maintain the complex mechanical structures which we refer to as merchant ships. Their turnover in 2004 was about $90 billion.

A third group of businesses are concerned with marine resources, mainly oil and gas which turns over about $113 billion per annum. Marine fisheries, the fourth group, are also very significant, including fishing, aquaculture, seaweed and seafood processing. Marine tourism is larger still, but this group includes a wide range of activities, including research, surveys, IT, and submarine telecoms. Finally, there are the marine services such as insurance, shipbroking, banking, legal services, classification and publishing. Whilst it is doubtful whether any of these global figures are very accurate, they provide a starting point by putting the businesses we will study in this volume into the context of the marine industry as a whole.

2.3 THE INTERNATIONAL TRANSPORT INDUSTRY

The modern international transport system consists of roads, railways, inland waterways, shipping lines and air freight services, each using different vehicles (see Table 2.2). In practice the system falls into three zones: inter-regional transport, which covers deep-sea shipping and air freight; short-sea shipping, which transports cargoes short distances and often distributes cargoes brought in by deep-sea services; and inland transport, which includes road, rail, river and canal transport.

Deep-sea shipping and air freight

For high-volume inter-regional cargoes deep-sea shipping is the only economic transport between the continental landmasses. Traffic is particularly heavy on the routes between the major industrial regions of Asia, Europe and North America, but the global transport network is now very extensive, covering many thousands of ports and offering services ranging from low-cost bulk transport to fast regular liner services. Air freight started to become viable for transporting high-value commodities between regions in the 1960s. It competes with the liner services for premium cargo such as

Table 2.2 International transport zones and available transport modes

Zone	Area	Transport sector	Vehicle
1	Inter-regional	Deep-sea shipping	Ship
		Air freight	Plane
2	Short-sea	Coastal seas	Ship/ferry
3	Land	River and canal	Barge
		Road	Lorry
		Rail	Train

Source: Martin Stopford 2007

electronic goods, processed textiles, fresh fruit, vegetables and automotive spare parts. Since the 1960s air freight has grown at over 6% per annum, reaching 111 billion ton miles (btm) by 2005. Maritime trade has been growing more slowly, averaging 4.2% growth per annum over the same period, but the volume of cargo is much larger. Compared with the 28.9 trillion ton miles of maritime cargo in 2005, air freight still accounted for only 0.4% of the volume of goods transported between regions.[5] Its contribution has been to widen the range of freight transport by offering the option of very fast but high-cost transport.

Short-sea shipping

Short-sea shipping provides transport within regions. It distributes the cargo delivered to regional centres such as Hong Kong or Rotterdam by deep-sea vessels, and provides a port-to-port service, often in direct competition with land-based transport such as rail. This is a very different business from deep-sea shipping. The ships are generally smaller than their counterparts in the deep-sea trades, ranging in size from 400 dwt to 6,000 dwt, though there are no firm rules. Designs place much emphasis on cargo flexibility.

Short-sea cargoes include grain, fertilizer, coal, lumber, steel, clay, aggregates, containers, wheeled vehicles and passengers. Because trips are so short, and ships visit many more ports in a year than deep-sea vessels, trading in this market requires great organizational skills:

> It requires a knowledge of the precise capabilities of the ships involved, and a flexibility to arrange the disposition of vessels so that customers' requirements are met in an efficient and economic way. Good positioning, minimisation of ballast legs, avoiding being caught over weekends or holidays and accurate reading of the market are crucial for survival.[6]

The ships used in the short-sea trades are generally smaller versions of the ships trading deep-sea. Small tankers, bulk carriers, ferries, container-ships, gas tankers and vehicle carriers can be found trading in most of the regions on short-haul routes. Short-sea shipping is also subject to many political restrictions. The most important is cabotage, the practice by which countries enact laws reserving coastal trade to ships of their national fleet. This system has mainly been operated in countries with very long coastlines, such as the United States and Brazil, but is no longer as prevalent as it used to be.

Land transport and the integration of transport modes

The inland transport system consists of an extensive network of roads, railways, and waterways using trucks, railways and barges. It interfaces with the shipping system through ports and specialist terminals, as shown in Table 2.2, and one of the aims of modern transport logistics is to integrate these transport systems so that cargo flows smoothly and with minimum manual handling from one part of the system to another.[7] This is achieved in three ways: first, by adopting international standards for the units in which cargoes are transported, and these standards are applied to containers, pallets, packaged lumber, bales (e.g. of wool) and bulk bags; second, by investing in integrated handling systems designed to move the cargo efficiently from one transport mode to another; and third, by designing the vehicles to integrate with these facilities – for example, by building rail hopper cars which speed up the discharge of iron ore and building open-hatch bulk carriers with holds that exactly comply with the standards for packaged lumber.

As a result, transport companies operate in a market governed by a mix of competition and cooperation. In many trades the competitive element is obvious: rail competes with road; short-sea shipping with road and rail; and deep-sea shipping with air freight for higher-value cargo. However, a few examples show that the scope of competition is much wider than appears possible at first sight. For example, over the last 50 years bulk carriers trading in the deep-sea markets have been in cut-throat competition with the railways. How is this possible? The answer is that users of raw materials, such as power stations and steel mills, often face a choice between use of domestic and imported raw materials. Thus, a power station at Jacksonville in Florida can import coal from Virginia by rail or from Colombia by sea. Or container services shipping from Asia to the US West Coast and then transporting the containers by rail to the East Coast are in competition with direct services by sea via the Panama Canal. Where transport accounts for a large proportion of the delivered cost, there is intense competition. But cost is not the only factor, as shown by the seasonal trade in perishable goods such as raspberries and asparagus. These products travel as air freight because the journey by refrigerated ship is too slow to allow delivery in prime condition. However, the shipping industry has tried to recapture that cargo by developing refrigerated containers with a controlled atmosphere to prevent deterioration.

Although the different sectors of the transport business are fiercely competitive, technical development depends upon close cooperation because each component in the transport system must fit in with the others by developing ports and terminals designed for efficient cargo storage and transfer from one mode to another. There are many examples of this cooperation. Much of the world's grain trade is handled by a system of barges, rail trucks and deep-sea ships. The modal points in the system are highly automated grain elevators which receive grain from one transport mode, store it temporarily and ship it out in another. Similarly, coal may be loaded in Colombia or Australia, shipped by sea in a large bulk carrier to Rotterdam, and distributed by a small short-sea vessel to the final consumer. The containerization of general cargo is built around standard containers which can be carried by road, rail or sea with equal facility. Often road transport companies are owned by railways and vice versa. One way or another, the driving force which guides the development of these transport systems is the quest to win more business by providing cheaper transport and a better service.

2.4 CHARACTERISTICS OF SEA TRANSPORT DEMAND

The sea transport product

The merchant shipping industry's product is transport. But that is like saying that restaurants serve food. It misses out the qualitative part of the service. People want different food for different occasions, so there are sandwich bars, fast-food chains and cordon bleu restaurants. The Rochdale Report, one of the most thorough investigations of the shipping industry ever carried out, commented on these sectoral divisions within the industry as follows:

> Shipping is a complex industry and the conditions which govern its operations in one sector do not necessarily apply to another; it might even, for some purposes, be better regarded as a group of related industries. Its main assets, the ships themselves, vary widely in size and type; they provide the whole range of services for a variety of goods, whether over shorter or longer distances. Although one can, for analytical purposes, usefully isolate sectors of the industry providing particular types of service, there is usually some interchange at the margin which cannot be ignored.[8]

Like restaurateurs, shipping companies provide different transport services to meet the specific needs of different customers, and this gives rise to three major segments in the shipping market, which we will refer to as liner, bulk and specialized shipping. The liner business carries different cargoes, provides different services and has a different economic structure than bulk shipping, whilst the 'specialist' market segments which focus on the transport of cars, forest products, chemicals, LNG and refrigerated produce each have their own, slightly different, characteristics. But as Rochdale points out, they do not operate in isolation. They often compete for the same cargo – for example, during the 1990s the container business won a major share of the refrigerated trade from the reefer fleet. In addition, some shipping companies are active in all the shipping sectors and investors from one sector will enter another if they see an opportunity.

So although there is some market segmentation, these markets are not isolated compartments. Investors can, and do, move their investment from one market sector to another,[9] and supply–demand imbalances in one part of the market soon ripple across to other sectors. In what follows we will first explore the characteristics of the world trade system which creates the demand for different types of transport service; then we discuss how this translates into price and qualitative aspects of the transport product; and finally, we discuss how this has led to segmentation in the shipping business (ground we have already covered historically in Chapter 1, but which we will now examine in a more structured way). Is shipping one industry or several?

The global sea transport demand model

Shipping companies work closely with the companies that generate and use cargo. As we saw in Chapter 1, today's multinational companies source raw materials where they are cheapest and locate manufacturing facilities in any low-cost corner of the world, however remote, drawing many towns and cities into the global economy. These oil companies, chemical producers, steel mills, car manufacturers, sugar refiners, consumer goods manufacturers, retail chains and many others are the shipping industry's biggest customers.

These businesses need many different types of transport, and Figure 2.1 gives a bird's-eye view of how shipping serves their global businesses.[10] On the left are the four primary producing sectors of the world economy: energy, including coal, oil and gas; mining, including metal ores and other crude minerals; agriculture, including grain and oilseeds, refrigerated foods, vegetable oils, and live animals; and forestry. These commodities are the building-blocks of economic activity, and transporting them from areas of surplus to areas of shortage, usually in the largest parcels possible to reduce transport costs, is a major market for the shipping industry.

Most of these raw materials need primary processing, and whether this takes place before or after transport makes a major difference to the trade. The principal industries involved are listed in the centre of Figure 2.1. At the top are oil refining, chemicals, and steel; the corporations that control these heavy industrial plants are major users of bulk transport and their policies change. For example, oil may be shipped as crude or products, with very different consequences for the transport operation. The more important manufacturing industries shown in the lower part of the middle column include vehicle manufacturing, light engineering, food processing, textiles, and wood and paper processing. They import semi-manufactures such as steel products, pulp, petroleum, chemicals, vegetable oils, textile fibres, circuit boards and a host of other products. Although these products still travel in large quantities, the cargo parcels are usually smaller and the commodities are more valuable. For example, iron ore is worth about \$40 per tonne, but steel products are worth about \$600–1,000 per tonne. They may also use special ships and cargo-handling facilities, as in the case of forest products and chemicals tankers.

Manufactured goods are often shipped several times, first to assembly plants and then on to other plants for finishing and packaging. This is a very different business from the raw materials and semi-manufactures discussed in previous paragraphs. Physical quantities are generally much smaller, and the components shipped around the world from one fabricator to another are increasingly valuable. For many products tight inventory control calls for fast, reliable and secure shipment, often in relatively small parcels, and transport now plays a central part in the world business model. A recent development in trade theory argues that comparative advantage is driven by clusters of expertise scattered around the globe.[11] Clusters of companies specializing in a particular business, say manufacturing ski boot clamps (or maritime equipment for that matter) develop a 'comparative advantage' in that product.[12] With the right communications and transport, these clusters can market their products globally, leading to a broader trade matrix, improved global efficiency and in the process giving shipowners more cargo. This is a theme we will develop in Chapter 10 where we examine the principles underlying maritime trade. For the present we can simply note that these remote clusters of expertise are reliant on cheap and efficient transport to deliver their products to market, and

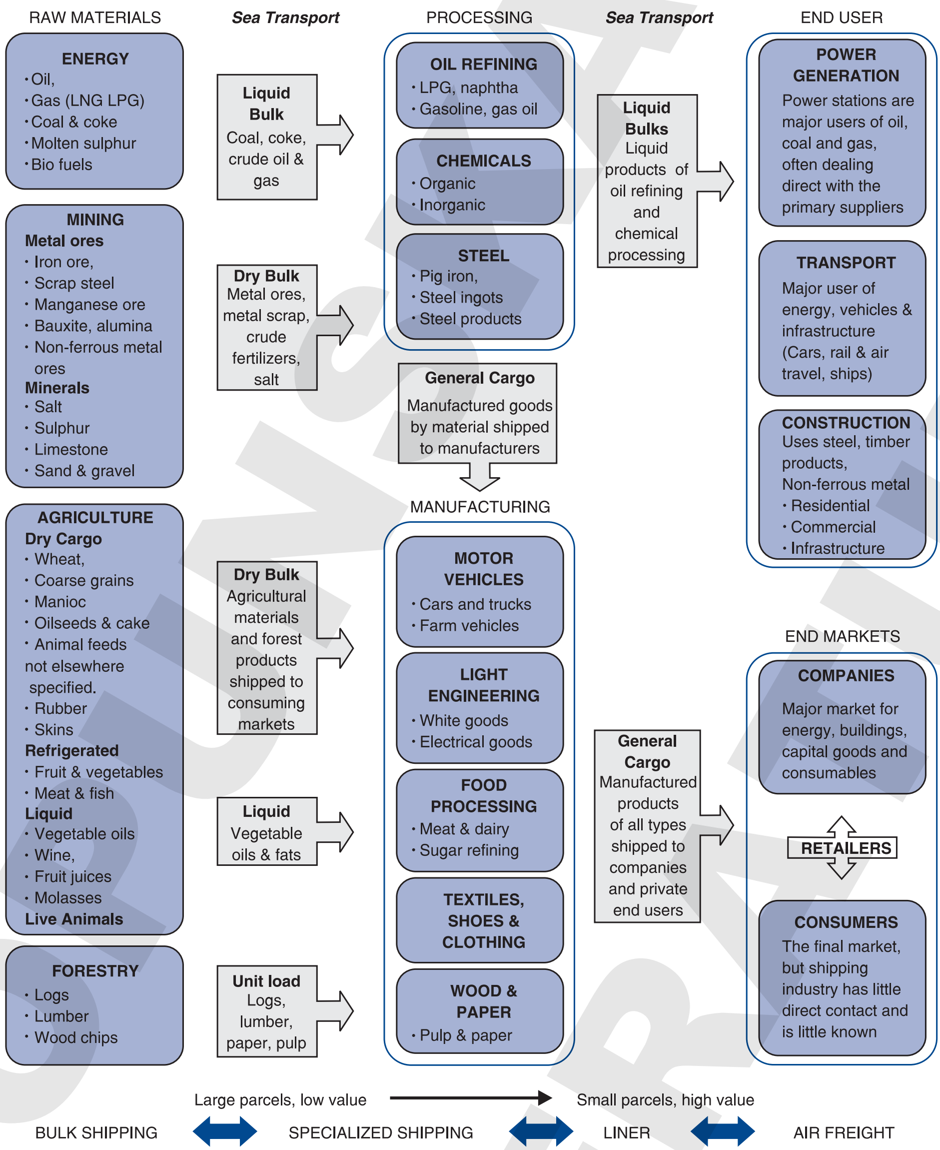


Figure 2.1
International transport system showing transport requirements
Source: Martin Stopford, 2007

the transport network developed by the container companies in the second half of the twentieth century must have contributed significantly to the growth of manufacturing in these areas.

