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1 Sea Transport and the Global Economy

Wonders are many on earth, and the greatest of these
Is man, who rides the ocean and takes his way
Through the deeps, through wind-swept valleys of perilous seas
That surge and sway.

(The chorus in *Sophocles' Antigone, 422* BC, trans. R.C. Jebb)

1.1 INTRODUCTION

Characteristics of the business

Shipping is a fascinating business. Since the first cargoes were moved by sea more than 5,000 years ago it has been at the forefront of global development. The epic voyages of Columbus, Diaz and Magellan opened the maritime highways of the world, and the same pioneering spirit brought supertankers,[1] container-ships, and the complex fleet of specialized ships which each year transport a ton of cargo for every person in the world. No business is more exciting. The great shipping boom of 2004 swept the industry from rags to riches in little more than a year, making its fortunate investors some of the wealthiest people in the world. This sort of volatility created superstars like Niarchos and Onassis, and a few villains like Tidal Marine, which built up a 700,000 dwt (deadweight tonnage) shipping fleet in the early 1970s and were indicted with a number of their bankers for fraudulently obtaining more than $60 million in loans.[2]

Our task in this book is to understand the economics of the industry. What makes it so interesting to economists is that the shipping investors who grapple with shipping risk are so visible, and their activities so well documented, that we can blend theory and practice. For all their flamboyance, they operate within a strict economic regime, which would be immediately recognizable by nineteenth-century classical economists. It is, more or less, the 'perfect' market place at work, an economic Jurassic Park where the dinosaurs of classical economics roam free and consumers get a very good deal – there are not many monopolies in shipping! Occasionally the investors miscalculate, as in the remarkable episode in 1973 when investors in the tanker market ordered over 100 million tons deadweight (m.dwt) of supertankers, for which there turned out to be no demand.

Some went from the builder's yard straight into lay-up, and few ever operated to their full economic potential. Or occasionally they run short of ships and rates go sky high, as they did during the booms of 1973 and 2004–8. But generally they 'deliver the goods' economically as well as physically at a cost which, on average, has increased surprisingly little over the years.[3]

Because shipping is such an old industry, with a history of continuous change, sometimes gradual and occasionally calamitous, we have a unique opportunity to learn from the past. Time and again we find that shipping and trade greased the slipway[4] from which the world economy was launched on new voyages in whatever political and economic vessel history had devised for it. No other industry had played such a central part in these economic voyages over thousands of years – the airline industry, shipping's closest counterpart, has barely 50 years of economic history to study! So before we plunge into the details of the shipping business as it is today, we will spend a little time studying the history of this ancient global industry to see how the economics worked in practice and where the industry is today in its latest epic voyage of globalization.[5]

The role of sea trade in economic development

The importance of sea transport in the early stages of economic development is well known to economists. In Chapter 3 of *The Wealth of Nations*, published in 1776, Adam Smith argued that the key to success in a capitalist society is the division of labour. As productivity increases and businesses produce more goods than they can sell locally, they need access to wider markets. He illustrated the point with the famous example of making pins. Working alone, ten craftsmen can produce less than 100 pins a day, but if each specializes in a single task, together they can produce 48,000 pins a day. This is far too many to sell locally, so unlocking the power of 'division of labour' depends on transport, and this is where shipping had a crucial part to play:

> As by means of water carriage a more extensive market is opened to every sort of industry than what land carriage alone can afford it, so it is upon the sea-coast, and along the banks of navigable rivers, that industry of every kind naturally begins to subdivide and improve itself, and it is frequently not until a long time after that those improvements extend themselves to the inland parts of the country.[6]

In primitive economies shipping is generally more efficient than land transport, allowing trade to get started earlier. Adam Smith paints a graphic picture of the economic benefits offered by sea transport in the eighteenth century:

> A broad wheeled wagon attended by two men and drawn by eight horses in about six weeks time carries and brings back between London and Edinburgh nearly 4 tons weight of goods. In about the same time a ship navigated by six or eight men, and sailing between the ports of London and Leith, frequently carries and brings back 200 ton weight of goods.[7]

That is a labour productivity benefit of 15 times. By exploiting economies of scale and integrated transport systems, shipping continues to demonstrate Adam Smith's insight. Today a lorry carrying one 40-foot container from Felixstowe to Edinburgh might be competing with a small container-ship carrying 200 containers. Or a truck hauling 40 tons of oil along our congested highways competes with a coastal oil tanker carrying 4,000 tons of oil by sea. Ships now travel at speeds that trucks can hardly match on congested urban roads and at a fraction of the cost. No wonder the oceans are the highways of economic development, an aspect of the business which hardly changes with the centuries. Many practical aspects of the business have not changed either. For example the bill of lading from AD 236 in Box 1.1 shows that Roman shipowners worried just as much about demurrage as shipowners do today. But new generations of shipowners also face new challenges, and shipping companies that do not adapt, however big or prestigious they may be, soon discover how ruthless the shipping market is in forcing the pace of change.

History of maritime development – the Westline

So in this chapter we are not just concerned with history. Winston Churchill said 'the further backward I look the further forward I can see',[8] and if he was right, the shipping industry is in a unique position to learn from its past about the economics of the maritime business. The evolution of sea transport is a well-travelled road which we can even plot on a map. Over 5,000 years, whether by chance or some deeply hidden economic force, the commercial centre of maritime trade has moved west along the line shown by the arrows in Figure 1.1. This 'Westline' started in Mesopotamia in 3000 BC, and progressed to Tyre in the eastern Mediterranean then to Rhodes, the Greek mainland and Rome. A thousand years ago Venice (and soon after Genoa) became the crossroads for

BOX 1.1 A BILL OF LADING, AD 236

This bill of lading is given by Aurelius Heracles, son of Dioscorus of Antaeopolis, master of his own ship of 250 artabae burden, without any figurehead, to Aurelius Arius, son of Heraclides, senator of Arsinoe, capital of Fayum, for the carriage of 250 artabae of vegetable seed, to be conveyed from the haven of the Grove to the capital of Arisonoe in the haven of Oxyrhynchus, the freightage agreed on being 100 clean silver drachmae, whereof he has received 40 drachmae, the remaining 60 drachmae he is to receive when he lands the cargo; which cargo he shall land safe and undamaged by any nautical mishap; and he shall take for the journey two days, from the 25th, and likewise he shall remain at Oxyrhynchus four days; and if he be delayed after that time he, the master, shall receive 16 drachmae per day for himself; and he the master shall provide a sufficient number of sailors and all the tackle of the ship; and he shall receive likewise for a libation at Oxyrhynchus one ceramion of wine. This bill of lading is valid, in the third year of Emperor Caesar Gaius Julius Verus Maximus the Pious, the fortunate, the 22nd of Phaophi (Oct. 19th). Source: The British Museum, London

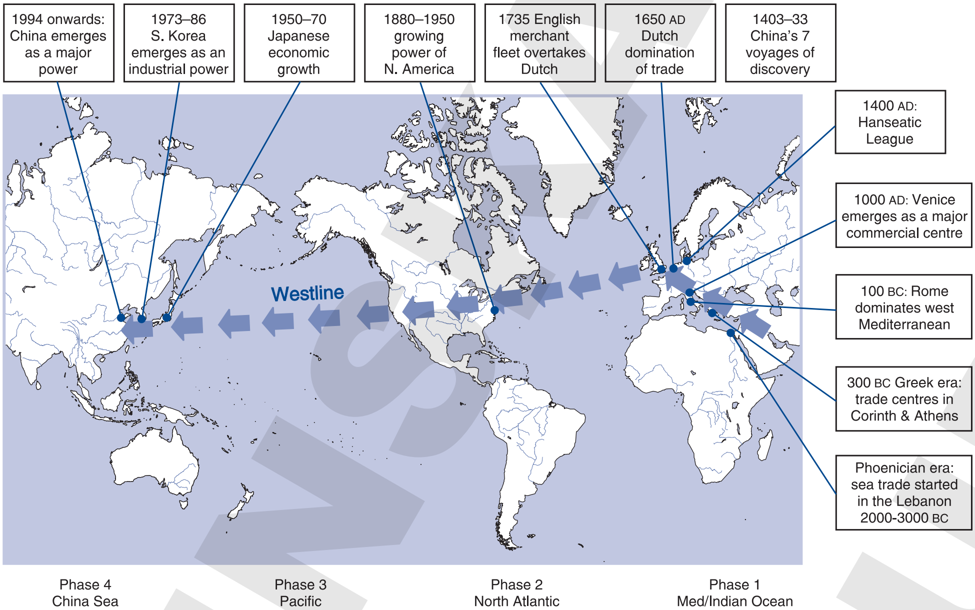


Figure 1.1
The Westline: 5,000 years of maritime trading centres
Source: Stopford (1988)

trade between the Mediterranean and the emerging north-western European centres of Cologne, Bruges, Antwerp and Amsterdam. Meanwhile the Hanseatic towns were opening up trading links with the Baltic and Russia. The two streams merged in Amsterdam in the seventeenth century and London in the eighteenth. By the nineteenth century steamships carried the Westline across the Atlantic, and North America became a leading centre of sea trade. Finally, in the twentieth century commerce took another giant step west across the Pacific as Japan, South Korea, China and India picked up the baton of growth.

This evolution of maritime trade was led successively by Babylon, Tyre, Corinth, Rhodes, Athens, Rome, Venice, Antwerp, Amsterdam, London, New York, Tokyo, Hong Kong, Singapore and Shanghai. At each step along the Westline there was an economic struggle between adjacent shipping super-centres as the old centre gave way to the new challenger, leaving a trail like the wake of a ship that has circumnavigated the world. The maritime tradition, political alignments, ports, and even the economic wealth of the different regions are the product of centuries of this economic evolution in which merchant shipping has played a major part.

In this chapter we will try to understand why Europe triggered the expansion rather than China, India or Japan, which were also major civilizations during this period. Fernand Braudel, the French trade historian, distinguished *the* world economy from *a* world economy which 'only concerns a fragment of the world, an economically autonomous section of the planet able to provide for most of its own needs, a section to which its internal links and exchanges give a certain organic unity'.[9] From this perspective shipping's achievement, along with the airlines and telecommunications, was to link Braudel's fragmented worlds into the single global economy we have today.

The discussion in the remainder of this chapter is divided into four sections. The first era, stretching from 3000 BC to AD 1450, is concerned with the early history of shipping, and the development of trade in the Mediterranean and north-western Europe. This takes us up to the middle of the fifteenth century when Europe remained completely isolated from the rest of the world, except for the trickle of trade along the Silk and Spice routes to the east. In the second period we start with the voyages of discovery and see how the shipping industry developed after the new trading routes between the Atlantic, the Pacific and the Indian Ocean were discovered. Global trade was pioneered first by Portugal, then the Netherlands and finally England. Meanwhile North America was growing into a substantial economy, turning the North Atlantic into a superhighway between the industrial centres of East Coast North America and north-western Europe. The third era, from 1800 to 1950, is dominated by steamships and global communications which together transformed the transport system serving the North Atlantic economies and their colonies. A highly flexible transport system based on liners and tramps was introduced and productivity increased enormously. Finally, during the second half of the twentieth century liners and tramps were replaced by new transport systems making use of mechanization technology – containerization, bulk and specialized shipping.