In the right-hand column of Figure 2.1 are listed the final customer groups for the processed and manufactured products. At the top are three very important industries: power generation, transport and construction. These use large quantities of basic materials such as fuel, steel, cement and forest products. They are usually very sensitive to the business cycle. Below them are listed the end markets for the goods and services produced by the world economy, loosely classified as companies and consumers.

This diversity of cargo makes analysing trade flows between these industries complex. Whilst primary materials, such as oil, iron ore and coal, move from areas of surplus to areas of shortage, and are quite simple to analyse, specialist cargoes are often traded for competitive reasons rather than supply and demand deficit – for example, the United States produces motor vehicles locally, but is also a major export market for manufacturers in Asia and Europe. In fact, when we view trade from the viewpoint of the underlying economic forces which drive it, there are three quite different categories. First, there is deficit trade, which occurs when there is a physical shortage of a product in one area and a surplus in another, leading to a trade flow which fills the gap in the importing country. This is very common in the raw material trades but also for semi-manufactures, for example when there are difficulties in expanding processing plant. Second, there is competitive trade. A country may be capable of producing a product, but cheaper supplies are available overseas. Or consumers or manufacturers may wish for diversity. For example, many cars are shipped by sea because consumers like a greater choice than domestic car manufacturers can offer. Third, there is cyclical trade which occurs in times of temporary shortages, for example due to poor harvests, or business cycles, leading to temporary trade flows. Steel products, cement and grain are commodities which often exhibit this characteristic. These are all issues which come up in discussing the trades in Part 4. This chapter simply introduces the transport systems that have developed to carry the cargoes.

The job of the shipping industry is to transport all these goods from place to place. There are about 3,000 significant ports handling cargo, with a theoretical 9 million routes between them. Add the complex mix of commodities and customers outlined above (a ton of iron ore is very different from a ton of steel manufactured into a Ferrari!) and the complexity of the shipping industry's job becomes all too apparent. How does it organize the job?

The commodities shipped by sea

We can now look more closely at the commodities the industry transports. In 2006 the trade consisted of many different commodities. Raw materials such as oil, iron ore, bauxite and coal; agricultural products such as grain, sugar and refrigerated food; industrial materials such as rubber, forest products, cement, textile fibres and chemicals; and manufactures such as heavy plant, motor cars, machinery and consumer goods. It covers everything from a 4 million barrel parcel of oil to a cardboard box of Christmas gifts.

One of the prime tasks of shipping analysts is to explain and forecast the development of these commodity trades, and to do this each commodity must be analysed in the context of its economic role in the world economy. Where commodities are related to the same industry, it makes sense to study them as a group so that interrelationships can be seen. For example, crude oil and oil products are interchangeable – if oil is refined before shipment then it is transported as products instead of crude oil. Similarly, if a country exporting iron ore sets up a steel mill, the trade in iron ore may be transformed into a

Table 2.3 World seaborne trade by commodity and average growth rate

	Million tonnes of cargo				% growth p.a.
	1995	2000	2005	2006	1995–2006
1. Energy trades					
Crude oil	1,400	1,656	1,885	1,896	2.8%
Oil products	460	518	671	706	4.0%
Steam coal	238	346	507	544	7.8%
LPG	34	39	37	39	1.3%
LNG	69	104	142	168	8.5%
Total	2,201	2,663	3,242	3,354	3.9%
		Share of total in 2006			44%
2. Metal industry trades					
Iron ore	402	448	661	721	5.5%
Coking coal	160	174	182	185	1.3%
Pig iron	14	13	17	17	1.8%
Steel product	198	184	226	255	2.3%
Scrap	46	62	90	94	6.7%
Coke	15	24	25	24	4.4%
Bauxite/alumina	52	54	68	69	2.6%
Total	887	960	1,269	1,366	4.0%
		Share of total in 2006			18%
3. Agricultural trades					
Wheat/coarse grain	184	214	206	213	1.3%
Soya beans	32	50	65	67	7.0%
Sugar	34	37	48	48	3.2%
Agribulks	80	88	97	93	1.4%
Fertilizer	63	70	78	80	2.2%
Phosphate rock	30	28	31	31	0.2%
Forest products	167	161	170	174	0.3%
Total	590	648	695	706	1.6%
		Share of total in 2006			9.4%
4. Other cargoes					
Cement	53	46	60	65	1.9%
Other minor bulk	31	36	42	44	3.2%
Other dry cargo	1,116	1,559	1,937	2,016	5.5%
Total	1,200	1,641	2,039	2,125	5.3%
		Share of total in 2006			28%
memo: Containerized	389	628	1,020	1,134	
	4,878	5,912	7,246	7,550	4.1%

Source: CRSL, *Dry Bulk Trades Outlook*, April 2007, *Oil & Tanker Trades Outlook*, April 2007, *Shipping Review & Outlook*, April 2007

smaller trade in steel products. To show how the various seaborne trades interrelate, the main seaborne commodity trades are shown in Table 2.3, arranged into four groups reflecting the area of economic activity to which they are most closely related. The growth rate of each commodity between 1995 and 2006 is also shown in the final column, illustrating the difference in character of the different trades. These groups can be summarized as follows.

- *Energy trades*. Energy dominates bulk shipping. This group of commodities, which by weight accounts for 44% of seaborne trade, comprises crude oil, oil products, liquefied gas and thermal coal for use in generating electricity. These fuel sources compete with each other and non-traded energy commodities such as nuclear power. For example, the substitution of coal for oil in power stations in the 1980s transformed the pattern of these two trades. The analysis of the energy trades is concerned with the world energy economy.
- *Metal industry trades*. This major commodity group, which accounts for 18% of sea trade, represents the second building-block of modern industrial society. Under this heading we group the raw materials and products of the steel and non-ferrous metal industries, including iron ore, metallurgical grade coal, non-ferrous metal ores, steel products and scrap.
- *Agricultural and forestry trades*. A total of seven commodities, accounting for just over 9% of sea trade, are the products or raw materials of the agricultural industry. They include cereals such as wheat and barley, soya beans, sugar, agribulks, fertilizers and forest products. The analysis of these trades is concerned with the demand for foodstuffs, which depends on income and population. It is also concerned with the important derived demand for animal feeds. On the supply side, we are led into the discussion of land use and agricultural productivity. Forest products are primarily industrial materials used for the manufacture of paper, paper board and in the construction industry. This section includes timber (logs and lumber) wood pulp, plywood, paper and various wood products, totalling about 174 mt. The trade is strongly influenced by the availability of forestry resources.
- *Other cargoes*. There are a wide range of commodities which together account for 28% of sea trade. Some are industrial materials such as cement, salt, gypsum, mineral sands, chemicals and many others. But there are also large quantities of semi-manufactures and manufactures such as textiles, machinery, capital goods and vehicles. Many of these commodities have a high value so their share in value is probably closer to 50%. They are the mainstay of the liner trades and the memo item at the bottom of the table estimates the volume of containerized cargo at 1.1 billion tons in 2006.

Viewing the trade as a whole, over 60% of the tonnage of seaborne trade is associated with the energy and metal industries, so the shipping industry is highly dependent upon developments in these two industries. But although these trade statistics convey the scale of the merchant shipping business, they disguise its physical complexity. Some shipments are regular, others irregular; some are large, others are small; some shippers are in a hurry, others are not; some cargoes can be handled with suction or grabs, while others are fragile; some cargo is boxed, containerized or packed on pallets, while other cargo is loose.

Parcel size distribution

To explain how the shipping industry transports this complex mix of cargoes, we use the parcel size distribution (PSD) function. A ‘parcel’ is an individual consignment of cargo for shipment, for example 60,000 tonnes of grain that a trader has bought; 15,000 tonnes of raw sugar for a sugar refinery; 100 cases of wine for a wholesaler in the UK; or a consignment of auto parts. The list is endless. For a particular commodity trade, the PSD function describes the range of parcel sizes in which that commodity is transported. If, for example, we take the case of coal shown in Figure 2.2(a), individual shipments ranged in size from under 20,000 tons to over 160,000 tons, with clusters around 60,000 tons and 150,000 tons. However, the PSD for grain, shown in Figure 2.2(b), is very different, with only a few parcels over 100,000 tons, many clustered around 60,000 tons and a second cluster around 25,000 tons. Figure 2.2(c) shows two even more extreme trades – iron ore is almost all shipped in vessels over 100,000 dwt, with the largest cluster of cargoes around 150,000 dwt, whilst bulk sugar, a much smaller trade, clusters around 25,000 tons.

There are hundreds of commodities shipped by sea (see Table 11.1 in Chapter 11 for more examples of the bulk commodities) and each has its own PSD function, the shape of which is determined by its economic characteristic. Three factors which have a particular impact on the shape of the PSD function are the stock levels held by users (e.g. a sugar refinery with an annual throughput of 50,000 tons is hardly likely to import raw sugar in 70,000 ton parcels); the depth of water at the loading and discharging terminals; and the cost savings by using a bigger ship (economies of scale become smaller as ship size increases and eventually using a bigger ship may not be worth the trouble). From these factors shipping investors have to sort out the mix of cargo parcels they think will be shipped in future and from this decide what size of ship to order. Will the average size of iron ore cargoes move up from 150,000 tons

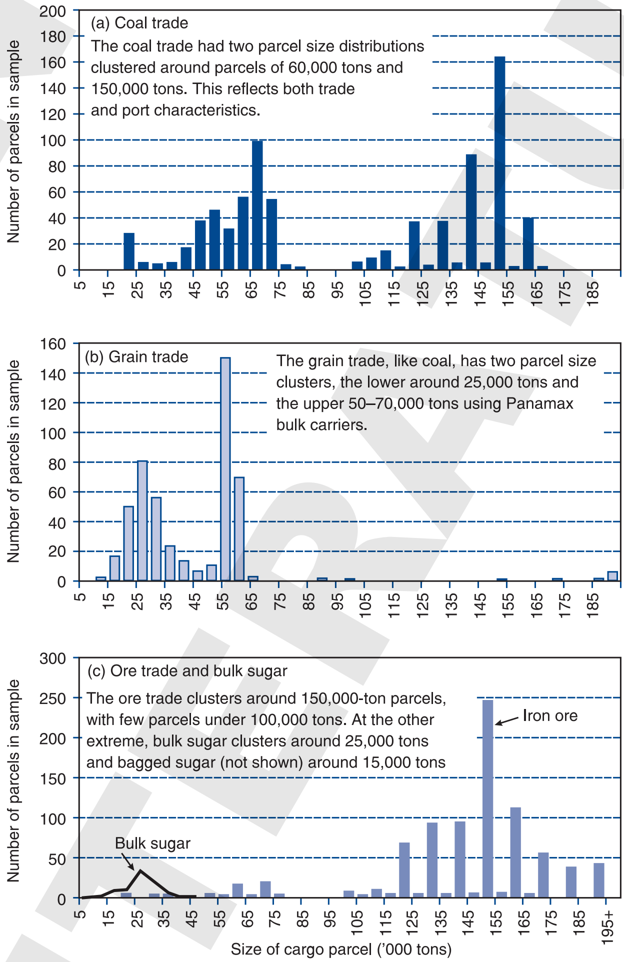


Figure 2.2
Parcel size distribution for coal, grain, ore and bulk sugar
Source: Sample of 7,000 dry cargo fixtures 2001–2

to 200,000 tons? If so, they should be ordering bigger Capesize bulk carriers. These are all subjects that we discuss more extensively in Part 4; for the present, we simply establish the principle that it is quite normal for the same commodity to be shipped in many different parcel sizes.

The importance of the PSD function is that it answers the question of which cargoes go in which ships. Cargoes of similar size and characteristics tend to be transported in the same type of shipping operation. One important division is between 'bulk cargo', which consists of large homogeneous cargo parcels big enough to fill a whole ship, and 'general cargo', which consists of many small consignments, each too small to fill a ship, that have to be packed with other cargo for transport. Another concerns ship size. Some bulk cargoes travel in small bulk carriers, while others use the biggest ships available. Each commodity trade has its own distinctive PSD, with individual consignments ranging from the very small to the very large.[13]

For many commodities the PSD contains parcels that are too small to fill a ship – for example, 500 tons of steel products – and that will travel as general cargo, and others – say, 5,000 tons of steel products – that are large enough to travel in bulk. As the trade grows, the proportion of cargo parcels large enough to travel in bulk may increase and the trade will gradually switch from being a liner trade to being predominantly a minor bulk trade. This happened in many trades during the 1960s and 1970s, and as a result the bulk trade grew faster than general cargo trade. Because many commodities travel partly in bulk and partly as general cargo, commodity trades cannot be neatly divided into 'bulk' and 'general' cargo. To do this it is necessary to know the PSD function for each commodity.