1.2 THE ORIGINS OF SEA TRADE, 3000 BC TO AD 1450

The beginning – the Arabian Gulf

The first sea trade network we know of was developed 5,000 years ago between Mesopotamia (the land between the Tigris and Euphrates rivers), Bahrain and the Indus River in western India (Figure 1.2). The Mesopotamians exchanged their oil and dates for copper and possibly ivory from the Indus.[10] Each river system probably had a population of about three quarters of a million, more than ten times as great as the population density in northern Europe at that time.[11] These communities were linked by land, but sheltered coastal sea routes provided an easy environment for maritime trade to develop. Bahrain, a barren

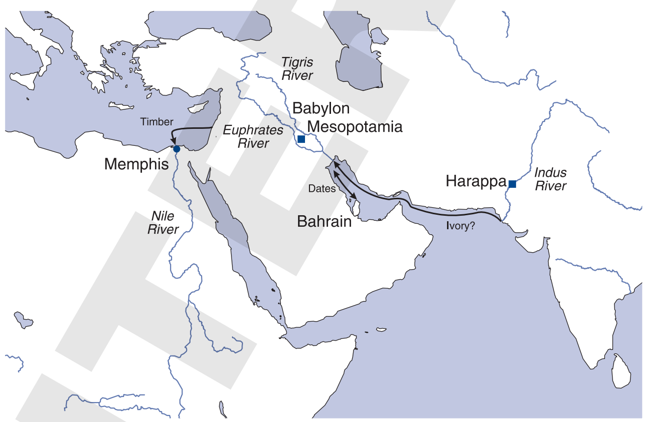


Figure 1.2
Early sea trade, 2000 BC

island in the Arabian Gulf, played a part in this trade, but it was Babylon which grew into the first 'super-city', reaching a peak in the eighteenth century BC under Hammurabi, the sixth Amorite king. By this time the Mesopotamians had a well-developed maritime code which formed part of the 3600-line cuneiform inscription, the legal Code of Hammurabi, discovered on a diorite column at Susa, the modern Dizful in Iran.[12] The Code required ships to be hired at a fixed tariff, depending on the cargo capacity of the vessel. Shipbuilding prices were related *pro rata* to size and the builder provided a one-year guarantee of seaworthiness. Freight was to be paid in advance and the travelling agent had to account for all sums spent. All of this sounds very familiar to modern shipowners, though there was obviously not much room for market 'booms' under this command regime of maritime law! About this time seagoing ships were starting to appear in the eastern Mediterranean where the Egyptians were active traders with the Lebanon.

Opening Mediterranean trade

Tyre in the Lebanon, located at the crossroads between the East and the West, was the next maritime 'super-city'. Although founded in 2700 BC, Tyre did not become a significant sea power until after the decline of Egypt 1700 years later.[13] Like the Greeks and Norwegians who followed in their steps, the poor, arid hinterland of this island encouraged its inhabitants to become seafarers.[14] Their trading world stretched from Memphis in Egypt through to Babylon on the Euphrates, about 55 miles south of Baghdad. Tyre, which lay at the crossroads of this axis, grew rich and powerful from maritime trade. The Phoenicians were shipbuilders and cross-traders (carriers of other people's merchandise) with a trade portfolio that included agricultural produce, metals and manufactures. By the tenth century BC they controlled the Mediterranean trade routes (Figure 1.3), using ships built from cedar planks, usually with a crew of four. Agricultural trades included honey from Crete, wool from Anatolia, plus timber, wine and oil. These were traded for manufactures such as Egyptian linen, gold and ivory, Anatolian wool, Cypriot copper and Arabian resins.[15]

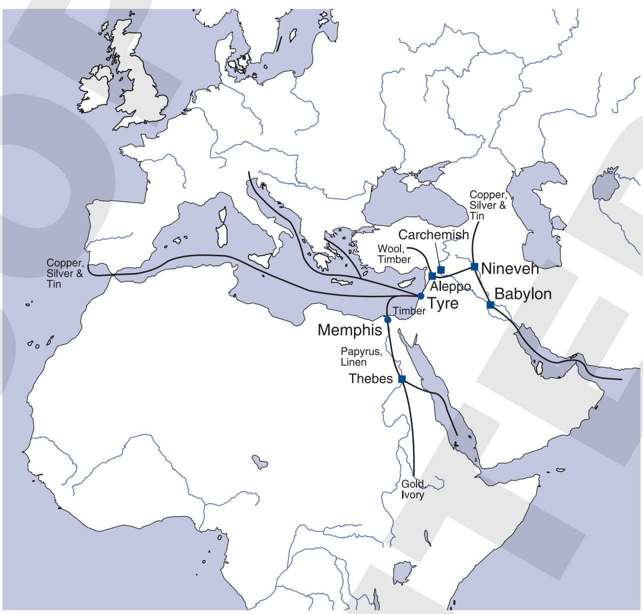


Figure 1.3
Phoenician trade, 1000 BC

This traffic grew steadily in the first millennium BC, and as local resources were depleted they travelled further for trading goods. After the discovery of Spain and the settlement of Sades (Cadiz) around 1000 BC, the Iberian peninsula became a major source of metal for the economies of the eastern Mediterranean, consolidating Tyre's commercial domination in the Orient. On land, the domestication of camels made it possible to establish trade routes between the Mediterranean and the Arabian Gulf and Red Sea, linking with the sea trade between the Ganges and the Persian Gulf. In about 500 BC King Darius of Persia, keen to encourage trade, ordered the first Suez Canal to be dug so that his ships could sail direct from the Nile to Persia. Finally, the city of Tyre was captured by Alexander the Great after a long siege and the Phoenician mastery of the Mediterranean came to an end.

The rise of Greek shipping

By 375 BC the Mediterranean was much busier and was ringed by major towns: Carthage in North Africa, Syracuse in Sicily, Corinth and Athens in Greece, and Memphis in Egypt (Figure 1.4). As the Phoenician merchants declined, the more centrally placed Greeks with their market economy took their place as the leading maritime traders. As Athens expanded, the city imported grain to feed its population, one of the earliest bulk trades.[16] Two hundred years later the eastern Mediterranean had become an active trading area dominated by the four principal towns of Athens, Rhodes, Antioch and Alexandria. The latter two grew particularly strong, thanks to their trading links to the East through the Red Sea and the Arabian Gulf.

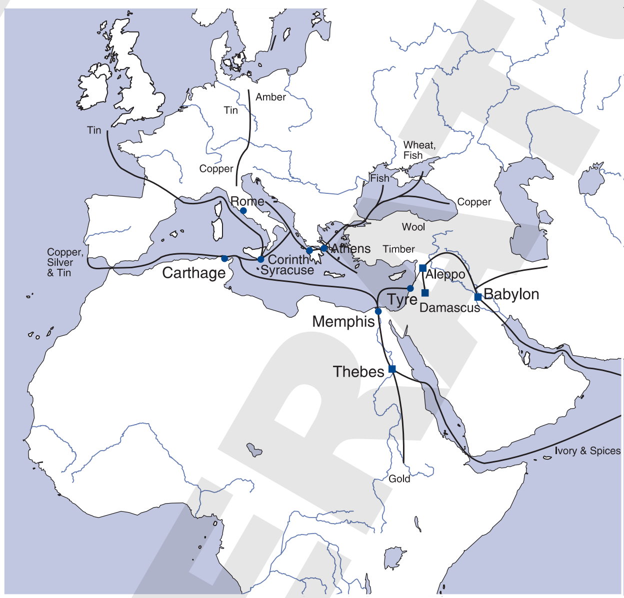


Figure 1.4
Mediterranean trade, 300 BC

The Greeks traded their wine, oil and manufactures (mostly pottery) for Carthaginian and Etruscan metals and the traditional products of Egypt and the East. Initially Corinth was the leading town, benefiting from its position on the Isthmus, but subsequently Athens became more prominent thanks to the discovery of silver in nearby Laurion (*c*.550 BC). This paid for the navy which triumphed at Salamis, liberating the Ionians and guaranteeing safe passage to grain ships from the Black Sea on which the enlarged city came to depend.[17] Grain and fish were shipped in from the Black Sea where, by 500 BC, Greece had founded more than 100 colonies. Carthage held most of the western Mediterranean, including the coast of North Africa, southern Spain, Corsica and western Sicily. However, this was not a developed area with less trade than the eastern Mediterranean.

Mediterranean trade during the Roman Empire

As Greece declined and Rome grew in economic and political importance, the centre of trade moved to Italy, and the Roman Empire built up a widespread trade network. Rome imported minerals from Spain, and more than 30 million bushels of grain a year from the grain lands of northern Africa, Sicily and Egypt.[18] To carry this trade a fleet of special grain ships was built. Manufactures were traded from the eastern Mediterranean and over the next 200 years the Roman Empire controlled the coasts of the Mediterranean and Black Sea, as well as southern Britain. Under the *Pax Romana*, Mediterranean trade expanded, though there were more towns and trade routes in the East than the West. The towns of the East imported minerals from the 'developing' countries of Spain and Britain, corn from North Africa, Egypt and the Black Sea, and manufactures from the still thriving commercial centres of the Lebanon and Egypt, where the eastern trade routes entered the Mediterranean. An insight into the mature commercial system employed is provided by the bill of lading from AD 236 for a cargo of seed carried up the Nile by a Roman boat (Box 1.1).

The Byzantine Empire

Towards the end of the fourth century AD the 'Westline' took a step backwards. In about AD 390 the failing Roman Empire, under attack from all sides, was split for administrative purposes into the Western Roman Empire and the Eastern Roman Empire. In modern-day jargon the Eastern Roman Empire contained the economically 'developed' world, while the Western Roman Empire, consisted mainly of 'underdeveloped' territories. The Eastern Roman Empire, with its new capital of Constantinople, grew into the Byzantine Empire, but by AD 490 the Western Roman Empire had fragmented into kingdoms controlled by the Vandals, Visigoths, Slavs, Franks, Saxons and others. Ships could no longer trade safely in the western Mediterranean, and sea trade in the West declined as Europe entered the Dark Ages. For three centuries its economy stagnated.[19]

Over the next 200 years the more stable Eastern Roman Empire, with its capital in Constantinople on the Black Sea, controlled an empire stretching from Sicily in the West to Greece and Turkey in the East. In about AD 650 its administration was overhauled, and because of growing Greek influence on its language and character it is subsequently referred to as the Byzantine Empire.[20] Gradually, by AD 700 the Arab Caliphate controlled the southern and eastern shores of the Mediterranean, and since their trade was principally by land, passage through the Mediterranean became safer. Mediterranean trade was re-established. Sea trade centred on Constantinople, which imported corn from the Black Sea and Sicily as well as commodities such as copper and timber, with shipping routes to Rome and Venice and the Black Sea, whilst the Eastern trade by land followed the Silk and Spice routes, both through Baghdad – a clear demonstration of how much shipping and trade depend on political stability.

Venice and the Hanseatic League, AD 1000–1400

By AD 1000 the economy of North Europe had begun to grow again, based particularly on the expansion of the wool industry in England and the textile industry in Flanders. As towns grew and prospered in NW Europe, trade with the Baltic and the Mediterranean grew rapidly, leading to the emergence of two important maritime centres, Venice and Genoa in the Mediterranean and the Hanseatic League in the Baltic.

Cargoes from the East arrived in the Mediterranean by the three routes marked on Figure 1.5. The southern route (S) was via the Red Sea and Cairo; the middle route (M) through the Arabian Gulf, Baghdad and Aleppo; whilst the northern route (N) was through the Black Sea and Constantinople. The cargoes were then shipped to Venice or Genoa, carried over the Alps and barged down the Rhine to northern Europe. The commodities shipped west included silk, spices and high-quality textiles from northern Italy which had become a prosperous processing centre. The trade in the other direction included wool, metals and timber products.

Figure 1.5
North-west Europe opens up, 1480

In the Mediterranean, Venice emerged as the major maritime entrepôt and super-city, with Genoa as its main rival. Venice was helped initially by its political independence, its island sites and the commercial links with the Byzantine Empire which was by then in economic decline, with little interest in sea trade. State legislation, which enforced low interest rates for agricultural reasons, discouraged the Byzantine merchants from entering the business and the Byzantine seafarers could not compete with the low-cost Venetians, even on internal routes. So gradually the Venetian network replaced the native Byzantine one.[21] By accepting Byzantine suzerainty

Venice was able to control the East–West trade. In return for their shipping services they procured preferential tax rates, and in 1081 they won the right to trade anywhere within the Byzantine Empire, without restriction or taxation of any kind. This was an early example of outsourcing sea transport to an independent flag. We will come across many other examples, especially in the twentieth century.

But by the beginning of the thirteenth century the epicentre of maritime trade started to move west. The weakened Byzantine Empire had lost control of Anatolia to the Seljuk Turks, and by 1200 Venice's privileged position with the Byzantine Empire was fading. But this was its peak as a maritime power[22] and as the economy of NW Europe grew, Venice and Genoa's commercial position gradually declined. The sacking of Constantinople by the Ottoman's in 1453 blocked the busy northern trade routes through the Black Sea, increasing the risks and diminishing the returns of the East–West trade. Meanwhile Bruges in Belgium was emerging as Venice's successor. It had an excellent position on the River Zwin estuary, and its monopoly in the English wool trade was strengthened when the direct sea route with the Mediterranean was opened. After the first Genoese ships put in at Bruges in 1227, trade gradually bypassed Venice and the arrival of sailors, ships and merchants from the Mediterranean brought an influx of goods and capital along with commercial and financial expertise. Bruges became the new maritime entrepôt, with a huge trading network covering the Mediterranean, Portugal, France, England, Rhineland and the Hansa ports. Its population grew rapidly from 35,000 inhabitants in 1340 to 100,000 in 1500.[23]

The other strand was NW Europe's need for raw materials to support its economic growth. Russia and the Baltic states were the primary source, exporting fish, wool, timber, corn and tallow, which was replacing vegetable oil in lamps. As this trade grew, Hamburg and Lübeck, which were at the crossroads between the NW Atlantic and the Baltic, grew prosperous and organized themselves into the Hanseatic League.

1.3 THE GLOBAL ECONOMY IN THE FIFTEENTH CENTURY

By the fifteenth century there were four developed areas of the world: China, with a population of 120 million; Japan, with 15 million; India, with a population of 110 million; and Europe, with a population of about 75 million. But the only links between them were the tenuous silk and spice routes through Constantinople and Tabriz to China, and the spice route through Cairo and the Red Sea from India.

In terms of wealth and economic development, the Chinese Empire had no rival, with a bureaucracy of indestructible traditions and a history going back 3,000 years.[24] China's seagoing expertise was also in some areas significantly ahead of Europe's. In 1403 the Ming Emperor Zhu Di ordered the construction of an imperial fleet, under the command of Admiral Zheng He. This fleet undertook seven voyages between 1405 and 1433, with over 300 ships and 27,000 men (the need to supply the ships so quickly which must have triggered quite a shipbuilding boom). Contemporary Ming texts suggest that the treasure ships were over 400 feet long with a beam of 150 feet, four times the size of European ocean-going ships, which were typically

100 feet long with 300 tons capacity, but there are doubts about whether such large wooden hulls could have been built.[25] However, the Chinese vessels were certainly technically advanced, with multiple masts, a technique only just developed by the Portuguese, and up to 13 watertight compartments. In sail technology, the Europeans still relied on square sail rigs on their ocean vessels, whilst the Chinese had been using fore-and-aft lugsails in ocean-going ships since the ninth century, giving them a great advantage when sailing upwind. During the seven voyages the great fleet visited Malaysia, the Indian subcontinent, the Arabian Gulf, and Mogadishu in East Africa, travelling about 35,000 miles. There is also some evidence that on one of the voyages the fleet sailed into the South Atlantic and mapped the Cape of Good Hope.[26]

Although by the fifteenth century Chinese mariners were ahead of Europe in some areas of ocean-going ship technology and had the ships and navigational skills to explore and trade with the world, they chose not to do so. In 1433 the expeditions were halted, the ships destroyed and laws passed banning further construction of ocean-going ships, leaving the way open for European seafarers to develop the global sea transport system we have today. What followed was a major shift in global trade as the nations of NW Europe, whose route to the East was now blocked by the Ottoman Empire, discovered the sea route round the Cape and used their naval superiority to create and control global trade routes.

1.4 OPENING UP GLOBAL TRADE AND COMMERCE, 1450–1833

Europe discovers the sea route to Asia

In just a few years in the late fifteenth century, Europe laid the foundation for a global sea trade network which would dominate shipping for the next 500 years. It is hard to imagine the impact which the voyages of discovery (Figure 1.6) must have had, penetrating the Atlantic Ocean and turning sea trade into a global business.[27] The goal was economic: to find a sea route to Asia, the source of the precious spices and silk traded along the spice and silk routes from the east. Marco Polo's 'Description of the World' published in 1298 had publicized the East as an economically attractive destination. He reported that the 'spice islands' consisted of

> 7,488 islands, most of them inhabited. And I assure you that in all these islands there is no tree that does not give off a powerful and agreeable fragrance and serves some useful purpose. There are, in addition, many precious spices of various sorts. The islands produce pepper as white as snow and in great abundance, besides black pepper. Marvellous indeed is the value of the gold and other rarities found in these islands.[28]

No wonder the fabulous 'Spice Islands' gripped the imagination of the European kings and adventurers.

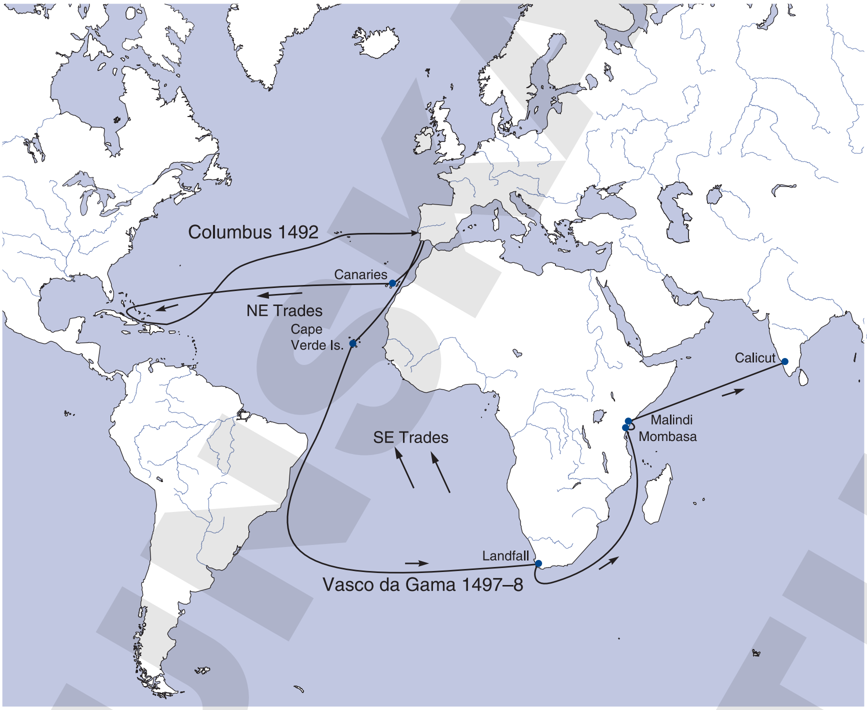


Figure 1.6
The European voyages of discovery 1492–98

The problem was getting there. The overland trade was increasingly difficult, and a map drawn by Ptolemy in the second century AD showed the Indian Ocean as being landlocked. However, information gleaned from Moorish traders who had crossed the Sahara hinted that this might not be the case. It was difficult to find out because the South Atlantic was a challenging barrier for sailing ships. Currents and winds opposed ships sailing south,[29] and there were few landfalls on the African coast between Guinea and the Cape. But by the fifteenth century the European explorers had some technical advantages, including the compass, and the astrolabe had been developed in 1480.[30] This navigational instrument allowed sailors to calculate their latitude by measuring the angle between the horizon and the Sun or the pole star, and looking up the latitude for that angle in sea tables. With it explorers could accumulate knowledge about the position of land masses they visited and gradually they built up the knowledge about the Atlantic they needed to make the journey to the east.

The Portuguese expeditions

At first progress was slow. In the early 1400s Henry 'the Navigator', King of Portugal, a small barren land with a lengthy coastline on the southern tip of Atlantic Europe, became obsessed with finding a way around Africa.[31] His first success came in 1419 when an expedition was blown off course and discovered Madeira. Discovery of the Azores, the Canaries and the Cape Verde Islands soon followed,[32] providing the fifteenth-century explorers with a base for their voyages into the Atlantic. Another big step was taken in 1487 when the Portuguese explorer Bartholomew Diaz successfully sailed down the coast of Africa and rounded the Cape of Good Hope. However, the storms were so severe (he christened it the 'Cape of Storms', but the King of Portugal renamed it the 'Cape of Good Hope') that after making landfall just beyond the Cape his exhausted crew persuaded him to turn back, which they did, mapping the African coast as they went.