Product differentiation in shipping

In addition to the parcel size, there are other factors which determine how a cargo is shipped. Although sea transport is often treated as a 'commodity' (i.e. all cargoes are assumed to be the same), this is an obvious oversimplification. In the real world different customer groups have different requirements about the type and level of service they want from their sea transport suppliers, and this introduces an element of product differentiation. Some just want a very basic service, but others want more. In practice there are four main aspects to the transport service which contribute to the product 'delivered' by shipping companies:

- *Price*. The freight cost is always important, but the greater the proportion of freight in the overall cost equation, the more emphasis shippers are likely to place on it. For example, in the 1950s the average cost of transporting a barrel of oil from the Middle East to Europe was 35% of its c.i.f. cost. As a result, oil companies devoted great effort to finding ways to reduce the cost of transport. By the 1990s the price of oil had increased and the cost of transport had fallen to just 2.5% of the c.i.f. price, so transport cost became less important. In general, demand is relatively price inelastic. Dropping the transport cost of a barrel of oil or a container load of sports shoes has little or no impact on the volume of cargo transported, at least in the short term.

- *Speed*. Time in transit incurs an inventory cost, so shippers of high-value commodities prefer fast delivery. The cost of holding high-value commodities in stock may make it cheaper to ship small quantities frequently, even if the freight cost is greater. On a three-month journey a cargo worth $1 million incurs an inventory cost of $25,000 if interest rates are 10% per annum. If the journey time can be halved, it is worth paying up to $12,500 extra in freight. Speed may also be important for commercial reasons. A European manufacturer ordering spare parts from the Far East may be happy to pay ten times the freight for delivery in three days by air if the alternative is to have machinery out of service for five or six weeks while the spares are delivered by sea.
- *Reliability*. With the growing importance of 'just in time' stock control systems, transport reliability has taken on a new significance. Some shippers may be prepared to pay more for a service which is guaranteed to operate to time and provides the services which it has promised.
- *Security*. Loss or damage in transit is an insurable risk, but raises many difficulties for the shipper, especially when the parcels are high in value and fragile. In this case they may be prepared to pay more for secure transportation with lower risk of damage.

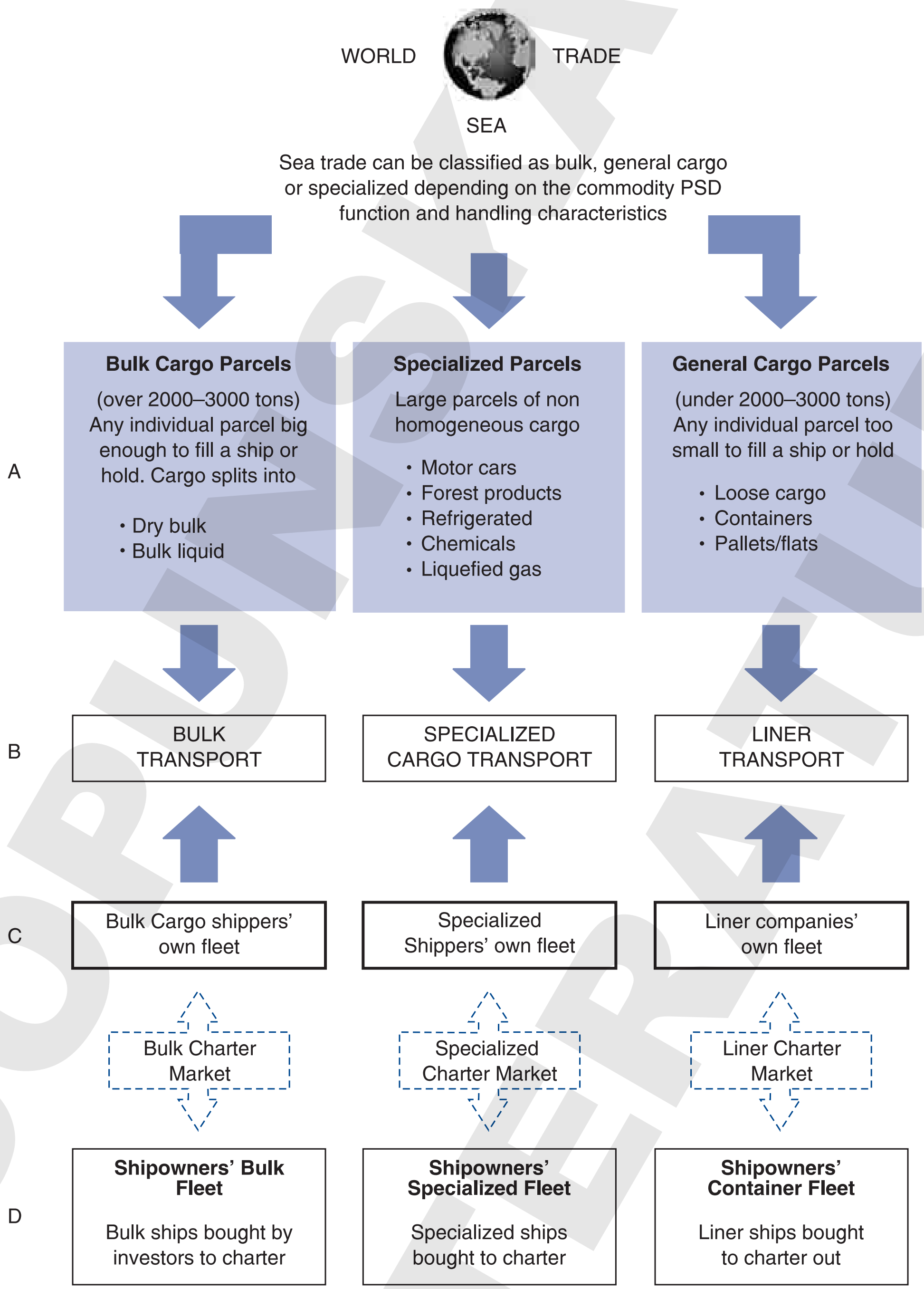
Together these introduce an element of differentiation into the business.

2.5 THE SEA TRANSPORT SYSTEM

The economic model for sea transport

In Chapter 1 we saw that over the last 50 years the shipping industry has developed a new transport system based on mechanization and systems technology. Within this system the economic pressures arising from the parcel size distribution and demand differentiation create the demand for different types of shipping service. Today's shipping market has evolved into three separate but closely connected segments: bulk shipping, specialized shipping and liner shipping. Although these segments belong to the same industry, each carries out different tasks and has a very different character.

The transport model is summarized in Figure 2.3. Starting at the top of this diagram (row A), world trade splits into three streams – bulk parcels, specialized parcels and general cargo parcels – depending on the PSD function for the commodity and service requirements of each cargo parcel. Large homogeneous parcels such as iron ore, coal and grain are carried by the bulk shipping industry; small parcels of general cargo are carried by the liner shipping industry; and specialized cargoes shipped in large volumes are transported by the specialized shipping industry. These three cargo streams create demand for bulk transport, specialized transport and liner transport (row B). The lower half of the diagram shows how the supply of ships is organized. A major distinction is drawn between the fleets of ships owned by the companies moving their own cargo in their own ships (row C) and the ships owned by independent shipowners (row D) and chartered



Supply Structure: The primary fleet is owned by the primary service operators shown in row C (shippers and liner companies). Additional capacity is hired from independent shipowners who buy ships to charter out. The 'charter market' arrows go both ways because shippers may charter their ships out as well as in.

Figure 2.3
The sea transport system, showing cargo demand and three shipping market segments
Source: Martin Stopford, 2008

to the cargo owners in Row C. Between rows C and D are the charter markets where rates for transport are negotiated. This is a highly flexible structure. For example, an oil company might decide to buy its own fleet of tankers to cover half of its oil transport needs and meet the other half by chartering tankers from shipowners. The same applies to the specialized and liner markets.

The bulk shipping industry on the left of Figure 2.3 carries large parcels of raw materials and bulky semi-manufactures. This is a very distinctive business. Bulk vessels handle few transactions, typically completing about six voyages with a single cargo each year, so the annual revenue depends on half a dozen negotiations per ship each year. In addition, service levels are usually low (see the discussion of pools in Section 2.9) so little overhead is required to run the ships and organize the cargo. Typically bulk shipping companies have 0.5–1.5 employees in the office for every ship at sea, so a fleet of 50 ships worth $1 billion could be run by a staff of 25–75 employees, depending on how much of the routine management is subcontracted. In short, bulk shipping businesses focus on minimizing the cost of providing safe transport and managing investment in the expensive ships needed to supply bulk transport.

The liner service shown on the right of Figure 2.3 transports small parcels of general cargo, which includes manufactured and semi-manufactured goods and many small quantities of bulk commodities – malting barley, steel products, non-ferrous metal ores and even waste paper may be transported by liner. For example, a container-ship handles 10,000–50,000 revenue transactions each year, so a fleet of six ships completes 60,000–300,000 transactions per annum. Because there are so many parcels to handle on each voyage, this is a very organization-intensive business. In addition, the transport leg often forms part of an integrated production operation, so speed, reliability and high service levels are important. However, cost is also crucial because the whole business philosophy of international manufacturing depends on cheap transport. With so many transactions, the business relies on published prices, though nowadays prices are generally negotiated with major customers as part of a service agreement. In addition, cargo liners are involved in the through-transport of containers. This is a business where transaction costs are very high and the customers are just as interested in service levels as price.

Specialized shipping services, shown in the centre of Figure 2.3 transport difficult cargoes of which the five most important are motor cars, forest products, refrigerated cargo, chemicals and liquefied gas. These trades fall somewhere between bulk and liner – for example, a sophisticated chemical tanker carries 400–600 parcels a year, often under contracts of affreightment (COAs), but they may take 'spot' (i.e. individually negotiated) cargoes as well. Service providers in these trades invest in specialized ships and offer higher service levels than bulk shipping companies. Some of the operators become involved in terminals to improve the integration of the cargo-handling operations. They also work with shippers to rationalize and streamline the distribution chain. For example, motor manufacturers and chemical companies place high priority on this and in this sector the pressure for change often comes from its sophisticated clients.

So although the three segments of the shipping industry shown in Figure 2.3 all carry cargo in ships, they face different tasks in terms of the value and volume of cargo, the number of transactions handled, and the commercial systems employed. Bulk shipping carries the high-volume, price-sensitive cargoes; specialized shipping carries those higher-value 'bulk' cargoes such as cars, refrigerated cargo, forest products and chemicals; the container business transports small parcels; and air freight does the rush jobs. But these segments also overlap, leading to intense competition for the minor bulk cargoes such as forest products, scrap, refrigerated cargo and even grain.

Definition of 'bulk shipping'

Bulk shipping developed as the major sector in the decades following the Second World War. A fleet of specialist crude oil tankers was built to service the rapidly expanding economies of Western Europe and Japan, with smaller vessels for the carriage of oil products and liquid chemicals. In the dry bulk trades, several important industries, notably steel, aluminium and fertilizer manufacture, turned to foreign suppliers for their high-quality raw materials and a fleet of large bulk carriers was built to service the trade, replacing the obsolete 'tweendeckers previously used to transport bulk commodities. As a result, bulk shipping became a rapidly expanding sector of the shipping industry, and bulk tonnage now accounts for about three-quarters of the world merchant fleet.

Most of the bulk cargoes are drawn from the raw material trades such as oil, iron ore, coal and grain, and are often described as 'bulk commodities' on the assumption that, for example, all iron ore is shipped in bulk. In the case of iron ore this is a reasonable assumption, but many smaller commodity trades are shipped partly in bulk and partly as general cargo; for example, a shipload of forest products would be rightly classified as bulk cargo but consignments of logs still travel as general cargo in a few trades. There are three main categories of bulk cargo:

- *Liquid bulk* requires tanker transportation. The main ones are crude oil, oil products, liquid chemicals such as caustic soda, vegetable oils, and wine. The size of individual consignments varies from a few thousand tons to half a million tons in the case of crude oil.
- The five *major bulks* – iron ore, grain, coal, phosphates and bauxite – are homogeneous bulk cargoes which can be transported satisfactorily in a conventional dry bulk carrier or multi-purpose (MPP) stowing at 45–55 cubic feet per ton.
- *Minor bulks* covers the many other commodities that travel in shiploads. The most important are steel products, steel scrap, cement, gypsum, non-ferrous metal ores, sugar, salt, sulphur, forest products, wood chips and chemicals.

Definition of 'liner shipping'

The operation of liner services is a very different business. General cargo consignments are too small to justify setting up a bulk shipping operation. In addition, they are often high-value or delicate, requiring a special shipping service for which the shippers prefer a fixed tariff rather than a fluctuating market rate. There are no hard-and-fast rules about what constitutes general cargo – boxes, bales, machinery, 1,000 tons of steel products, 50 tons of bagged malting barley are typical examples. The main classes of general cargo from a shipping viewpoint are as follows:

- Loose cargo, individual items, boxes, pieces of machinery, etc., each of which must be handled and stowed separately. All general cargo used to be shipped this way, but now almost all has been unitized in one way or another.
- Containerized cargo, standard boxes, usually 8 feet wide, often 8 feet 6 inches high and mostly 20 or 40 feet long, filled with cargo. This is now the principal form of general cargo transport.
- Palletized cargo, for example cartons of apples, are packed onto standard pallets, secured by straps or pallet stretch film for easy stacking and fast handling.
- Pre-slung cargo, small items such as planks of wood lashed together into standard-sized packages.
- Liquid cargo travels in deep tanks, liquid containers or drums.
- Refrigerated cargo, perishable goods that must be shipped, chilled or frozen, in insulated holds or refrigerated containers.
- Heavy and awkward cargo, large and difficult to stow.