The economics of discovery

Meanwhile Christopher Columbus, a Geonese trader, seafarer and mapmaker, was planning an expedition to reach the Spice Islands by a different route. From ancient writings,[33] his own travels in the North Atlantic and intelligence from the seafaring community – including reports that trees and canes were washed up in Madeira by westerly gales[34] – he concluded that Asia could be reached by sailing west. Using the tables in *Imago Mundi*[35] he calculated that Cipangu, one of the wealthy Spice Islands described by Marco Polo, lay 2400 miles across the Atlantic.[36]

Raising funds for such a speculative scheme proved difficult. In 1480 he appealed to the Portuguese crown but the *junto* appointed to look into his scheme rejected it. However, they secretly instructed a vessel to test the theory by sailing west from Cape Verde. It was not a success and after a few days the mariners, terrified by the rough weather and the vastness of the ocean, turned back. When he heard of this duplicity Columbus left Portugal[37] and, after trying Venice, in 1485 he arrived in Spain penniless and got an audience with Ferdinand and Isabella.

After six years of procrastination Columbus's project was again rejected by the Spanish crown's advisory committee in January 1492. Then an influential courtier named Luis de Santangel took up his case. Spain had just occupied Granada, and the young nobles who had fought were expecting to be rewarded with land. Since there was not enough land in Spain, Santangel's idea was to look west as Columbus suggested. The agreement signed on 17 April 1492 appointed Columbus admiral, viceroy, governor and judge of all islands and mainlands he discovered and awarded him 10% of any treasure and spices he obtained. A royal decree was issued requiring Andalusian shipowners to provide three vessels ready for sea, and two shipping families, the Pinzons and the Ninos, finally invested in the modest expedition. Two caravels and a larger vessel set sail for the Canaries where they spent six weeks fitting out, finally setting sail for the great island of Cipangu on 6 September 1492. The NE Trades carried them across the Atlantic and at 2 a.m. on 12 October they sighted land (Figure 1.6). In reality the landfall was Watling Island (now San Salvador) in the Bahamas, but it was 20 years before anyone knew for sure that it was not the Indies.[38] Anyway there were no spices or fabulous cities, so from a trade perspective it was a false start.

The Portuguese trade network

Columbus's discovery shocked the Portuguese who had been trying to reach Asia for nearly a century, as the Spanish appeared to have found it at their first attempt. They redoubled their efforts and on 3 August 1497 Vasco da Gama set off from Lisbon with a fleet of four ships, 170 men, three months' supplies, the maps of Africa prepared by Diaz and a new navigational strategy. After calling at Cape Verde, instead of coast-hopping as Diaz had done and beating against the SE Trades, he swung south-west into the Atlantic for 10 weeks, sailing until he reached the latitude of the Cape of Good Hope, and then turned east (see Figure 1.6). It worked brilliantly, and three months after setting sail he made landfall 1° north of the Cape! A great victory for the astrolabe. Rounding the Cape, he landed at Mombasa where he was not well received, so he sailed up the coast to Malindi where he got a better reception and found a pilot. Twenty-seven days later, in May 1497, he arrived at Calicut in India, 9 months after leaving Lisbon.

Although the voyage was a success, the trade was not. After a lavish welcome by the Zamorin of Calicut, things went downhill fast. Diaz's modest gifts were ridiculed by the wealthy Calicut merchants, who had no intention of sharing their business with impoverished adventurers. Da Gama scraped together a cargo by selling his trade goods at a fraction of their cost in Portugal and bought cloves, cinnamon and a few handfuls of precious stones.[39] Discouraged, they careened their ships in Goa and headed back. The return voyage took a year and they limped back to Portugal in August 1499 with only 54 of the 170 who had set out with the expedition. But the welcome was tumultuous. The trade route was established and although the cargo was sparse, da Gama brought an invaluable piece of commercial information. The hundredweight of pepper sold in Venice for 80 ducats could be purchased in Calicut for 3 ducats! All that was needed was to eliminate the Muslim grip on the trade and build a new commercial empire.

The Portuguese set about doing this. Six months later an expedition of 13 ships and 1300 men was despatched under Pedro Alvares Cabral to set up a depot, so that spices could be purchased and stored, ready to load when ships arrived. This time they reached Calicut in just 6 months and their lavish gifts impressed the Zamorin, who signed a trade treaty. However, after only two ships had been loaded the resentful Moslem traders rioted and stormed the depot, killing most of the staff. Cabral retaliated by bombarding Calicut, setting fire to part of the city, then moved on to Cochin where he set up a new trading post and depot, with a garrison, before returning to Portugal. Although he had lost half his ships and men, the voyage was tremendously profitable and the basis of the Portuguese trading empire had been laid. Over the next decade the Portuguese established strongholds on the East African coast and in 1510 seized the town of Goa which grew into a thriving community of 450 settlers. A year later they took Malacca, now in Malaysia, a vital spice emporium, and Hormuz on the doorstep of the Persian Gulf. The trickle of trade between East and West turned into a torrent, as cargo ships, each carrying a few hundred tons of cargo, plied the new trade route around the Cape of Good Hope.

New directions in European trade

In less than a decade Europe had established sea routes to every part of the globe and set about turning these discoveries to its advantage. Most trade in medieval Europe was in local goods, and trading opportunities were limited by the rather similar climate and technology of these countries. The voyages of discovery opened new markets for European manufactured goods and new sources of raw materials such as wool, dyestuffs, sugar, cotton, tea, coffee and of course the much sought-after spices. Over the next century the European explorers, with their improving navigational techniques and superior weapons, set about developing these trades.[40] The Cape route to the Spice Islands had an immediate commercial impact, but the Americas, which were more easily reached from Europe by exploiting the Trade winds, added a completely new dimension to the trade revolution that was taking place. These were sparsely populated territories, rich in raw materials, and provided an endless source of trade goods, a market for European manufactures, and near-perfect conditions for economic development. Over the next 200 years the trading triangle shown in Figure 1.7 developed in the North Atlantic. Manufactures were shipped from Europe to West Africa and slaves to the West Indies, the ships returning with sugar, rum, tobacco and cotton.

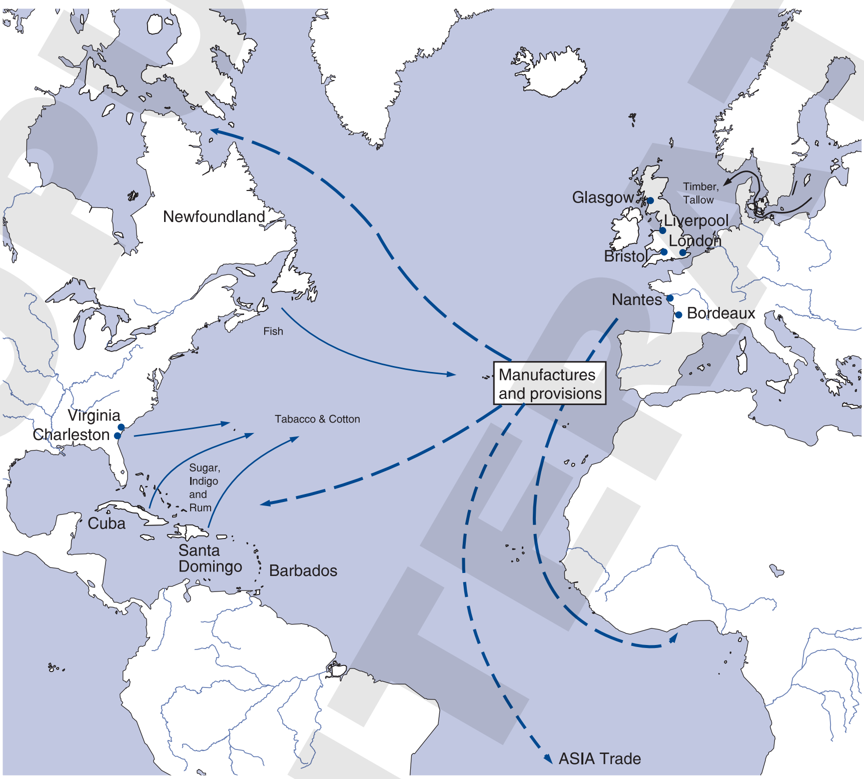


Figure 1.7
Sea trade in the eighteenth century

Trading in this enlarged world economy made NW Europe rich, and the new wealth soon produced a flourishing financial system with joint stock companies, bourses (stock exchanges), central banks and insurance markets. It also transformed the shipping business. Transport was still expensive (coal in London cost five times as much as it did at the pit head in Newcastle), and shipping was mainly an archaic business 'where the men who built the boats themselves loaded goods on board and put to sea with them, thus handling all the tasks and functions occasioned by maritime trade'.[41] Much more was needed to develop the new world economy. Deep-sea trade needed bigger ships, capital to finance the long voyages, and specialization.

The rise of Antwerp

Although Portugal developed the important eastern trade, and Spain the Americas, the next maritime capital was not Lisbon or Seville, but Antwerp on the River Scheldt. Situated at the heart of the new overseas trading network and benefiting from an inland trade network built up during the Hapsburg occupation of the Low Countries, it became the most important market place for the rapidly developing global trade. In the late fifteenth century Antwerp had started to take over the distribution of Venetian cargoes from Bruges, whose harbour was silting up, and in 1501 the first Portuguese ship laden with Indian pepper, nutmeg, cinnamon and cloves berthed in Antwerp. It was a logical step for the Portuguese who were carrying the huge cost of sending ships to the Indies, and preferred to leave the wholesale distribution to the established Antwerp merchants who already handled the Venetian trade. Other trades followed. English merchants traded English cloth and wool; the southern German bankers (Fuggers, Welsers) traded cloth, spices and metals with Germany and Italy, while Spanish merchants from Cadiz brought cargoes of wool, wine and silver, with backhaul cargoes of cloth, iron, coal and glass. By 1520 Antwerp had become the market place for trade with the Mediterranean and the East.[42]

Antwerp also grew into a financial centre. The money market which it created between 1521 and 1535 played a major part in financing the Spanish development of the Americas. Merchants became expert at such capitalist techniques as double-entry bookkeeping, joint-stock companies, bills of exchange, and stock markets.[43] The efficiency of this new society was apparent in its most essential aspect – shipping. In 1567 Luigi Guicciardini counted 500 vessels moored before the roadstead in Antwerp and was impressed by the mighty crane on the wharf.[44]

However, Antwerp's dominant position as the leading maritime centre was short-lived. In 1585 the city was sacked by Spanish troops and the Scheldt was blocked by the Dutch. Many of the merchants fled to Amsterdam, which rapidly took over as the maritime capital.

Amsterdam and the Dutch trade

Amsterdam's advantage was both geographical and economic. Its location as a maritime centre was excellent, with the Zuider Zee providing superb protected access for big ships, though it was difficult to navigate. It also had the support of the whole Dutch seaboard open to maritime trade, and between 1585 and 1620 took over from Genoa in the South and Antwerp in the North as the centre of a network of sea trade stretching from the Baltic to India. By 1701 a French guide reported 8,000 ships in Amsterdam harbour 'whose masts and rigging were so dense that it seems the sun could hardly penetrate it',[45] and the Amsterdam Gazette reported dozens of boats leaving and arriving every day. The Dutch fleet was estimated in 1669 to consist of 6,000 ships, of roughly 600,000 tons, the equivalent of all the other European fleets put together.[46]

However, the commercial advantages of the Dutch entrepreneurs should not be overlooked. As the Dutch became the entrepreneurs, merchants, bankers and 'cross-traders' of the newly emerging global trade there was much talk of the 'Dutch miracle'. This small, bare country had a population of about 1 million in 1500, half living in towns, far more than elsewhere in Europe, and they were 'so given to seafaring that one might think water rather than land their element'.[47] Dutch shipping's success owed much to their low costs, at least a third less than anyone else. To carry the growing bulk trade the Dutch developed an ocean-going merchantman, the *fluyt* or 'flyboat'. These vessels had 20% more cargo capacity and needed only seven or eight crew on a 200-ton vessel, compared with 10 or 12 on an equivalent French boat. The Dutch also had a very competitive shipbuilding industry[48] and a thriving sale and purchase market for second-hand ships.[49] With the cheap freight rates provided by the flyboat, the Dutch expanded in the bulk trades in corn, timber, salt and sugar. One great success was the Baltic grain trade, which increased rapidly as the growing population of NW Europe created a demand for imports.

By 1560 the Dutch had three-quarters of the Baltic bulk trade,[50] trading grain, forest products, pitch, and tar. Amsterdam became 'the corn bin of Europe'. Next they opened trade with the Iberian peninsula, trading wheat, rye and naval stores for salt, oil, wine and silver. Amsterdam's position as a financial centre developed with the opening of the Bourse (stock exchange), and with their lower costs they were able to squeeze out the northern Italian merchants, whose strategic position was already weakened.[51] Venetian ships had stopped sailing to the Netherlands, and 50 years later the Mediterranean to North Europe trade was being serviced by English and Dutch vessels, with half the Venetian fleet being built in Dutch shipyards.

However their greatest success was in the East where, after a slow start, they established a dominant position. Initially the Dutch merchants made little headway against Portuguese, English and Asian merchants. They needed large ships for the long voyages, fortified trading posts and military strength to deal with local opposition from natives and other traders. Individuals could not capitalize ventures on this scale, and their solution was to set up a company to provide capital and manage the trade. The Dutch East India Company was founded in 1602 with capital of 6,500,000 florins raised from the public. Its charter permitted it to trade 'westward into the Pacific from the Straits of Magellan to the Cape of Good Hope' with total administrative and judicial authority.[52] This strategy was very successful and the company rapidly grew in influence, obtaining a monopoly in the trade with Malaysia, Japan and China.

By 1750 Amsterdam's position as an entrepôt was waning as more trade went direct and the industrial revolution moved the hub of maritime trade to Britain. The steam engine made it possible to use coal to power machinery and as machines replaced people in manufacturing, the output of goods increased. The most immediate application was in that staple of international trade, textiles. Over the next 50 years, British manufacturers automated all the most skilled and time-consuming aspects of textile manufacture, radically reducing the cost of cotton cloth. After Hargreaves invented the 'spinning jenny', a machine for manufacturing cotton thread, the price of cotton yarn fell from 38 shillings per pound in 1786 to under 10 shillings per pound in 1800. Arkwright's water frame (1769), Crompton's 'mule' (1779) and Cartwright's power loom extended the automation to cloth manufacture. By 1815 exports of cotton textiles from Britain accounted for 40% of the value of British domestic exports.[53] New raw materials were introduced. The two most important were coal, which freed iron makers from the dependence on forests for charcoal, and cotton, which opened up a new market for clothing.

Sea trade in the eighteenth century

Sea trade, dominated by textiles, woollen cloth, timber, wine and groceries, grew rapidly and British foreign trade (net imports and domestic exports) grew from £10 million in 1700 to £60 million in 1800.[54] As the century progressed the character of imports changed. Semi-tropical foodstuffs and raw materials from the Americas appeared and after 1660 London, with its growing exports of manufactures and range of financial and shipping services, gradually moved into a leading position.[55] The long-haul Asian trade was still controlled by the English and Dutch East India Company monopolies, but the Atlantic trade was served by small traders operating in the Baltic, the Mediterranean, the West Indies, East Coast North America, and sometimes West Africa and Brazil. An idea of the size of these trades and the number of ships in them is given by the statistics of ships entering and cleared for foreign trade in Great Britain in 1792 (Table 1.1).

The trade with the Baltic, Germany, Poland, Russia and Scandinavia was one of the biggest. In 1792, 2700 ships entered Britain carrying shipbuilding materials, hemp, tallow, iron, potash and grain. Much of this trade was carried in Danish and Swedish vessels. If the ships performed three voyages a year, which seems likely given that little winter trade was possible in these northerly waters, a thousand ships would have been needed to service this trade. An equally important trade for merchants was the West Indies. Colonial produce, including sugar, rum, molasses, coffee, cocoa, cotton and dyes, was shipped home, whilst some vessels performed a triangular voyage, sailing to the Guinea Coast to pick up slaves for transport to the West Indies. In 1792 between 700 and 900 ships were employed in the trade.[56] London, Liverpool and Bristol were the chief ports in the West Indies trade. Trade with the United States employed about 250 British vessels, with an average size of around 200 tons, carrying outward cargoes of British manufacturers and re-exports of Indian and foreign products and returning with tobacco, rice, cotton, corn, timber and naval stores. There was also an active trade with British North America and Newfoundland to supply the needs of the fishermen in Hudson's Bay.

Table 1.1 British ships entered and cleared in foreign trade, 1792

	Number of ships				
	Entered	Cleared	Total	%	Average Tonnage
Baltic trades[a]	2,746	1,367	4,113	27%	186
Holland and Flanders	1,603	1,734	3,337	22%	117
France	1,413	1,317	2,730	18%	126
Spain, Portugal	975	615	1,590	10%	126
Mediterranean	176	263	439	3%	184
Africa	77	250	327	2%	202
Asia	28	36	64	0%	707
British North America	219	383	602	4%	147
USA	202	223	425	3%	221
West Indies	705	603	1,308	9%	233
Whale Fisheries	160	135	295	2%	270
Total	8,304	6,926	15,230		2,519

[a] Russia, Scandinavia, Baltic, Germany

Source: Fayle (1933, p. 223)

Shorter-haul trades with Spain, Portugal, Madeira and the Canaries provided employment for around 500 or 600 small vessels carrying wine, oil, fruit, cork, salts, and fine wool from Spain. There was also a long-distance trade to Greenland and the South Sea whale fisheries. Whaling was an extremely profitable industry with about 150 ships sailing annually for the whaling grounds from English and Scottish ports. Finally, there was the coasting trade. A fleet of small vessels of about 200 tons plied the east coast between the Scottish ports and Newcastle, Hull, Yarmouth and London carrying coal, stone, slate, clay, beer and grain. These were the ships that Adam Smith used to illustrate the efficiency of sea transport in *The Wealth of Nations*. Coal was by far the most important cargo, by the late eighteenth century employing around 500 vessels, of around 200 tons, making eight or nine round voyages a year.

Finally, there was the passenger trade. In addition to cargo, many of the merchant ships in the Atlantic carried a few passengers for a price agreed with the master. Most passengers, however, travelled by the Post Office packets, fast-sailing vessels of about 200 tons which carried the mail weekly to Spain, Portugal and the West Indies and at longer intervals to Halifax, New York, Brazil, Surinam and the Mediterranean. In 1808 there were 39 Falmouth packets, carrying 2,000–3,000 passengers a year. As the fare from Falmouth to Gibraltar was 35 guineas (£36.75), the command of a packet was a profitable job.

The rise of the independent shipowner

In the late eighteenth century the Atlantic trade was still mainly controlled by merchants and private partnerships. A syndicate would build or charter a ship, provide it with a cargo, and take their profit from trade or by carrying freight for hire. A 'supercargo' generally travelled with the ship to handle the business affairs, though this was sometimes left to the master, if he was qualified. The supercargo bought and sold cargoes and could, for example, order the vessel to a second port of discharge, or to sail in ballast to a port where a cargo might be available. As trade increased, this speculative approach gradually gave way to a more structured system, with some companies specializing in the trade of specific areas like the Baltic or the West Indies and others in the ownership and operating of ships, so the roles of trader and shipowner gradually grew apart.

Some voyages undertaken by Captain Nathaniel Uring in the early eighteenth century illustrate how the trading system worked in practice.[57] In 1698 he loaded groceries in Ireland and sailed to Barbados where he sold them and purchased rum, sugar and molasses for the Newfoundland fishermen, from whom he intended to purchase a cargo of fish for Portugal. However, when he reached Newfoundland, the market was overstocked with colonial products and fish prices were so high that he sailed back to Virginia where he sold his cargo and bought tobacco. On another voyage in 1712, in the 300-ton *Hamilton*, he was instructed to load logwood at Campeachy, to be sold in the Mediterranean. He called first at Lisbon, where he sold 50 tons of logs and filled up with sugar for Leghorn (Livorno) in Italy. At Leghorn he consulted the English consul as to the respective advantages of Leghorn and Venice as markets for logwood, finally selling the cargo at Leghorn, where he entered into a charter party to carry 100 tuns of oil at Tunis for Genoa. When he arrived in Tunis the Bey compelled him to make a short coastal voyage to fetch timber from Tabarca, after which he loaded the oil and, seeing no bargains about, he filled the ship with 'other goods I could procure upon freight' for Genoa. In Genoa he contracted 'For the freight of a lading of wheat, which I was to carry first to Cadiz, and try the market there; and if that did not answer, to proceed to Lisbon'. But the winds were unfavourable for entering Cadiz, so he sailed direct to Lisbon. After delivering the wheat and 'finding the ship perfectly worn-out with age' he then sold it to Portuguese shipbreakers 'as I was empowered to do'. Quite a voyage!

Uring was both a trader and a carrier, but by the end of the century the distinction between the shipowning and trading interests was becoming clearer. The term 'shipowner' first appeared in the shipping registers in 1786,[58] and early nineteenth-century advertisements for the General Shipowner's Society laid special emphasis on the fact that their members' business was confined to running ships, with no outside interests.[59] This change was accompanied by a rise in the numbers of shipbrokers, marine underwriters and insurance brokers, whose business was involved with shipping. In 1734 *Lloyd's List* was published as a shipping newspaper, primarily for marine underwriters, and soon afterwards in 1766 Lloyd's Register of Shipping published shipping's first register of ships.[60]

Although the transport system was improving, the ships and the standards of navigation remained so inefficient that sea passage times were very long. For example, Samuel Kelly recorded that in the 1780s the voyage time from Liverpool to Philadelphia took between 43 and 63 days, whilst the return voyage from Philadelphia to Liverpool took between 29 and 47 days. Similarly, the trip from Liverpool to Marseilles was 37 days. His worst experience was a winter passage from Liverpool to New York, which took 119 days.[61] The ships were generally around 300–400 tons in size, though the East India

Company operated a fleet of 122 vessels averaging 870 tons. This unsatisfactory state of affairs was about to change.