Until the mid-1960s most general cargo (called ‘break-bulk’ cargo) travelled loose and each item had to be packed in the hold of a cargo liner using ‘dunnage’ (pieces of wood or burlap) to keep it in place. This labour-intensive operation was slow, expensive, difficult to plan and the cargo was exposed to the risk of damage or pilferage. As a result cargo liners spent two-thirds of their time in port and cargo-handling costs escalated to more than one-quarter of the total shipping cost,[14] making it difficult for liner operators to provide the service at an economic cost, and their profit margins were squeezed.[15]

The shipping industry’s response was to ‘unitize’ the transport system, applying the same technology which had been applied successfully on the production lines in manufacturing industry. Work was standardized, allowing investment to increase productivity. Since cargo handling was the main bottleneck, the key was to pack the cargo into internationally accepted standard units which could be handled quickly and cheaply with specially designed equipment. At the outset many systems of unitization were examined, but the two main contenders were pallets and containers. Pallets are flat trays, suitable for handling by fork-lift truck, on which single or multiple units can be packed for easy handling. Containers are standard boxes into which individual items are packed. The first deep-sea container service was introduced in 1966 and in the next 20 years containers came to dominate the transport of general cargo, with shipments of over 50 million units per year.

Definition of ‘specialized shipping’

‘Specialized’ shipping sits somewhere between the liner and the bulk shipping sectors and has characteristics of both. Although it is treated as a separate sector of the business, the dividing line is not particularly well defined, as we will see in Part 4. The principal distinguishing feature of these specialized trades is that they use ships designed to carry a specific cargo type and provide a service which is targeted at a particular customer group. Buying specialized ships is risky and is only worthwhile if the cargoes have handling or storage characteristics which make it worth investing in ships designed to improve transport performance of that specific cargo.

Over the years new ship types have been developed to meet specific needs, but many specialist cargoes continue to be carried in non-specialist ships. A brief review of the development of ship types designed for a specific commodity is provided in Table 2.4. Starting with the *John Bowes*, the first modern collier built in 1852, we have in rapid succession the cargo liner, the oil tanker, refrigerated cargo ships, the chemical parcel tanker, the container-ship, the LPG tanker, the forest products carrier, and the LNG tanker. Some of these trades have now grown so big that they are no longer regarded as being specialized, for example crude oil tankers. Today the five main specialized sectors are as follows.

- *Motor vehicles*. Perhaps the best examples of a specialized transport sector. The cars are large, high-value and fragile units which need careful stowage. In the early days of the trade they were shipped on the deck of liners or in specially converted bulk carriers with fold-down decks. Apart from being inefficient, the cars were often damaged and in the 1950s purpose-built vessels were developed with multiple decks. The first car carrier was the 260 vehicle *Rigoletto* (see Table 2.4).

Table 2.4 Development of ship types designed for a specific commodity, 1852–2008

Date	First specialized ship of class	Name	Commodity	Size
1852	Bulk Carrier	SS *John Bowes*	Coal	650 dwt
1865	Cargo liner	SS *Agamemnon*	General cargo	3,500 dwt
1880	Reefer	SS *Strathleven*	Frozen meat	400 carcasses
1886	Oil Tanker	SS *Glückauf*	Oil	3,030 dwt
1921	Ore-Oil Carrier	*G.Harrison Smith*	Iron ore/oil	14,305 grt
1926	Heavy Lift Ship	*Belray*	Heavy cargo	4,280 dwt
1954	Chemical Parcel Tanker	*Marine Dow-Chem*	Chemical parcels	16,600 dwt
1950	LPG Tanker (Ammonia)	*Heroya*	Ammonia	1,500 dwt
1956	Car Carrier	*Rigoletto*	Wheeled vehicles	260 cars
1956	Containership (conversion)	*Ideal-X*	Containers/oil	58 TEU
1962	Forest Products Carrier	*MV Besseggen*	Lumber	9,200 dwt
1964	LNG Tanker (purpose built)	*Methane Princess*	LNG	27,400 m^3

Source: Martin Stopford 2007

Modern pure car and truck carriers (PCTCs) carry over 6,000 vehicles (see Chapter 14 for technical details).

- *Forest products*. The problem with logs and lumber is that although they can be carried easily in a conventional bulk carrier, cargo handling is slow and stowage is very inefficient. To deal with this the shippers started to 'package' lumber in standard sizes and built bulk carriers with holds designed around these sizes, hatches which opened the full width of the ship, and extensive cargo-handling gear. The first was the *Besseggen*, built in 1962. Companies such as Star Shipping and Gearbulk have built up extensive fleets of this sort of vessel.
- *Refrigerated foods*. The practice of insulating the hold of a ship and installing refrigeration equipment so that chilled or frozen food could be carried was developed in the nineteenth century. The first successful cargo was carried in the *Strathleven* in 1880. There has always been competition between the specialist 'reefer' operators and the liner service operators who used refrigerated holds or, more recently, refrigerated containers.
- *Liquid gas*. To transport gases such as butane, propane, methane, ammonia or ethylene by sea it is necessary to liquefy them by cooling, pressure or both. This requires specially built tankers and high levels of operation.
- *Chemical parcels*. Small parcels of chemicals, especially those which are dangerous or need special handling, can be carried more efficiently in large tankers designed with large numbers of segregated tanks. These are complex and expensive ships because each tank must have its own cargo-handling system.

The important point is that 'specialization' is not just about the ship design, it is about adapting the shipping operation to the needs of a specific customer group and cargo flow. Setting up a specialized shipping operation is a major commitment because the ships are often more expensive than conventional bulk vessels, with a restricted second-hand market, and provision of the service generally involves a close relationship with the cargo shippers. As a result, specialist shipping companies are easier to recognize than they are to define.

Some limitations of the transport statistics

An obvious question is: 'What is the tonnage of bulk, specialized and general cargo shipped by sea?' Unfortunately there is a statistical problem in determining how the commodities are transported. Because we only have commodity data, and transport of some commodities is carried out by more than one segment, the volume of trade in general cargo cannot be reliably calculated from commodity trade statistics. For example, we may guess that a parcel of 300 tons of steel products transported from the UK to West Africa will travel in containers, whereas a parcel of 6,000 tons from Japan to the USA would be shipped in bulk, but there is no way of knowing this for certain from the commodity statistics alone. As we have already noted, some commodities (such as iron ore) are almost always shipped in bulk and others (such as machinery) invariably travel as general cargo, but many commodities (such as steel products, forest products and non-ferrous metal ores) straddle the two. In fact, as a trade flow grows it may start off being shipped as general cargo but eventually become sufficiently large to be shipped in bulk.[16] The difficulty of identifying bulk and general cargo trade from commodity trade statistics is very inconvenient for shipping economists, since seaborne trade data are collected mainly in this form and very little comprehensive information is available about cargo type.

2.6 THE WORLD MERCHANT FLEET

Ship types in the world fleet

In 2007 the world fleet of self-propelled sea-going merchant ships was about 74,398 vessels over 100 gt, though because there are many small vessels, the exact number depends on the precise lower size limit and whether vessels such as fishing boats are included. In Figure 2.4 the cargo fleet is divided into four main categories: bulk (oil tankers, bulk carriers and combined carriers), general cargo, specialized cargo and non-cargo. Although these groupings seem well defined, there are many grey areas. Merchant ships are not mass-produced like cars or trucks and classifying them into types relies on selecting distinguishing physical characteristics, an approach which has its limitations. For example, products tankers are difficult to distinguish from crude tankers on physical grounds, or ro-ro vessels which can be used in the deep-sea trades or as ferries, so which category does a particular ship belong in?

Detailed statistics of various ship types are shown in Table 2.5, which splits the fleet into 47,433 cargo ships and 26,880 non-cargo vessels. In the bulk cargo fleet there were 8040 oil tankers trading in July 2007, with the ships over 60,000 dwt mainly carrying crude oil and the smaller vessels carrying oil products such as gasoline and fuel oil. Note that there is also a fleet of chemical tankers which generally have more tanks and segregated cargo-handling systems, and these are included in the specialized

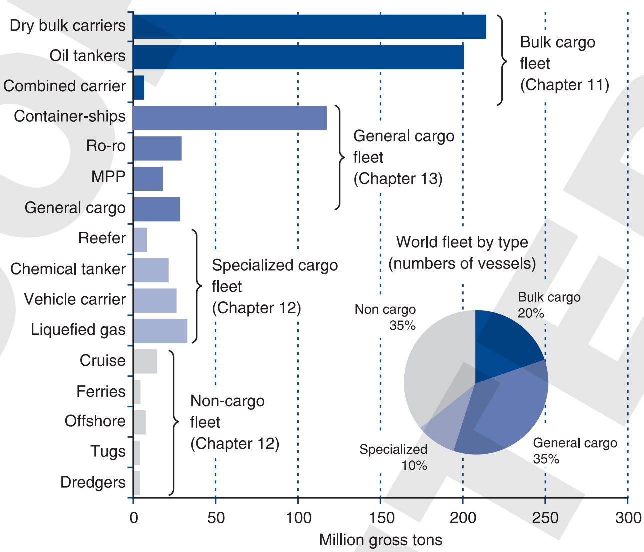


Figure 2.4
Merchant fleet classified by main cargo type. July 2007
Source: Clarkson Register, July 2007, CRS London

Table 2.5 Commercial shipping fleet by ship type, July 2007

No.	Name	Size	Numbers	Fleet size: Mill. GT	Mill. Dwt	Dwt/GT	Age	Comment
1. Bulk Cargo Fleet								
Tankers over 10,000 dwt		dwt						
1	VLCC over 200,000 dwt	Over 200,000	501	77.5	147.0	1.9	9.1	Long haul crude oil
2	Suezmax	120–199,999	359	29.0	54.2	1.9	9.1	Medium haul crude
3	Aframax	80–120,000	726	41.1	74.2	1.8	9.3	Some carry products
4	Panamax	60–80,000	329	13.2	23.0	1.7	8.8	Very short haul
5	Handy	10–60,000	1,496	33.0	53.1	1.6	13.5	Mainly products, some chemicals
6	Total over 10k		3,411	193.7	351.4	1.8		
7	Small tankers	<10,000	4,629	6.8	10.6	1.6	26.6	
8	**Total tankers**		**8,040**	**200**	**362**	**1.8**	**20.0**	
Bulk carriers over 10,000 dwt		dwt						
9	Capesize	Over 100,000	738	64.4	125.7	2.0	11.1	Mainly carry ore and coal
10	Panamax	60–100,000	1,453	57.0	106.0	1.9	11.7	Coal, grain, few geared
11	Handymax	40–60,000	1,547	44.8	74.1	1.7	11.6	Workhorse, mainly geared
12	Handy	10–40,000	2,893	47.8	77.1	1.6	20.7	Smaller workhorse
13	Total dry bulk		6,631	214	382.9	1.8	15.6	
of which:								
14	Open hatch		481		16.6			Designed for unit loads
15	Ore carrier		51		8.8			Low cubic (0.6 m^3/tonne)
16	Chip carrier		129		5.9			High cubic (2 m^3/tonne)
17	Cement carrier		77					
Combined carriers								
18	Bulk/oil/ore		85	4.7	8.2	1.8	19.3	Dry and wet
	Total bulk fleet		**14,756**	**419**	**753**	**5.4**		
2. General cargo fleet								
19	Container-ship fleet	size (TEU)						
20	Large	Over 3,000	1,207	72.1	79.6	1.1	7.0	Fast (25 knots), no gear
21	Medium	1,000–2,999	1,747	37.2	45.9	1.2	11.2	Faster, some geared
22	Small	100–999	1,251	8.2	10.2	1.2	14.9	Slow, geared
23	Total container-ship fleet		4,205	117	136	1.2	11.1	
24	Ro-ro fleet	100–50,000	3,848	28.0	12.7	0.5	23.7	Ramp access to holds
25	MPP fleet	100–2,000	2,618	17.7	23.9	1.3	16.1	Open hatch, cargo gear
26	Other general cargo		15,113	27.8	39.1	1.4	27.2	Liner types, tramps, coasters
27	**Total general cargo fleet**		**25,784**	**191**	**211**	**1.1**		
4. Specialized cargo fleet								
28	Reefer		1,800	7.6	7.7	1.0	23.9	Refrigerated, palletized
29	Chemical tankers		2,699	18	29	1.6	14.6	Chemical parcels
30	Specialized tankers		511	2	3	1.5	24.5	
31	Vehicle carrier		651	24.8	9.1	0.4	14.7	Multiple decks
32	LPG		1,082	10.1	11.9	1.2	17.7	Several freezing systems
33	LNG		235	21.2	16.1	0.8	12.0	–161 degrees Celsius
34	**Total specialized cargo fleet**		**6,978**	**84**	**77**			
memo: Total cargo ships			47,433	689	1,033	1.5		
5. Non-cargo fleet								
35	Tugs		11,097	2.9	1.0	0.4	23.8	Port or deep sea transport
36	Dredgers		1,812	3.0	3.6	1.2	26.8	Dredging ports and aggregates
37	Offshore tugs and supply		4,394	4.6	5.0	1.1	22.7	Offshore support functions
38	Other offshore support		2,764	4.2	2.5	0.6	22.5	
39	Floating, production, storage and offloading system Drill ships, etc.		500	20.3	33.8	1.7	25.4	Development and production
40	Cruise		452	13.1	1.5	0.1	21.8	Holidays and travel
41	Ferries		3,656	2.6	0.6	0.2	24.4	Passengers and vehicle transport
42	Miscellaneous		2,205	9.2	5.7	0.6	23.0	
43	**Total non cargo fleet**		**26,880**	**60**	**54**	**0.9**		
5. Total commercial fleet			**74,398**	**753.6**	**1,094.8**	**1.5**	**21.8**	

Source: Clarkson Register July 2007, CRSL, London Note: average ages are weighted by numbers, not capacity cargo ships category; though there is some overlap with the products tankers (see Chapter 12). The tanker fleet is split into five segments known in the industry as VLCCs, Suezmax, Aframax, Panamax, Handy (sometimes called 'Products') and small tankers. These different sizes operate in different trades, with the bigger vessels working in the long-haul trades, but there is much overlap. There were 6631 dry bulk carriers in July 2007, divided into four groups: Capesize, Panamax, Handymax and Handy. Within these groups are some specialized hull designs including open hatch, ore carriers, chip carriers and cement carriers. These bulk carriers carry homogeneous dry cargoes, mainly in parcels over 10,000 dwt. Bulk carriers have steel hatch covers with hydraulic opening mechanisms and most vessels under 50,000 dwt have cranes or derricks.