1.5 LINER AND TRAMP SHIPPING, 1833–1950

Four innovations transform merchant shipping

In the nineteenth century shipping changed more than in the previous two millennia. A Venetian master sailing into London in 1800 would soon have felt at home. The ships were bigger, with better sails, and the navigation techniques had improved, but they were still wooden sailing ships. A century later he would have been in for a shock. The river would have been crammed with enormous steel ships, belching steam and sailing against wind and tide in response to instructions cabled across the world. In a few decades shipping was transformed from a loose system run by traders like Captain Uring to a tightly run industry specializing in the transport of cargo by sea.

This transformation was part of the industrial revolution taking place in Great Britain and Europe at this time. As manufacturing productivity increased, especially in textiles, output could not possibly be consumed locally and trade became a necessary part of the new industrial society. The engineering technology which transformed textile manufacturing also produced a new transport system to carry the manufactures to new markets and to bring in the raw materials and foodstuffs that the growing industrial population required. Many factors contributed to this change, but four were of particular importance: first, steam engines which freed ships from dependence on the wind; second, iron hulls which protected cargo and allowed much larger vessels to be built; third, screw propellers which made merchant ships more seaworthy, and fourth, the deep sea cable network which allowed traders and shipowners to communicate across the world.

As canals, railways and steamships merged into a global transport network, in the second half of the nineteenth century the shipping industry developed a completely new transport system which raised transport speed and efficiency to new heights. This new system had three parts: ‘passenger liners’ which transported mail and passengers on regular services between the economic ‘hubs’ of North America, Europe and the Far East; ‘cargo liners’ which transported cargo and some passengers on a widespread network of regular services between the developed and imperial markets; and the tramp shipping business which carried ‘spot’ cargoes on routes not served by liner services, or when cargo became available and they could offer cheaper freight.

Growth of sea trade in the nineteenth century

The scale of the change is illustrated by the speed of trade growth. Sea trade increased from 20 million tons in 1840 to 140 million tons in 1887, averaging 4.2% per year (Table 1.2). Ton miles also increased as the trades with the Baltic and the Mediterranean were

Table 1.2 Merchandise carried by sea, annual totals 1840 to 2005 (thousands of tons)

	1840	1887	1950	1960	1975 (1)	2005
Crude oil		2,700	182,000	456,000	1,367,000	1,885,000
Products		n.a.	n.a.	n.a.	253,700	671,000
Liquefied gas					21	179,000
Total oil		2,700	216,000	456,000	1,620,700	2,556,000
Iron ore				101,139	291,918	661,000
Coal	1,400	49,300		46,188	127,368	680,000
Grain	1,900	19,200		46,126	137,202	206,000
Bauxite and alumina				15,961	41,187	68,000
Phosphate				18,134	37,576	31,000
Total				227,548	635,251	1,646,000
Iron and steel	1,100	11,800			55,000	226,000
Timber	4,100	12,100			77,500	170,000
Sugar	700	4,400			17,291	48,000
Salt	800	1,300			8,700	24,000
Cotton	400	1,800			2,315	7,800
Wool	20	350			1,200	
Jute		600			450	382
Meat		700			3,200	26,640
Coffee	200	600			3,134	5,080
Wine	200	1,400			1,217	
Other	9,180	33,750	334,000	426,452	646,042	2,412,098
Total seaborne trade	20,000	137,300	550,000	1,110,000	3,072,000	7,122,000
% increase since previous period		4.2%	2.2%	7.3%	7.0%	2.8%

Source: Craig (1980, p. 18); UN *Statistical Yearbook* 1967 onwards; *Fearnleys Review* 1963 onwards; Maritime Transport Research (1977); CRSL, *Dry Bulk Trade Outlook*, Dec. 2007 and *Oil Trade & Transport*, Dec. 2007 edition. The statistics are not precisely comparable and only provide a rough idea of trade developments over this long period.

replaced by long-haul trades with North America, South America and Australia. For the first time industrial cargoes appeared on the market in very large quantities, the most important being the coal trade. For many years coal had been shipped from the north-east of England as a domestic fuel, but in the nineteenth century large quantities started to be used by industry and as bunkers for steamships. The tonnage of trade increased from 1.4 million tons in 1840 to 49.3 million tons in 1887. During the same period the trade in textile fibres, notably cotton, wool and jute also grew rapidly to supply the new textile industries of industrial Britain. After the repeal of the Corn Laws in 1847, the grain trade increased from 1.9 million tons in 1842 to 19.2 million tons in 1887. Initially the trade came from the Black Sea, but as railways opened up North and South America, the trades with the US East Coast, the Gulf and South America, especially River Plate, became equally important. Timber and the trades with the Baltic also grew and in 1887 we see the first petroleum cargoes, just 2.7 million tons, the beginning of a trade which in due course would reach over 2 billion tonnes.

In addition to cargo, as global trade developed so did passenger traffic and mail and there was tremendous commercial pressure to speed up these services. With a 60-day round-voyage time on the North Atlantic, doing business was difficult and there was a market for fast transit. The passenger trade was also swelled by emigrants from Europe to the USA and Australia. Numbers increased from 32,000 a year between 1825 and 1835 to 71,000 a year between 1836 and 1845, and 250,000 a year between 1845 and 1854, following the 1847 California gold rush. Although this pace was not continued, the trade remained brisk until the 1950s.

Steam replaces sail in the merchant fleet

As the nineteenth century progressed, steamship technology improved dramatically. In the first half of the century sail set the pace and competition between shipyards in Britain and the United States produced some of the most efficient merchant sailing ships ever built. Until the 1850s the fledgling steamships could not compete, mainly because the engines were so inefficient. For example, in 1855 the 900 dwt steamship shown in Table 1.3 burnt 199 lb of fuel per thousand ton miles at 7.5 knots. On an Atlantic crossing it would use 360 tons of coal, occupying 40% of its cargo space. As a result, steamers were still too inefficient to be economic on deep-sea routes (see Table 1.3) and in 1852 only 153 were listed in *Lloyd's Register*.[62] But by 1875 the steam engines were using only 80 lb per thousand cargo ton miles and for the first time the shipbuilders were offering steamships well able to compete with sail in the deep sea trades.[63] The opening of the Suez Canal in 1869 was well timed to generate a surge of investment innovation, trebling the world merchant fleet from 9 m.grt in 1860 to 32 m.grt in 1902 (Figure 1.8).

The 650-ton *John Bowes*, built in Jarrow in 1852 for the coastal coal trade, and one of the first modern bulk carriers, demonstrates the way the new technology, when used in the right trade, increased transport efficiency (see Section 6.2 and, in particular, Table 6.1). On her first trip she loaded 650 tons of coal in four hours; in 48 hours she

Table 1.3 Fuel consumption of typical cargo ships

Year built	Gross registered tonnage	Dead weight tonnage	Cargo tons	Speed knots	Engine type	Horse-power	Fuel type	Tons per day	Cargo	lb fuel/ 1,000 ton miles
1855	700	900	750	7.5	Steam 1	400 ihp	coal	12	63	199.1
1875	1,400	1,900	1,650	8.5	Steam 2	800 ihp	coal	12	138	79.9
1895	3,600	5,500	4,900	9.5	Steam 3	1,800 ihp	coal	25	196	50.1
1915	5,300	8,500	7,500	11	Steam 3	2,800 ihp	coal	35	214	39.6
1935	6,000	10,000	9,000	12.5	Steam 3	4,000 ihp	oil	33	273	27.4
1955	7,500	11,000	10,000	14	Diesel	6,000 bhp	oil	25	400	16.7
1975	13,436	17,999	17,099	16	Diesel	9,900 bhp	oil	37	462	12.6
2006	12,936	17,300	16,435	15	Diesel	9,480 bhp	oil	25	657	9.5

Key: Steam 1 = steam reciprocating simple, Steam 2 = Steam reciprocating compound, Steam 3 = steam reciprocating triple expansion

Source: British Shipbuilding Database (Prof. Ian Buxton, Newcastle University)

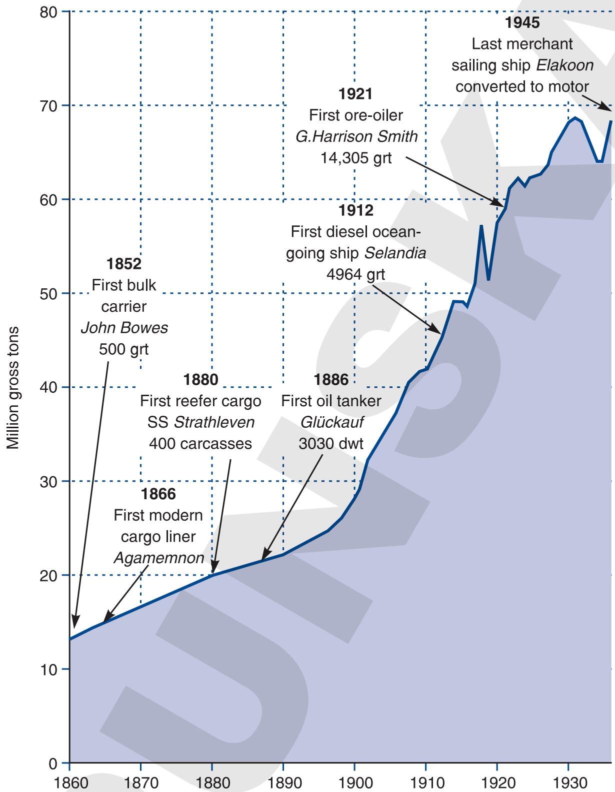


Figure 1.8
World fleet and design innovation, 1860–1930
Sources: Craig (1980, pp. 7, 12); Kummerman and Jacquinet (1979, p. 127); Hosking (1973, p. 14); Dunn L. (1973, p. 95); Britannic Steamship Insurance Association (2005, p. 24); Kahre (1977, p. 145); *Lloyd's Register* 1900–30.

arrived in London; she took 24 hours to discharge her cargo; and in 48 hours she was back in the River Tyne.[64] Compared with the five weeks taken by a sailing ship, this five-day round trip increased productivity by 600%. In addition to speed and reliability, the iron hulls were more consistently water-tight, reducing cargo damage, and the cargo payload was 25% bigger than a wooden ship. By 1875 a 'Handy' vessel had increased to 1400 grt (1900 dwt), and by the end of the nineteenth century ships of 4600 grt were common-place. This phase of technical progress peaked in the early decades of the twentieth century with high-speed ocean liners like the 45,000 grt *Aquitania*, built in 1914 to carry passengers and cargo between North Europe and North America. Passenger traffic had become a central feature of the maritime trade, not just for the big passen-ger liner operators, but also for the cargo liners and even some tramps.

But despite their productivity advantage, steamships were so expensive to build and operate that the transition from sail to steam took over 50 years. In 1850, 2,000 grt fast clippers could easily compete with the early steamships which burned so much coal that there was little cargo space on long voyages. Triple expansion steam engines solved this problem, and between 1855 and 1875 fuel consumption fell 60% from 199 pounds per thousand cargo ton miles to 80 pounds, and by 1915 it had halved again (see Table 1.3). In 1915, a 5300 grt cargo tramp used only 35 tons of coal per day and consumed only 40 pounds per cargo ton mile. Steel hulls allowed bigger ships to be built, and the open-ing of the Suez Canal in 1869 shortened the vital sea route between the East and Europe by 4,000 miles, with plenty of bunkering stations, giving the steamships a major advantage. With each step forward in steam technology the economic pressure on sailing ships increased, but they proved surprisingly resilient in long-haul bulk trades such as wool, rice, grain, nitrates and coal. For example, in 1891 there were still 77 sailing vessels in

Sydney loading wool for London and the last merchant sailing ship, the *Elakoon*, was not converted to motor power until 1945. There were other technical changes along the way, though none so fundamental. The first deep sea diesel-powered ship, the *Selandia,* went into service in 1912, and over the next 50 years the diesel engine replaced the steam engine, except in the most powerful ships. In the 1930s welding started to replace rivets in hull construction, and in the 1970s automation halved the number of crew required to staff a deep sea vessel.

During the next 50 years a steady stream of specialized ships were developed to carry particular types of cargo (see Figure 1.8): the *Agamemnon*, the first cargo liner in 1866; the first reefer in 1880; the first tanker, the *Glückauf* in 1886; the first diesel ship in 1912; and the first ore-oiler in 1921. However, the passenger liners were the outstanding development of this era. These vessels, designed to carry passengers and mail at great speed across the Atlantic and the Imperial routes, first appeared in the second half of the nineteenth century and reached their peak immediately before the First World War, reducing the Atlantic crossing from 17 days to five and a half days in the process (see Table 1.4).

Deep-sea cables revolutionize shipping communications

Of equal importance in transforming the shipping industry in the nineteenth century was the undersea cable network linking the continents. Until the 1860s international communication was by letter and little was heard of a ship until she returned, the ‘Supercargo’ or the master being relied upon to attend to business.[65] Ships could sit for weeks waiting for a return cargo. Businesses needed better information about the availability of ships and cargoes and invested heavily in trying to achieve this. In 1841, P&O introduced a fast mail service to India, sailing to Suez by sea, crossing the isthmus by camel staging posts, and then on to India by sea.[66] This allowed a bill of lading to arrive in India ahead of the cargo. Then in 1855 the first Atlantic cable was laid. The signal was feeble and after 40 days it stopped working, but it showed what could be done. A land cable across Siberia to Bombay was opened in 1865 but messages took 10 days to pass along the staging posts.[67]

Then in the 1865 the first successful transatlantic cable[68] was laid by the *Great Eastern*, Brunel’s 18,915 grt iron steamship. It could manoeuvre more effectively than the sailing ships used in 1855 and was big enough to carry a cable long enough to stretch from Ireland to Newfoundland, with a mechanism to control the cable as it was paid out. On the first expedition in 1865 the cable parted in mid-ocean, and was lost along with $3 million of its investor’s money, about $180 million in today’s terms.[69] However, in 1866 it laid a new cable and retrieved and repaired the 1865 cable. Within a decade a network of cables linked the major cities of the world[70] and, by 1897, 162,000 nautical miles of cable had been laid, with London at the heart of the network.[71] This communications network transformed the shipping business, for the first time allowed transport to be planned. So in the end Brunel’s commercial ‘white elephant’, the *Great Eastern*, made a far greater contribution to shipping as a humble cable layer than it could possibly have done carrying passengers.

Table 1.4 Evolution of Atlantic liners, 1830–1914

Name	Length (feet)	Gross tonnage	Indicated horse power	Knots per hour	Consumption tons/day	Hull material	Propulsion system	Engine design	Built	Transit days
Royal William	176	137	180n	7		Wood	Aux Paddle	Steam	1833	17.0
Sirius	208	700	320n	7.5		Wood	Paddle	Steam	1838	16.0
Great Western	236	1,320	440n	9	28	Wood	Paddle	Steam	1838	14.0
Britannia[a]	207	1,156	740	8.5	31.4	Wood	Paddle	Steam	1840	14.3
Great Britain	302.5	2,935	1,800	10	35-50	Iron	Screw prop	Steam	1843	
America	251	1,825	1,600	10.25	60	Wood	Paddle	Steam	1848	
Baltic	282	3,000	800			Wood	Paddle	Steam	1850	9.5
Persia	376	3,300	3,600	13.8	150	Iron	Paddle	Steam	1856	9.5
Great Eastern	680	18,914	8,000	13.5	280	Iron	Screw and Paddle	Steam	1858	9.5
Russia	358	2,959	3,100	14.4	90	Iron	Single screw	Compound	1867	8.8
Britannic	455	5,004	5,000	15	100	Iron	Single screw	Compound	1874	8.2
City of Berlin	488.6	5,490	4,779	15	120	Iron	Single screw	Compound	1875	7.6
Servia	515	7,391	10,000	16.7	200	Steel	Single screw	Compound	1881	7.4
Umbria	500	7,718	14,500	18		Steel	Single screw	Compound	1884	6.8
City of Paris	527.5	10,699	18,000	19	328	Steel	Twin screw	Triple expansion	1888	6.5
Teutonic	565.7	9,984	16,000	19		Steel	Twin screw	Triple expansion	1888	6.5
Campania	600	12,950	30,000	21	458	Steel	Twin screw	Triple expansion	1893	5.9
Kaiser Wilhelm II	678	19,361	45,000	23.5	700	Steel	Twin screw	Quad. expansion	1901	5.4
Mauretania	787	31,938	70,000	25	1000	Steel	Quad screw	Turbines	1907	5.0
Aquitania	901	45,647	60,000	23	850	Steel	Quad screw	Turbines	1914	5.5

[a]Consumption reported as 450 tons for the crossing of 14.3 days; n = nominal horse power, about half ihp pre-1850

Sources: Kirkaldy (1914), Appendix XVIII; British Shipbuilding Database (Prof. Ian Buxton, Newcastle University).

The liner and tramp shipping system emerges

The steamships and the communications revolution set the scene for a new and more sophisticated shipping system. As trade grew, and the complexity of the transport operation increased, the market gradually divided into three segments: passenger liners, cargo liners and tramp shipping. The basic model is illustrated in Figure 1.9. The range of cargoes being shipped by sea in the mid- to late nineteenth century is shown at the top of the diagram and included bulks, liquids, general cargo, passengers and, later in the century, refrigerated cargo. Passengers were the cream cargo which was most sought after, and one segment of the business, the passenger liners, was designed to provide fast transport on the busy routes across the Atlantic and to the Far East. The passenger liners built for these trades were fitted with passenger accommodation and were usually relatively fast, operating to a published schedule. Cargo liners also operated on regular schedules and were often designed for specific routes. Typically they had several decks to allow them to load and discharge cargo in many ports, and they would often have provision for specialist cargoes such as refrigerated cargo and heavy lift. Finally, the tramps carried bulk cargoes such as coal and grain on a voyage by voyage basis. They were usually of a very basic design, often with just a single ’tween deck and an economical speed and cargo-handling gear. However, some were sufficiently versatile to carry general cargo and be chartered by liner companies when they were short of capacity, and the more sophisticated tramps were designed with this in mind.

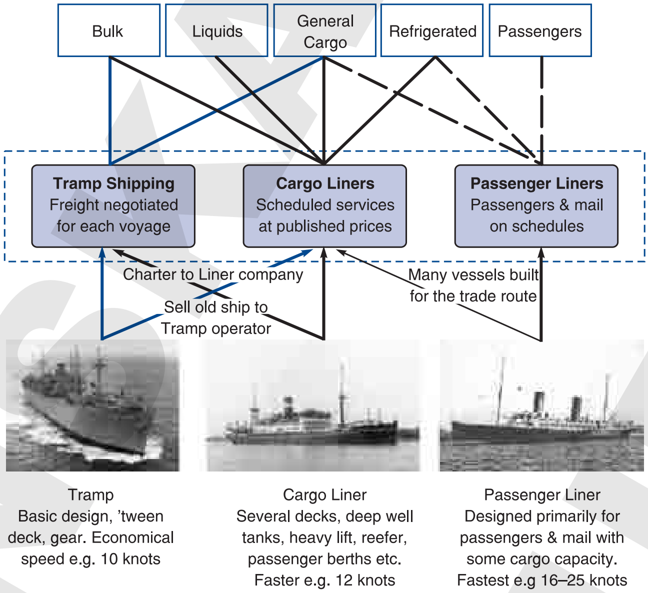


Figure 1.9
The liner and tramp shipping system, 1869–1950

The passenger liner services

Once reliable steamships were available, travel between regions became far more manageable and a network of passenger liner services rapidly developed. Initially the focus was on speed to carry mail and passengers between the continents, and the North Atlantic was the showpiece for the development of nineteenth-century shipping technology. Early liner services used sailing ships and the competition stimulated efficiency. In 1816 the Old Black Ball Line, the first liner service, was set up by Isaac Wright, a US owner. Using much-admired American sailing clippers, it offered fortnightly departures between New York and London, in competition with the Swallowtail Line, a New Bedford company. Although a great improvement, over the first 10 years the transit still averaged 23 days from New York to Liverpool and 43 days from Liverpool to New York.[72] Eventually they carried a thousand passengers a week, but by the 1850s they were eclipsed by the screw steamers of Great Britain which reduced the transit time to less than 10 days in each direction (see Table 1.4).[73]

As the century progressed the ‘passenger liners’ evolved into big, fast, luxurious ships with limited cargo capacity, built for the fast transport of passengers and mail and the important emigrant trade from Europe to the USA.[74] The improving technology of ships used on the North Atlantic is demonstrated in Table 1.4, which shows that between 1833 and 1914 every aspect of ship design changed. The hull grew from 176 ft to 901 ft, and gross tonnage from 137 tons to 45,647 tons. Hull construction switched from wood to iron in the 1850s, and from iron to steel in the 1880s, whilst paddle propulsion was replaced in the 1850s by screws driven by steam engines. Triple expansion steam engines arrived in the 1880s and turbines from 1900. Speed increased from 7 knots per hour in 1833 to 25 knots per hour in 1907, and fuel consumption from around 20 tons a day to 1,000 tons a day, with a significant improvement in thermal efficiency.