The table shows 25,784 general cargo ships, of which the most important are the 4205 container-ships. These ships have box-shaped holds and cell guides so that containers can be lowered securely into place below deck without the need for locking devices, reducing loading times to a matter of minutes. In recent decades it has been by far the most dynamic segment of the shipping market. Ro-ro ships provide access to the cargo holds by ramp, allowing wheeled vehicles such as fork-lift trucks to load cargo at high speed, whilst MPP vessels have open holds and cargo-handling gear, but not cell guides, so they can carry bulk and project cargoes. There is still a large fleet of 15,113 general cargo ships including tramps and many small vessels operating in the short sea trades.

Specialized vessels include reefers, chemical and specialized (e.g. for molasses) tankers, vehicle carriers, and gas tankers, with a fleet of 6,978 ships (note that Chapter 12 on specialized cargoes includes some other vessel types – see Table 12.1). All of these ships are related to vessels found in other categories, but their design has been modified to improve efficiency in carrying a specific cargo. For example, chemical tankers have many parcel tanks and special coatings for carrying small parcels of specialized liquid cargoes, but they are really a subset of the tanker fleet.

Finally, the non-cargo fleet includes 26,880 vessels used in various related maritime business activities. Tugs are mainly used in ports, though more powerful ones are used for deep-sea towage of heavy lift barges. Dredgers are used for clearing shipping channels or dredging material such as aggregates from the sea floor for construction or land fill. There is a large fleet of offshore support vessels used by the oil industry, whilst cruise ships and ferries carry people.

The table also shows that the average age of the fleet is 21.8 years, though the average varies between the fleet segments. For example, the fleet of deep-sea tankers averages about 9 years old, and bulk carriers about 11 years, no doubt reflecting regulatory pressures in the last decade. But many of the fleets of small vessels and service craft average over 20 years of age. Making the best use of this diverse fleet, built over so many years, to transport the thousands of commodities is not straightforward. Unfortunately, we cannot just say that bulk cargo goes in bulk carriers and general cargo goes in containers because shipping companies use the ships that are available and sometimes the old ships are very different from their modern counterparts – for example, general cargo ships which pre-date containerization. The task of the shipping market is to find commercial opportunities for even the sub-optimal ships in the fleet, and it achieves this by adjusting the price and earnings of each market segment and relying on shipping investors to seek out profitable opportunities for the marginal ships which they can buy cheap. When no opportunities can be found they may come up with a project to modify or convert the ship, for example by converting an old tanker into an offshore storage vessel or even a bulk carrier. In this way the maximum economic value is extracted from even the oldest ships.

Ownership of the world fleet

Ownership is a major commercial issue in the shipping business. A merchant ship must be registered under a national flag, and this determines the legal jurisdiction under which it operates. For example a ship registered in the United States is subject to the laws of the United States, whilst if it chooses the Marshall Islands or the Bahamas it is subject to their maritime laws. Of course the shipowner is also subject to the international conventions to which the flag of registration is a signatory, and when it sails into the territorial waters of another country it becomes subject to their laws. As we saw in Chapter 1, low-cost flags have been used for many years, one of the earliest examples being the Venetians shipping Byzantine trade. A more detailed account of these issues can be found in Chapter 16. For the present, it is sufficient to note that the business does not have close national affiliations. For this reason it is useful when analysing the national ownership of vessels to recognize that the fleets registered in a particular country are not necessarily a true indication of the fleet controlled by nationals of that country.

We can take as an example the fleets of the 35 leading maritime countries (Table 2.6). In January 2006 they controlled 95 per cent of the total world fleet, so the analysis only excludes 5% of the total. Out of a total fleet of 906 m.dwt in 2006, 303 m.dwt was registered under the national flag of the owner, and 603 m.dwt was registered under a foreign flag. In many cases the ships on foreign registers were under ‘flags of convenience’, though there may be other reasons for registering abroad. For example, a Belgian shipowner with a ship on time-charter to a French oil company might be required to register the ship in France. The table also shows that the world’s biggest shipowning nation is Greece, which controls 163 m.dwt of ships, but with only 47.5 m.dwt registered under the Greek flag. For Japan the ratio is even greater, with 91% registered under foreign flags and only 12 m.dwt under the Japanese flag. This diversity of registration has become an increasingly important issue in shipping industry over the last 20 years.

Ageing, obsolescence and fleet replacement

The continuous progress in ship technology, combined with the costs of ageing over the twenty- or thirty-year life of a ship, presents the shipping industry with an interesting economic problem. How do you decide when a ship should be scrapped? Ageing and obsolescence are not clearly defined conditions. They are subtle and progressive. A great deal of trade is carried by ships which are obsolete in some way or other. It took

Table 2.6 The 35 most important maritime countries, January 2006

	Million deadweight			% under foreign flag
	National	Foreign	Total	
Asia				
Japan	11.8	119.9	131.7	91%
China	29.8	35.7	65.5	54%
Hong Kong, China	18.0	25.9	43.8	59%
Republic of Korea	12.7	17.0	29.7	57%
Taiwan	4.8	19.6	24.4	80%
Singapore	14.7	8.3	23.0	36%
India	12.5	1.3	13.8	9%
Malaysia	5.5	4.2	9.6	43%
Indonesia	3.8	2.4	6.2	39%
Philippines	4.1	1.0	5.0	19%
Thailand	2.4	0.5	2.9	16%
Total	120.0	235.6	355.6	66%
Europe				
Greece	47.5	115.9	163.4	71%
Germany	13.1	58.4	71.5	82%
Norway	13.7	31.7	45.4	70%
United Kingdom	9.0	12.3	21.3	58%
Denmark	9.2	10.3	19.6	53%
Italy	10.2	4.3	14.5	30%
Switzerland	0.8	11.0	11.8	93%
Belgium	5.9	5.7	11.6	49%
Turkey	6.8	3.5	10.3	34%
Netherlands	4.5	4.3	8.8	49%
Sweden	1.7	4.7	6.4	73%
France	2.2	2.7	4.9	55%
Spain	0.9	3.2	4.1	79%
Croatia	1.7	1.0	2.7	37%
Total	127.1	269.0	396.1	68%
Middle East				
Saudi Arabia	1.0	10.4	11.4	91%
Iran (Islamic)	8.9	0.9	9.8	10%
Kuwait	3.7	1.4	5.0	27%
UAE	0.6	3.9	4.5	88%
Total	14.1	16.6	30.7	
Other				
Israel	0.9	1.8	2.7	68%
United States	10.2	36.8	46.9	78%
Canada	2.5	4.0	6.5	61%
Brazil	2.6	2.2	4.8	46%
Russian Federation	6.8	9.9	16.7	59%
Australia	1.4	1.3	2.6	48%
Total	24.3	54.1	77.5	
Total (35 countries)	285.5	575.3	860.0	95%
World total	303.8	603.0	906.8	100%

Source: *UNCTAD Yearbook*, 2006 Table 16, p. 33

fifty years for steamships to drive sailing ships from the sea. Yet somehow the industry has to decide when to scrap the old ships and order new ones.

This is where the sale and purchase market comes in. When an owner has finished with a ship, he sells it. Another shipping company buys it at a price at which it believes it can make a profit. If no owner thinks he can make a profit, only the scrap dealer will bid. As the ship grows old or obsolete it trickles down the market, falling in value, until at some stage, usually between 20 and 30 years, the only buyer is the demolition market. This whole process is eased forward by shipping market cycles. By driving freight rates and market sentiment sharply upwards (when new ships are ordered) and downwards (when old ships are scrapped) the cycles make poorly defined economic decisions much clearer. In case there is any doubt, it reinforces economics with sentiment. Owners are more likely to make the decision to sell for scrap if they feel gloomy about the future. Thus, cycle by cycle, fleet replacement lurches forward. We discuss cycles in Chapter 3 and the four markets which are involved in the fleet replacement process in Chapter 5.

2.7 THE COST OF SEA TRANSPORT

World trade and the cost of freight

One of the contributions of shipping to the global trade revolution has been to make sea transport so cheap that the cost of freight was not a major issue in deciding where to source or market goods. In 2004 the value of world import trade was $9.2 trillion and the cost of freight was $270 billion, representing only 3.6% of the total value of world trade.[17] Since these statistics cover both bulk and liner cargoes, and would normally include inland distribution, they probably overstate the proportion of sea freight in the total cost.

In fact coal and oil cost little more to transport in the 1990s than 50 years earlier as can be seen from Figure 2.5, which shows freight costs in the money of the day. In 1950 it cost about $8 to transport coal from East Coast North America to Japan. In 2006 it costs $32. Along the way there were nine market cycles, peaking in 1952, 1956, 1970, 1974, 1980, 1989, 1995, 2000 and 2004, but the average transport cost was $12.30 per ton. The cheapest year for shipping coal was 1972 when it cost $4.50 per ton, while the most expensive was 2004 when it cost $44.80 per ton. The oil trade shows the same long-term trend, with transport costs fluctuating between $0.50 and $1 per barrel. The highest cost was during the 2004 boom when the cost went up to $3.37 per barrel. In four years, 1949, 1961, 1977 and 1994, it fell to $0.50 per barrel and in 2002 it fell to $0.80 per barrel before increasing to $2.20 per barrel in 2006.

Compared with other sectors of the economy, the transport industry's achievement is exceptional. Average dollar prices in 2004 were six times higher than in 1960 (Table 2.7). A basic Ford motor car had increased in price from $1385 to $13,430; the UK rail fare from London to Glasgow from $23.50 to $100; the price of a ton of domestic coal in the UK from $12 to $194; and the price of a barrel of crude oil increased from $1.50 to $50. The three products with the smallest increase in prices are air fares, rail fares and

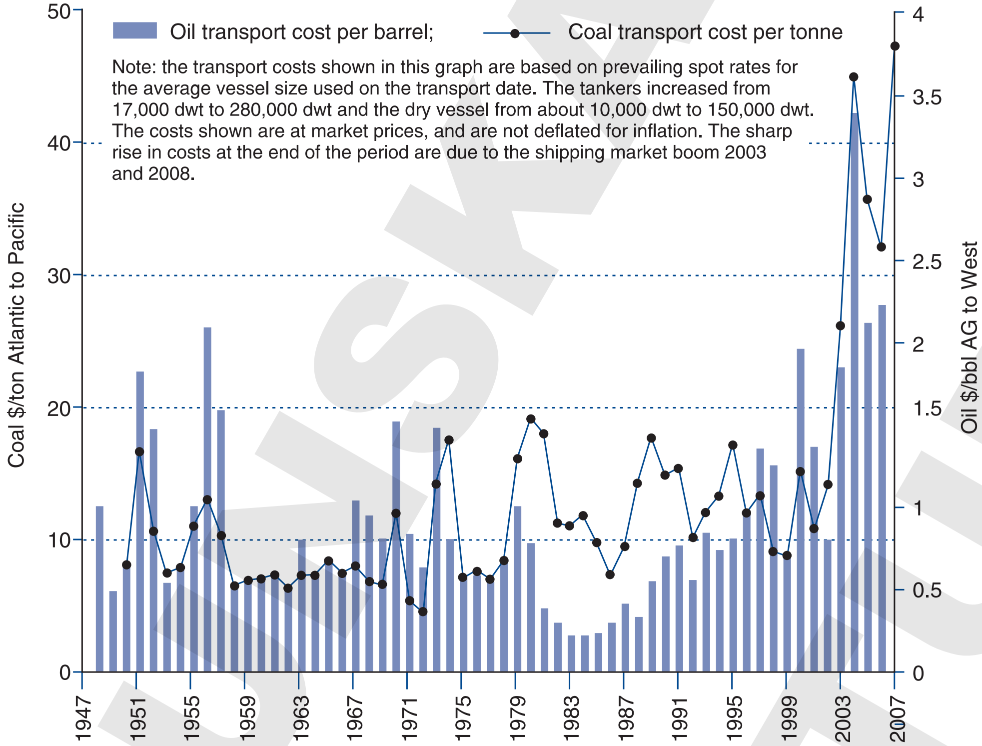


Figure 2.5
Transport cost of coal and oil, 1947–2007
Source: Compiled by Martin Stopford from various sources

a man's suit, illustrating the impact of Chinese exports on the clothing business. Seaborne oil freight and dry bulk freight came second and third in the table, but it is not really a fair comparison because 2004 was a high point in the shipping cycle, with the highest freight rates for a century (see Chapter 3 for discussion of cycles). The fact that air fares head the list provides an insight into why shipping lost the passenger transport business during this period.

This demonstrates that the shipping business was very successful in maintaining costs during a period when the cost of the commodities it carried increased by 10 or 20 times. As a result, for many commodities freight is now a much smaller proportion of costs than it was 30 years ago. For example, in 1960 the oil freight was 30% of the cost of a barrel of Arabian light crude oil delivered to Europe.[18] By 1990 it had fallen to less than 5% and in 2004 it was about the same, making the tanker business less important to the oil companies. This cost performance was achieved by a combination of economies of scale, new technology, better ports, more efficient cargo handling and the use of international flags to reduce overheads. These are the topics which we will address in the remainder of this chapter.

Table 2.7 Prices of goods, services and commodities 1960–2004 at current market prices

	Unit	1960	1990	2004	Average increase 1960–2004 (% p.a.)
Atlantic air fare[a]	$	432.6	580.9	230.0	–1%
Rail fare[b]	$	23.5	106.1	99.8	3%
Men's suit (Daks)	$	84	484	478	4%
Oil freight Gulf/West	$/barrel	0.55	0.98	3.30	4%
Coal freight Hampton Roads/Japan	$/ton	6.9	14.8	44.8	4%
Ford car[c]	$	1,385	11,115	13,430	5%
Dinner at the Savoy[d]	$	7	52	96	6%
Household coal	$/ton	12	217	194	6%
Bread (unsliced loaf)	cents	6.7	75.5	115.2	6%
Postage stamp[e]	cents	4	67	83	8%
Crude oil (Arabian Light)	$/barrel	1.5	20.5	50.0	8%
memo: US consumer prices	Index	100.0	442.0	640.0	4%
exchange rate $ per £		2.8	1.8	1.9	–1%

Source: 'Prices down the years', *The Economist,* 22 December 1990, updated.

Notes

[a]London to New York return

[b]London to Glasgow, 2nd class, return

[c]Cheapest model

[d]Soup, main course, pudding, coffee

[e]London to America

[f]Average % increase 1960–2004

Although less easily documented, the achievements of the container business are equally impressive. The cost of shipping 7,500 pairs of trainers on the main leg from the Far East to UK in 2004 was 24 cents a pair. On the return leg the cost of shipping 15,500 bottles of scotch whisky in a 20-foot container from the UK to Japan fell from $1660 in 1991 to $735 in 2004. That works out at 4.7 cents a bottle.[19]

Ship size and economies of scale

Economies of scale played a major part in keeping sea transport costs low. We have already noted that many sizes of ships are required to deal with differing parcel sizes, water depths and distance over which cargo is shipped (see Table 2.5). For example, tankers range in size from 1,000 dwt to over 400,000 dwt and separate market segments have developed, differentiated by ship size. Tankers evolved into VLCCs (over 200,000 dwt) which work on the long-haul routes; Suezmaxes (199,999 dwt) for medium-haul crude oil trades; Aframaxes (80,000–120,000 dwt) for the short-haul crude trade; Panamax tankers (60,000–80,000 dwt) for very short-haul crude and dirty products; and products tankers (10,000–60,000 dwt). In the dry bulk market, Capesize bulk carriers of

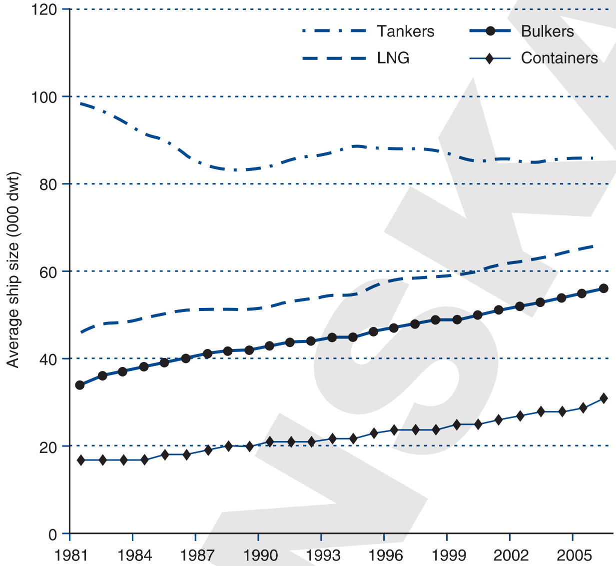


Figure 2.6
Ship size trends, 1980–2006
Source: Compiled from fleet data

around 170,000 dwt specialize in the coal and iron ore trade, whilst Panamax bulk carriers carry grain, coal and small iron ore parcels and Handy bulkers (20,000–60,000 dwt) do smaller parcels of minor bulks. Over time the average size of ship in each of these size bands tends to edge upwards. For example, the cutting edge Handy-sized bulk carrier being delivered was 25,000 dwt in 1970, 35,000 dwt in 1985, and 50,000 dwt in 2007. Ship size increased because businesses were able to handle larger parcels of cargo, and port facilities were developed to accommodate bigger ships. Much the same sort of size escalation is taking place in tankers and, of course, container-ships. As can be seen in Figure 2.6, over the 25 years from 1981 to 2006 the size trend was generally up. For example, the average bulk carrier increased in size from 34,000 dwt to 56,000 dwt. But sizes do not always increase. The average size of tanker fell from 96,000 dwt in 1981 to 86,000 dwt in 2005 as a result of structural changes in the fleet, caused by a switch from long-haul to short-haul oil.[18]

The sea transport unit cost function

We can see why investors go for bigger ships when we examine the unit cost function. The unit cost of transporting a ton of cargo on a voyage is defined as the sum of the capital cost of the ship (*LC*), the cost of operating the ship (*OPEX*) and the cost of handling the cargo (*CH*), divided by the parcel size (*PS*), which for bulk vessels is the tonnage of cargo it can carry:

$$\text{Unit Cost} = \frac{LC + OPEX + CH}{PS}$$

In calculating capital and operating costs, time spent repositioning the ship between cargoes must be taken into account. The unit cost generally falls as the size of the ship increases because capital, operating and cargo-handling costs do not increase proportionally with the cargo capacity. For example a 330,000 dwt tanker only costs twice as much as an 110,000 dwt vessel, but it carries three times as much cargo (we examine this in more detail in Chapter 6), so the cost per tonne of shipping a 110,000 tonne parcel of oil is much higher than shipping a 330,000 tonne parcel. If the cargo parcel is too small to occupy a whole ship the cost escalates further because of the high cost of handling and stowing small parcels. For example, crude oil can be transported 12,000 miles from the Arabian Gulf to the USA for less than $1 per barrel using a 280,000 dwt tanker, whereas the cost of shipping a small parcel of lubricating oil from Europe to Singapore in a small parcel can be over $100 a tonne.

The shape of the unit cost function is illustrated in Figure 2.7 which relates the cost per tonne of cargo transported (vertical axis) to the parcel size (horizontal axis). Unit costs escalate significantly as the parcel size falls below the size of a ship and the cargo slips into the liner transport system. There is clearly a tremendous incentive to ship in large quantities, and it is the slope of the unit cost curve which creates the economic pressure which has driven parcel sizes upwards over the last century. It also explains why containerization has been so successful. By packing 10 or 15 tonnes of cargo into a 20-foot container which can be loaded onto a containership of 8,000 twenty-foot equivalent units (TEU) in a couple of minutes it is possible to reduce the freight to around $150 per tonne, which is not much more than some small bulk parcels. Imagine having to load the 1300 cases of scotch whisky that the container carries and then pack them into the hold (not to mention the damage and pilferage).

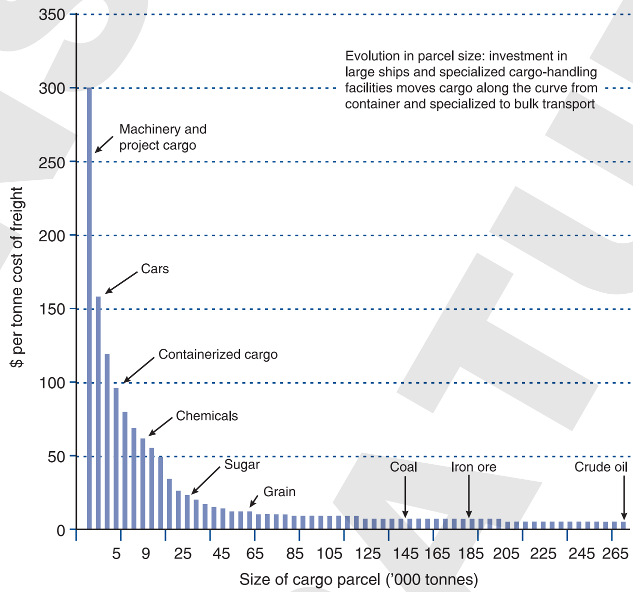


Figure 2.7
Shipping unit cost function: parcel size and transport cost
Source: Compiled by Martin Stopford from various sources

Liner and bulk shipping companies, which operate at opposite ends of the unit cost function, carry out fundamentally different tasks. Liner companies have to organize the transport of many small parcels and need a large shore-based staff capable of dealing with shippers, handling documentation and planning the ship loading and through-transport operations. The bulk shipping industry, in contrast, handles fewer, but much larger cargoes. A large shore-based administrative staff is not required, but the few decisions that have to be made are of crucial importance, so the owner or chief executive is generally intimately involved with the key decisions about buying, selling and chartering ships. In short, the type of organizations involved, the shipping policies, and even the type of people employed in the two parts of the business are quite different. The nature of the liner and bulk shipping industries is discussed in detail in Chapters 11 and 13, so the comments in this chapter are limited to providing an overview of these two principal sectors of the shipping market.

These differences in the nature of demand provide the basis for explaining the division of the shipping industry into two quite different sectors, the bulk shipping industry and the liner shipping industry. The bulk shipping industry is built around minimizing unit cost, while the liner shipping industry is more concerned with speed, reliability and quality of service.

Bulk shipping economics

The bulk shipping industry provides transport for cargoes that appear on the market in shiploads. The principle is ‘one ship, one cargo’, though we cannot be too rigid about this. Many different ship types are used for bulk transport, but the main ones fall into four groups: tankers, general-purpose dry bulk carriers, combined carriers, and specialist bulk vessels. The tankers and bulk carriers are generally of fairly standard design, while combined carriers offer the opportunity to carry dry bulk or liquid cargo. Specialist vessels are constructed to meet the specific characteristics of difficult cargoes. All of these ship types are reviewed in detail in Chapter 14.

Several different bulk cargoes may be carried in a single ship, each occupying a separate hold or possibly even part of a hold in a traditional ‘tramping operation’, though this is less common than it used to be. The foundation of bulk shipping is, however, economies of scale (Figure 2.8). Moving from a Handy bulk carrier to a Handymax saves about 22% per tonne, whilst upsizing to a Panamax bulk carrier saves 20% and the much bigger jump to a Capesize an additional 36%. So the biggest dry bulk ships can more than halve the cost of transport, though this analysis depends on many assumptions which we will discuss in depth in Chapter 6 (see, in particular, Table 6.1). A shipper with bulk cargo to transport can approach the task in several different ways, depending on the cargo itself and on the nature of the commercial operation – his choices range from total involvement by owning his own ships to handing the whole job over to a specialist bulk shipper.

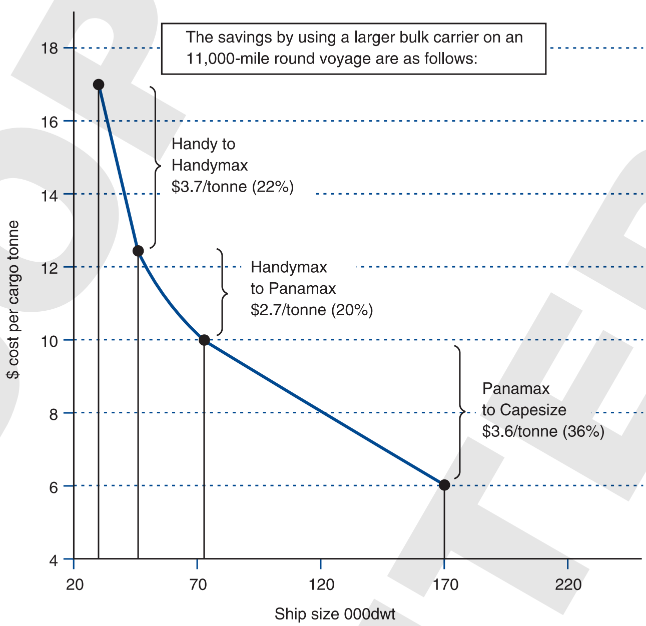


Figure 2.8
Economies of scale related to ship size for bulk carriers
Source: based on 11,000-mile round voyage from Table 10.5, Chapter 10

Large companies shipping substantial quantities of bulk materials sometimes run their own shipping fleets to handle a proportion of their transport requirements. For example, in 2005 the major oil companies collectively owned approximately 22.7 m.dwt of oil tankers, representing 7% of the tanker fleet. Steel companies in Japan and Europe also run fleets of large bulk carriers for the transport of iron ore and coal. This type of bulk shipping operation suits shippers running a stable and predictable through-transport operation.

One of the first examples of modern dry bulk transportation was the construction for Bethlehem Steel of two ore carriers to carry iron ore from Chile to the newly constructed coastal steel plant in Baltimore, USA (see Chapter 11). The whole transport operation was designed to minimize transport costs for that particular plant, and this pattern is still followed by heavy industrial operations importing bulk cargo. Some industrial shippers in the oil and steel business still follow this practice to optimize the shipping operation and ensure that basic transport requirements are met at a predictable cost without the need to resort to the vagaries of the charter market.

The main problem raised by this strategy is the capital investment required and the question of whether owning ships reduces transport costs.[21] If the shipper has a long-term requirement for bulk transport but does not wish to become actively involved as a shipowner, he may charter tonnage on a long-term basis from a shipowner. Some companies place charters for 10 or 15 years to provide a base load of shipping capacity to cover long-term material supply contracts – particularly in the iron ore trade. For example, the Japanese shipping company Mitsui OSK ships iron ore for Sumitomo, Nippon Kokan and Nippon Steel on the basis of long-term cargo guarantees and operates a fleet of ore carriers and combined carriers to provide this service. In the early 1980s the company was carrying about 20% of Japanese iron ore imports.[22] In such cases, the contract is generally placed before the vessel is actually built. Shorter-term time charters for 12 months or 3–5 years are obtained on the charter market and this practice has not changed significantly over the last thirty years.

However, some shippers have only an occasional cargo to transport. This is often the case in agricultural trades such as grain and sugar where seasonal factors and the volatility of the market make it difficult to plan shipping requirements in advance, or where the cargo is a consignment of prefabricated buildings or heavy plant. In such cases, bulk or multi-deck tonnage is chartered for a single voyage at a negotiated freight rate per ton of cargo carried.

Finally, the shipper may enter into a long-term arrangement with a shipowner who specializes in a particular area of bulk shipping supported by suitable tonnage. For example, Scandinavian shipowners such as Star Shipping and the Gearbulk Group are heavily involved in the carriage of forest products and run fleets of specialist ships designed to optimize the bulk transportation of forest products. Similarly, the transportation of motor cars is serviced by companies such as Wallenius Lines, which runs a fleet of pure vehicle carriers and transports 2 million vehicles around the world each year.

The service offered in specialist bulk trades involves adherence to precise timetables, using ships with a high cargo capacity and fast cargo handling. Such an operation requires close cooperation between the shipper and the shipowner, the latter offering a better service because he is servicing the whole trade rather than just one customer. Naturally, this type of operation occurs only in trades where investment in specialist tonnage can provide a significant cost reduction or quality improvement as compared with the use of general-purpose bulk tonnage.

Liner shipping economics

Liner services provide transport for cargoes that are too small to fill a single ship and need to be grouped with others for transportation. The ships operate a regular scheduled service between ports, carrying cargo at fixed prices for each commodity, though discounts may be offered to regular customers. The transport of a mass of small items on a regular service faces the liner operator with a more complex administrative task than the one facing the bulk shipowner. The liner operator must be able to:

- offer a regular service for many small cargo consignments and process the associated mass of paperwork;
- charge individual consignments on a fixed tariff basis that yields an overall profit – not an easy task when many thousands of consignments must be processed each week;
- load the cargo/container into the ship in a way that ensures that it is accessible for discharge (bearing in mind that the ship will call at many ports) and that the ship is 'stable' and 'in trim';
- run the service to a fixed schedule while allowing for all the normal delays – arising from adverse weather, breakdowns, strikes, etc.; and
- plan tonnage availability to service the trades, including the repair and maintenance of existing vessels, the construction of new vessels and the chartering of additional vessels to meet cyclical requirements, and to supplement the company's fleet of owned vessels.

All of this is management-intensive and explains why, in commercial terms, the liner business is a different world than bulk shipping. The skills, expertise and organizational requirements are very different.

Because of their high overheads and the need to maintain a regular service even when a full payload of cargo is not available, the liner business is particularly vulnerable to marginal cost pricing by other shipowners operating on the same trade routes. To overcome this, liner companies developed the 'conference system', which was first tried out in the Britain to Calcutta trade in 1875. In the 1980s there were about 350 shipping conferences operating on both deep-sea and short-sea routes. However, the prolonged market recession in the 1980s, the changes brought about by containerization, and regulatory intervention weakened the system to such an extent that liner operators started to look for other ways of stabilizing their competitive position. Liner operations are discussed extensively in Chapter 13.

2.8 THE ROLE OF PORTS IN THE TRANSPORT SYSTEM

Ports are the third component in the transport system and provide a crucial interface between land and sea. It is here that much of the real activity takes place. In the days of cargo liners and tramps the activity was obvious. Ports were crowded with ships and bustling with dockers loading and unloading cargo. Artists loved to paint these busy scenes, and the waterfronts were famous for the entertainment they provided to sailors during their long portcalls. Anyone could see what was going on. Modern ports are more subtle. Ships make fleeting calls at highly automated and apparently deserted terminals, often stopping only a few hours to load or discharge cargo. The activity is less obvious, but much more intense. Cargo-handling speeds today are many times higher than they were fifty years ago.

Before discussing ports, we must define three terms: 'port', 'port authority' and 'terminal'. A port is a geographical area where ships are brought alongside land to load and discharge cargo – usually a sheltered deep-water area such as a bay or river mouth. The port authority is the organization responsible for providing the various maritime services required to bring ships alongside land. Ports may be public bodies, government organizations or private companies. One port authority may control several ports (e.g. Saudi Ports Authority). Finally, a terminal is a section of the port consisting of one or more berths devoted to a particular type of cargo handling. Thus we have coal terminals, container terminals, etc. Terminals may be owned and operated by the port authority, or by a shipping company which operates the terminal for its exclusive use.

Ports have several important functions which are crucial to the efficiency of the ships which trade between them. Their main purpose is to provide a secure location where ships can berth. However, this is just the beginning. Improved cargo handling requires investment in shore-based facilities. If bigger ships are to be used, ports must be built with deep water in the approach channels and at the berths. Of equal importance is cargo handling, one of the key elements in system design. A versatile port must be able to handle different cargoes – bulk, containers, wheeled vehicles, general cargo and passengers all require different facilities. There is also the matter of providing storage facilities for inbound and outbound cargoes. Finally, land transport systems must be efficiently integrated into the port operations. Railways, roads and inland waterways converge on ports, and these transport links must be managed efficiently.

Port improvement plays a major part in reducing sea transport costs. Some of this technical development is carried out by the shipping companies which construct special terminals for their trade, or shippers such as oil companies and steel mills. For example, the switch of grain transport from small vessels of about 20,000 dwt to vessels of 60,000 dwt and above depended upon the construction of deep-water grain terminals with bulk handling and storage facilities. Similarly, the introduction of container services required container terminals. However, the port industry provides much of the investment itself. It has its own market place which is every bit as competitive as the shipping markets. The ports within a region are locked in cut-throat competition to attract the cargo moving to inland destinations or for distribution within the region.

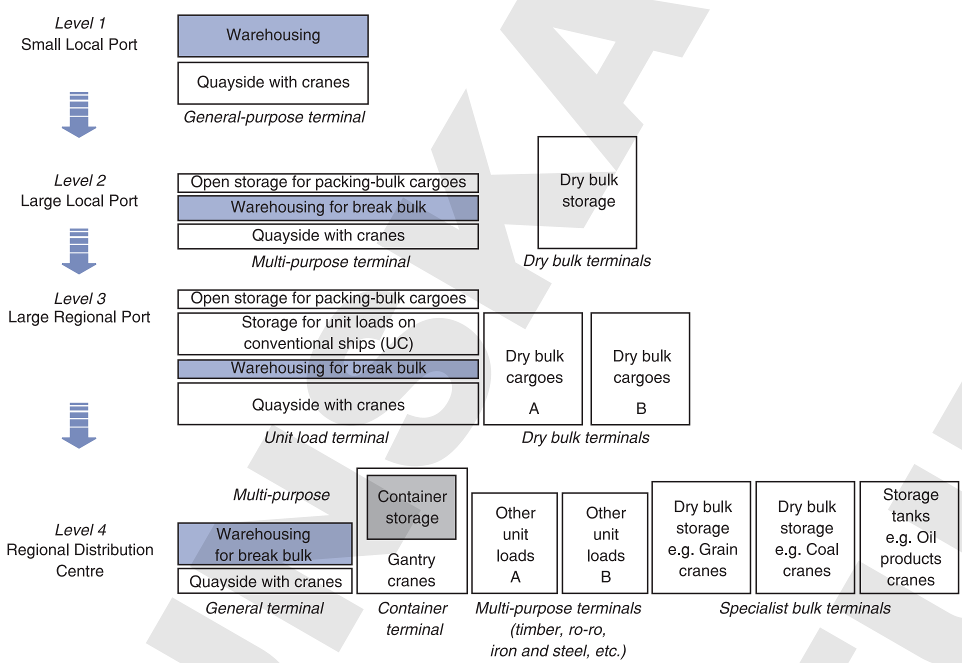


Figure 2.9
Four levels of port development
Source: Compiled by Matin Stopford from various sources

Hong Kong competes with Singapore and Shanghai for the Far East container distribution trade. Rotterdam has established itself as the premier European port in competition with Hamburg, Bremen, Antwerp and, in earlier times, Liverpool. Investment in facilities plays a key part in the competitive process.

The facilities provided in a port depend on the type and volume of cargo which is in transit. As trade changes, so do the ports. There is no such thing as a typical port. Each has a mix of facilities designed to meet the trade of the region it serves. However, it is possible to generalize about the type of port facilities which can be found in different areas. As an example, four types of port complex are shown in Figure 2.9, representing four different levels of activity. In very rough terms, the blocks in these diagrams represent, in width, the number of facilities or length of quay wall, and in height, the annual throughput of each.

- Level 1: *Small local port*. Around the world there are thousands of small ports serving local trade. They handle varied cargo flows, often serviced by short-sea vessels. Since the trade volume is small the facilities are basic, consisting of general-purpose berths backing on to warehouses. Only small ships can be accommodated and the port probably handles a mixture of containers, break-bulk cargo plus shipments of commodities in packaged form (e.g. part loads of packaged timber or oil in drums) or shipped loose and packaged in the hold prior to discharge. Cargo is unloaded from the ship on to the quayside and stored in the warehouses, or on the quayside until collected. Ports like this are found in developing countries and in the rural areas of developed countries.

- Level 2: *Large local port*. When the volume of cargo is higher, special investment becomes economic. For example, if the volume of grain and fertilizers increases, a dry bulk terminal may be constructed with the deeper draft required to handle bigger bulk carriers (e.g. up to 35,000 dwt), a quayside with grab cranes, apron space to stack cargo, railway lines and truck access. At the same time the break-bulk facilities may be expanded to handle regular container traffic, for example, by purchasing container handling equipment and strengthening the quayside.
- Level 3: *Large regional port*. Ports handling high volumes of deep-sea cargo require heavy investment in specialized terminal facilities. Unit loads such as pallets, containers or packaged timber are handled in sufficient volume to justify a unit-load terminal with cargo-handling gear such as gantry cranes, fork-lift trucks and storage space for unit-load cargo. For high-volume commodity trades, moving in volumes of several million tons a year, special terminals may be built (e.g. coal, grain, oil products terminals) capable of taking the bigger ships of 60,000 dwt and above used in the deep-sea bulk trades.
- Level 4: *Regional distribution centre*. Regional ports have a wider role as distribution hubs for cargo shipped deep sea in very large ships, and requiring distribution to smaller local ports. This type of port, of which Rotterdam, Hong Kong and Singapore are prime examples, consists of a federation of specialist terminals, each dedicated to a particular cargo. Containers are handled in container terminals; unit-load terminals cater for timber, iron and steel and ro-ro cargo. Homogeneous bulk cargoes such as grain, iron, coal, cement and oil products are handled in purpose-built terminals, often run by the cargo owner. There are excellent facilities for trans-shipment by sea, rail, barge or road.

Ports and terminals earn income by charging ships for the use of their facilities. Leaving aside competitive factors, port charges must cover unit costs, and these have a fixed and variable element. The shipowner may be charged in two ways, an ‘all-in’ rate where, apart from some minor ancillary services, everything is included; or an ‘add-on’ rate where the shipowner pays a basic charge to which extras are added for the various services used by the ship during its visit to the port. The method of charging will depend upon the type of cargo operation, but both will vary according to volume, with trigger points activating tariff changes.

2.9 THE SHIPPING COMPANIES THAT RUN THE BUSINESS

Types of shipping company

A striking feature of the shipping business to outsiders is the different character of the companies in different parts of the industry. For example, liner companies and bulk shipping companies belong to the same industry, but they seem to have little else in common, a fact we shall discuss more extensively in later parts of the book. In fact there are several different groups of companies involved in the transport chain, some directly and others indirectly. The direct players are the cargo owners, often the primary producers such as oil companies or iron ore mines and the shipowners (shipping companies). However, in the last 20 years they have been joined by two other increasingly important groups: the traders who buy and sell physical commodities such as oil, for which they need transport, making them major charterers; and the 'operators' who charter ships against cargo contracts for an arbitrage. Ship managers and brokers are also involved in the day-to-day commercial operation of the business. Each has a slightly different perspective on the business.

In 2004, 5518 shipping companies owned the 36,903 ships carrying the world's deep-sea trade, an average of seven ships per company (Table 2.8). There are some very big companies, at least when measured by the number of ships owned, and one-third of the fleet was owned by 112 companies with over 50 ships. Amongst the biggest companies are the national shipping companies such as China Ocean Shipping Company (COSCO), China Shipping Group, the Indian government, and MISC. Then there are the large corporates, such as the Japanese trading houses (Mitsui OSK, NYK, K-Line), the Korean shipping groups and some very large independent companies such as Maersk, Teekay and the Ofer Group. Another third was owned by 716 companies operating 10–49 ships, many of which are privately owned companies, and the remainder was owned by 4690 companies with an average of 2.3 ships each. To really understand what is going on in those supply–demand curves that we will study in Chapter 4, or to track and forecast the cycles in shipping, we must understand what really drives these companies.

Table 2.8 Size of shipping companies, 2004[a]

No. of ships in fleet	No. of Companies	# Ships	% fleet (No. of ships)	Ships per company
Over 200	10	4074	11%	407
100–200	22	2754	7%	125
50–99	80	5538	15%	69
20–49	256	7520	20%	29
10–19	460	6211	17%	14
5–9	669	4389	12%	7
Under 5	4021	6417	17%	2
Grand total	5518	36,903	100%	7

[a]Includes deep-sea vessels, including bulk, specialized and liner.
Source: CRSL

In the background are the suppliers, including managers, ship repairers, shipbuilders, equipment manufacturers and shipbreakers. Each of these is a distinctive business with its own special culture and objectives. Ship finance forms another category, again with distinctive subdivisions, as do lawyers and other associated services such as ship surveying, insurance and information providers.

Who makes the decisions?

Because the business is internationally mobile, shipowners can choose to register their companies in the Bahamas, Liberia, the Marshall Islands or Cyprus. These countries have maritime laws that, as we discuss in Chapter 16, offer a favourable commercial environment. Several different types of company structure are used, including sole proprietorship, partnerships and corporate structures.

Within the bulk and liner shipping industries there are many different types of business, each with its own distinctive organizational structure, commercial aims and strategic objectives. Consider the examples in Box 2.1. This is by no means an exhaustive account of the different types of shipowning companies, but it illustrates the diversity of organizational types to be found and, more importantly, the different pressures and constraints on management decision-making.

The Greek shipowner with the private company runs a small tight organization which he controls, making all the decisions and having a direct personal interest in their outcome. In fact, the number of important decisions he makes is quite small, being concerned with the sale and purchase of ships and decisions about whether to tie vessels up on long-time charters. He is a free agent, dependent on his own resources to raise finance and beat the odds in the market place.

The other examples show larger structures where the top management are more remote from the day-to-day operation of the business and are subject to many institutional pressures and constraints in operating and developing the business. The container company has a large and complex office staff and agency network to manage, so there is an unavoidable emphasis on administration. The oil company division reports to a main board, whose members know little about the shipping business and do not always share the objectives of the management of the shipping division. The shipping corporate is under pressure from its high profile with shareholders and its vulnerability to take-over during periods when the market does not allow a proper return on capital employed. Each company is different, and this influences the way it approaches the market.

Joint ventures and pools

One of the methods used by smaller shipping companies to improve their profitability is to form pools which allow them to reduce overheads, use market information more efficiently and compete more effectively for contracts with shippers who require high service levels. A shipping pool is a fleet of similar vessel types with different owners, in the care of a central administration.[23] Pools often use an organization of the type shown in Figure 2.10. The pool manager markets the vessels as a single fleet and collects the earnings which, after deducting overheads, are distributed to pool members under a pre-arranged ‘weighting’ system (‘distribution key’) which reflects each ship’s revenue-generating characteristics. The revenue-sharing arrangements are of central importance, and for this reason pools are almost always restricted to ships of a specific type so that the revenue contribution of each vessel can be assessed accurately.

BOX 2.1 EXAMPLES OF TYPICAL SHIPPING COMPANY STRUCTURES

Private bulk company A tramp company owned by two Greek brothers. They run a fleet of five ships, three products tankers and two small bulk carriers. The company has a two-room office in London, run by a chartering manager with e-mail, a mobile phone and a part-time secretary. Its main office is in Athens, where two or three staff do the accounts and administration and sort out any problems. Three of the ships are on time charters and two are on the spot market. One of the brothers is now more or less retired and all the important decisions are taken by the other brother, who knows from experience that the real profits are made from buying and selling ships rather than from trading them on the charter market.

Shipping corporate A liner company in the container business. The company operates a fleet of around 20 container-ships from a large modern office block housing about 1,000 staff. All major decisions are taken by the main board, which consists of 12 executive board members along with representatives of major stockholders. In addition to the head office, the company runs an extensive network of local offices and agencies which look after their affairs in the various ports. The head office has large departments dealing with ship operations, marketing, documentation, secretariat, personnel and legal. In total the company has 3,500 people on its payroll, 2,000 shore staff and 1,500 sea staff.

Shipping division The shipping division of an international oil company. The company has a policy of transporting 30% of its oil shipments in company-owned vessels, and the division is responsible for all activities associated with the acquisition and operation of these vessels. There is a divisional board, which is responsible for day-to-day decisions, but major decisions about the sale and purchase of ships or any change in the activities undertaken by the division must be approved by the main board. The vice president is responsible for submitting an annual corporate plan to the board, summarizing the division's business objectives and setting out its operating plans and financial forecasts. In particular, company regulations lay down that any items of capital expenditure in excess of $2 million must have main board approval. Currently the division is running a fleet of ten VLCCs and 36 small tankers from an organization that occupies several floors in one of the company's office blocks.

Diversified shipping group A company which started in shipping but has now acquired other interests. It runs a fleet of more than 60 ships from its head office in New York, though operations and chartering are carried out from offices in other more cost-effective locations. The company is quoted on the New York Stock Exchange and the majority of shares are owned by institutional investors, so its financial and managerial performance is closely followed by investment analysts who specialize in shipping. In recent years the problems of operating in the highly cyclical shipping market have resulted in strenuous efforts to diversify into other activities. Recently the company was the subject of a major takeover bid, which was successfully resisted, but management is under constant pressure to increase the return on capital employed in the business.

Semi-public shipping group A Scandinavian shipping company started by a Norwegian who purchased small tankers in the early 1920s. Although it is quoted on the Stock Exchange, the family still owns a controlling interest in the company. Since the Second World War the company has followed a strategy of progressively moving into more sophisticated markets, and it is involved in liner shipping, oil tankers, and the carriage of specialist bulk cargoes such as motor vehicles and forest products, in both of which markets it has succeeded in winning a sizeable market share and a reputation for quality and reliability of service. To improve managerial control the tanker business was floated as a separate company. The company runs a large fleet of modern merchant ships designed to give high cargo-handling performance, and is based in an Oslo office with a sizeable staff.

From the owner's viewpoint participating in a pool is rather like having the ship on time charter, but with variable freight earnings. When a ship enters the pool its distribution key is agreed and this determines its share of the net earnings. It is generally based on the vessel's earning capacity compared with other ships in the pool and will typically take account of cargo capacity, equipment (cranes, types of hatches, etc.), speed and consumption. The ship is chartered into the pool which pays all voyage-related costs such as port costs, cargo handling and bunkers, whilst the owner continues to pay capital costs, manning and maintenance. After deducting overheads and commission, the net earnings of the pool are distributed between the participants. The pool agreement generally includes a non-competition clause which prevents the participant using other ships he owns or controls outside the pool to compete with pool vessels. Finally, for a pool to work there must be cultural understanding. For example, a small private shipping company may not fully

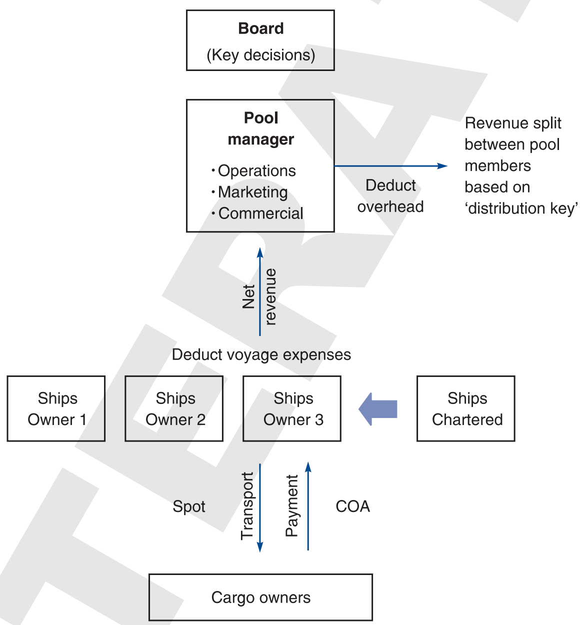


Figure 2.10
Structure of typical shipping pool
Source: Martin Stopford 2007

understand the constraints faced by a shipping company which is part of a large corporation, leading to frustration and misunderstanding. There must be benefits for both sides.

Shipping pools of this type are found in almost all segments of the tramp/non-liner shipping market, including product tankers, parcel tankers, chemical tankers, gas tankers and VLCCs, segments of the bulk carrier market (Handy, Handymax, Panamax and Capesize), reefers, LPG tankers, and forest product trades (lumber and wood chip carriers, etc.).

The pool may be managed by one of the participants, often the one who started the pool, or an independent manager. A pool agreement gives the manager control of day-to-day affairs, whilst a board nominated by participants takes decisions on chartering strategy, admission of new members and revision of the 'pool points' distribution key. The owners generally continue to be responsible for the crewing, maintenance and technical management of their ships, with defined terms of exit. Leaving the pool generally involves giving notice – typically 3–6 months – and settling obligations. However, there is a great deal of variation. Some pools are loose, whilst others are highly integrated, operating more like a joint venture. Participants prefer a short notice period, allowing them to withdraw their vessels if they feel the pool is not operating effectively or if they decide to sell the ship.

The pool manager has four main tasks. Firstly, he arranges employment for the fleet, including spot freight negotiations, time charters and in the longer term arranging COAs. Increasingly large shippers tender out large transportation contracts which pools, with their large fleet and specialist staff, are better positioned to win. In some cases the pools become an integrated logistics arm of the shippers. Secondly, he collects freight and pays voyage costs out of the earnings. Thirdly, he manages the fleet's commercial operations, including issuing instructions to the ships, nominating agents, keeping customers updated on vessel movements, issuing freight and demurrage invoices, collecting claims and ordering bunkers. Fourthly, he distributes the net earnings of the pool to participants in accordance with the distribution key.

To succeed the pools usually specialize in a specific trade or ship type where it is possible to offer members better than average earnings, more effective marketing of COAs, and time charters with lower marketing costs per ship, long-term planning, cost savings and economies of scale. For example, a large fleet may be able to significantly reduce its ballast time by arranging COAs to cover backhauls by providing return cargo, chartering additional vessels when members' ships are not available, and provide performance guarantees which an individual owner would not be able to undertake. By offering ships in the relevant areas, letters of credit can be arranged more quickly.

Organizations of this sort must comply with the competition laws of the states in which they trade. These laws generally make it illegal for pool members to collude to prevent or restrict competition. For example, in many countries agreements to fix prices, tenders, allocate customers between pool members or carve up geographical markets are illegal. In the last decade various governments, including the USA and the European Union (EU), have taken steps to tighten the application of these regulations to the shipping industry, initially liner conferences, but subsequently to the large companies and pools operating in the bulk shipping industry. The regulation of competition in shipping, including pools, is discussed in Section 16.10.

2.10 THE ROLE OF GOVERNMENTS IN SHIPPING

Finally, we cannot ignore national and international political aspects of the business. Because shipping is concerned with international trade, it inevitably operates within a complicated pattern of agreements between shipping companies, understandings with shippers and the policies of governments. From the Plimsoll Act (1870), which stopped ships being overloaded, to the US Oil Pollution Act (1990), which set out stringent regulations and liabilities for tankers trading in US national waters, politicians have sought to limit the actions of shipowners. The regulations they have developed have ranged from the efforts of the Third World countries to gain entry to the international shipping business through the medium of UNCTAD in the 1960s, to the subsidizing of domestic shipbuilding, the regulation of liner shipping and the increasing interest in safety at sea, pollution and crew regulations.

Just as these subjects cannot easily be understood without some knowledge of the maritime economy, an economic analysis cannot ignore regulatory influences on costs, prices and free market competition. These subjects will be discussed in later chapters.

2.11 SUMMARY

In this chapter we have concentrated on the maritime industry as a whole and shipping's part in it. During the last 50 years the cost of transporting commodities by sea has fallen steadily, and in 2004 accounted for 3.6% of the value of imports. Our aim is to show how this has been achieved and how the different parts of the shipping market – the liner business, bulk shipping, the charter market, etc. – fit together. We have discussed the transport system and the economic mechanisms which match a diverse fleet of merchant ships to an equally diverse but constantly changing pattern of seaborne trade.

Because shipping is a service business, ship demand depends on several factors, including price, speed, reliability and security. It starts from the volume of trade, and we discussed how the commodity trades can be analysed by dividing them into groups which share economic characteristics, such as energy, agricultural trades, metal industry trades, forest products trades and other industrial manufactures. However, to explain how transport is organized we introduced the subject of parcel size distribution. The shape of the PSD function varies from one commodity to another. The key distinction is between 'bulk cargo', which enters the market in ship-size consignments, and 'general cargo', which consists of many small quantities of cargo grouped for shipment.

Bulk cargo is transported on a 'one ship, one cargo' basis, generally using bulk vessels. Where trade flows are predictable, for example, servicing a steel mill, fleets of ships may be built for the trade or vessels chartered on a long-term basis. Some shipping companies also run bulk shipping services geared to the transport of special cargoes such as forest products and cars. To meet marginal fluctuations in demand, or for trades such as grain where the quantities and routes over which cargo will be transported are unpredictable, tonnage is drawn from the charter market.

General cargo, either loose or unitized, is transported by liner services which offer regular transport, accepting any cargo at a fixed tariff. Containerization transformed loose general cargo into a homogeneous commodity which could be handled in bulk. This changed the ships used in the liner trades, with cellular container-ships replacing the diverse fleet of cargo liners. However, the complexity of handling many small consignments remained and the liner business is still distinct from the bulk shipping business. They do, however, go to the charter market to obtain ships to meet marginal trading requirements.

Specialized shipping falls midway between general cargo and bulk, focusing on high-volume but difficult cargoes such as motor vehicles, forest products, chemicals and gas. Their business strategy is generally to use their specialist investment and expertise to give the company a competitive advantage in these trades. However, few specialist markets are totally segregated and competition from conventional operators is often severe.

Sea transport is carried out by a fleet of 74,000 ships. Since technology is constantly changing and ships gradually wear out, the fleet is never optimum. It is a resource which the shipping market uses in the most profitable way it can. Once they are built, ships 'trickle down' the economic ladder until no shipowner is prepared to buy them for trading, when they are scrapped.

Ports play a vital part in the transport process. Mechanization of cargo handling and investment in specialist terminals have transformed the business.

Finally, we discussed the companies that run the business. They have very varied organization and decision-making structures, a fact which market analysts are well advised to remember.