Cunard developed steamships for the North Atlantic capable of offering speed and reliability in all weathers. These services were obviously highly valued by businesses. For example, when Cunard's 1156 grt paddle steamer *Britannia* was frozen in Boston harbour in 1843–4, local merchants paid for a seven-mile channel to be cut to get her out.[75] The *Britannia* had a speed of 8.5 knots on 31.4 tons of coal a day, but 30 years later in 1874 the 4566 grt *Bothnia* had a speed of 13 knots on 63 tons a day and capacity for 340 passengers, in addition to 3,000 tons of cargo (Table 1.5). By the early twentieth century these passenger liners had evolved into sophisticated vessels. The 25 knot, 31,938 grt *Mauretania,* with its 350 stokers and 1,000 tons per day bunker consumption probably used more fuel than any ship ever built. However, not all passenger liners were so exotic. The *Balmoral Castle*, built in 1910 for the South Africa trade, was a four-deck ship of 13,361 gross tons, with two quadruple expansion engines of 12,500 ihp and a more modest speed of 17.5 knots. It could carry 317 first-class, 220 second-class and 268 third-class passengers.

The companies in this business, such as Cunard, White Star, North German Lloyd, and Holland America Line, were household names and their ships were symbols of national engineering prowess. From the 1880s onwards there was much latent competition for the transatlantic speed record, the Blue Riband, and it was probably this as much as commercial considerations which led to the construction of the most extreme ships such as Hamburg America's *Deutschland* (which suffered extreme vibration), North German Lloyd's record-breaking *Kaiser Wilhelm II*, and Cunard's turbine driven sister ships *Mauritania* and *Lusitania*.

Table 1.5 Performance of Cunard cargo ships, 1840–1874

	Gross tons	Built	Speed knots	Coal tons/day	Capacity		
					Cargo	Passengers	Bunkers
Britannia	1,139	1840	8	38	225	90	640
Persia	3,300	1855	13	150	1,100	180	1,640
Java	2,697	1865	13	85	1,100	160	1,100
Bothnia	4,556	1874	13	63	3,000	340	940

Source: Fayle (1933, p. 241)

The cargo liner services

The rapidly growing trade in manufactures and raw materials across the Atlantic and between the European states and their empires in the Far East, Oceania, Africa and South America created a demand for fast, cheap and regular cargo transport services. To deal with this the shipping industry developed a sophisticated system of cargo liner services using ships designed to transport the complex mix of passengers, mail and cargoes appearing as the international economy grew in the nineteenth century, supported by a fleet of tramp ships which carried the bulkier cargoes and supplemented the liners when the need arose (see Figure 1.9). They were the backbone of world trade, providing a reliable and flexible outward transport for general cargo, and often returning with a bottom cargo of logs, copra, grain and other minor bulks, topped up with passengers and whatever specialist cargoes they could pick up. As an economic solution to a complex problem the system worked well for a century and was every bit as revolutionary as containerization in the twentieth century.

From the 1870s onwards a network of liner services spread across the world, especially between Europe and its colonies, served by a new generation of steam cargo liners. These vessels were less elaborate and slower than the passenger liners. They were built for moderate speed, with several decks for stacking general cargo, bottom holds where bulk cargoes could be stowed on the return voyage, and special features such as refrigerated holds and deep well tanks for oils. There was often accommodation for some passengers. For example, the 6690 dwt *Ruahine* (1891) had accommodation for 74 first-class, 36 second-class and 250 emigrants. However, by the end of the century many cargo liners did not carry a Board of Trade Passenger Certificate. Vessel size gradually increased, as illustrated by the Ocean Steam Ship Company fleet. The 2200 grt *Agamemnon*, built in 1865, was 309 ft long with a 945 horsepower engine and with coal consumption of only 20 tons per day, allowing it to steam to the Far East. By 1890 the *Orestes* was 4653 grt, with a 2600 horsepower engine, and by 1902 the *Keemun* was 9074 grt with a 5,500 hp twin triple expansion engine. Finally, the *Nestor* built in 1914 was 14,000 grt. This more or less defined the liner vessel, and sizes did not increase significantly for the next 40 years.

The liner trades were complicated by the need for multi-port loading and discharge as well as the need for the service operator to offer trans-shipment to other ports not served directly by the liner. These operations were expensive and made the job of stowing and discharging cargo more complicated than a simple tramping operation. The cargo manifest for the 2849 grt cargo liner SS *Scotia*, carrying 5061 tons of cargo, shown in Table 1.6, illustrates this point. On the voyage in question the ship loaded 28 different commodities in bags, bales, cases and casks.

By the 1950s there were 360 liner conferences in the deep-sea trades, each with between 2 and 40 members which regulated sailings and freight rates.[76] The new liner companies were highly visible organizations with offices or agencies in the ports they served. Companies such as P&O, Blue Funnel, and Hamburg Süd became household names. Their prestigious office buildings housed teams of administrators, naval architects and operations staff who planned and directed fleets of a hundred ships or more as

Table 1.6 Cargo of SS *Scotia*, 1918

Item	Unit	Number
Skins	Bales	128
Turmeric	Bags	150
Tea	Cases	90
Shellac	Cases	208
Goat Skins	Bales	15
Shellac	Cases	175
Tea	Cases	1,386
Linseed	Bags	1,159
Hides		
Coffee	Casks	11
Gunnies	Bales	68
Fibre	Bales	605
Wheat	Bags	3,867
Tea	Cases	2,851
Goat Skins	Barrels	330
Gunnies	Bales	194
Wheat	Bags	4,321
Poppy seeds	Bags	1,047
Rapeseed	Bags	682
Potash	Bags	152
Wheat	Bags	1,086
Shellac	Cases	275
Copra	Cases	530
Coconuts	Bags	1,705
Hides	Bales	60
Gunnies	Bales	90
Gunnies	Bales	100
Linseed	Bags	2,022

Source: Captain H. Hillcoat, *Notes on Stowage of Ships*, (London, 1918), reproduced in Robin Craig (1980)

they plied back and forth on their trades. Naturally the ships were registered locally, and the companies were generally publicly quoted, even though the stock was usually held by family members. In short, liner shipping became a prominent and highly respectable business, and young men joined the industry confident in the knowledge that they were serving national institutions.

Tramp shipping and the global market place

The other component in the nineteenth-century sea transport system was tramp shipping, a very different business. Tramps filled the gaps in the transport system, carrying the bulk and general cargoes not catered for by the liner services. They were the direct descendants of Captain Uring, working from port to port carrying grain, coal, iron ore, and whatever was available. However, they had two important advantages which made them much more efficient than their eighteenth-century counterparts. First, they were steamships, usually with a ’tween deck for stacking cargo, offering speed and flexibility. Second, through the cable system they had access to the Baltic Exchange, so they could fix cargoes ahead without waiting or making speculative ballast voyages as Captain Uring had to do.

The growth of the Baltic Exchange was a response to the high cost and inflexibility of the early cable network. In 1866 a transatlantic cable cost 4*s*. 3*d*. (about $1.25) per word.[77] To put that in perspective, in 1870 a seaman earned about $12.50 (£2 2*s*.) a month.[78] Although rates soon fell, in 1894 communicating with outlying areas such as South and East Africa still cost over $1.25 per word. This favoured a central market place where cargoes could be ‘fixed’ by local brokers and agents and the terms communicated to their clients by cable. London was at the heart of the cable network and the Baltic exchange became the market place where trade was done. The Virginia and Baltic Coffee House had been a popular shipping venue for a century, in 1744 advertising itself as the place ‘where all foreign and domestic news are taken in; and all letters or parcels, directed to merchants or captains in the Virginia or Baltic trade will be carefully delivered according as directed and the best attendance given’.[79] By 1823 it had a committee, rules and an auction room where tallow was traded,[80] and when cables arrived in the 1860s it rapidly became the trading floor for the world tramp fleet.

Brokers circulated details of ships and cargoes at the Baltic, struck deals and cabled the terms to their principals in the briefest possible form.

London shipbroking companies were the intermediaries in the system.[81] The history of H. Clarkson & Co. Ltd records that in the 1870s Leon Benham, the company's leading broker, 'was in constant attendance at the Baltic Exchange. Several times a day he would return to the office to despatch telegrams, invariably drafted from jottings on the stiff cuff of his shirt'.[82] In 1869 Clarksons spent more on telegrams than on wages.[83] The Baltic reached a peak in 1903 when it opened the new exchange building in St Mary Axe. As long as international messaging remained cumbersome and expensive the Baltic was guaranteed a position as the global clearing house for shipping business.[84]

The shipping companies which operated in the tramp market were very different from the liner companies, though there was some overlap. Large tramp companies would sometimes establish liner services if they spotted a gap in the market and the liner companies sometimes engaged in 'tramping'. However, most of the tramp business was carried on by small companies. In 1912 over a third of the British tramp companies had only one or two ships, and by 1950 this had increased to more than half (Table 1.7). These businesses were often very small, relying heavily on outsourcing various skilled tasks. For example, marine and engineering superintendents were now available in most ports to deal with technical matters such as breakdowns and dry dockings; shipbrokers and agents chartered the ships for a commission; and chandlers provided deck and engine stores and victuals. Bunkers were readily available at advertised prices; crewing agencies supplied officers and crews; and insurance brokers and protection and indemnity (P&I) clubs were available to cover the various risks. In these circumstances a tramp owner really could 'carry his office under his hat'.[85] Some ships were owned by the captain or a syndicate using the system whereby the holding company was split into 64 shares (see Section 7.2).

Table 1.7 Size of British ocean tramp companies

	Number of companies		
Number of ships	1912	1950	% of total 1950
1	25	37	29%
2	12	28	22%
3	9	20	16%
4	12	15	12%
5	7	7	5%
6+	34	22	17%
Total	99	129	100%

Source: Gripaios (1959, Table 5)

Although the British were initially the biggest tramp owners, towards the end of the nineteenth century the Greek shipowners, who had built up thriving cargo shipping businesses on the commerce of the Black Sea and the Mediterranean, started to set up offices in London.[86] Soon they became an important part of the international tramp shipping scene. The Norwegians took a while to move from sail to steam and were less in evidence. Operating fleets of multi-deck vessels, these owners worked from port to port, carrying whatever cargoes became available, though by the early twentieth century they were mainly carrying bulk commodities. The breakdown of cargoes in

Table 1.8 British deep-sea tramp shipping cargoes, 1935

Cargo	Voyages	Cargo tons
Coal and coke	1,873	12,590,000
Grain	1,200	8,980,000
Grain and timber	105	890,000
Timber	196	1,345,000
Timber and other cargo	19	110,000
Ore	398	2,830,000
Fertilizers	207	1,535,000
Sugar	204	1,425,000
Other cargoes	610	3,785,000
Totals	4,812	33,490,000

Source: Isserlis (1938).

Table 1.8 shows that by 1935 coal and grain accounted for two-thirds of the tonnage of cargo shipped, with timber, ores, fertilizers and sugar making up another quarter.

A typical tramp itinerary in the 1930s illustrates how the tramp business worked. The ship was chartered to carry rails from Middlesbrough to Calcutta. From there it loaded jute gunny-bags for Sydney, then ballasted to Newcastle, NSW, to load coal for Iquiqui in Chile, expecting to load nitrate. However, there were many ships waiting in the nitrate ports, so instead, after an exchange of cables, the ship ballasted to the River Plate where the maize harvest would soon be coming forward and demand was expected to be brisk. However, by the time the ship reached Buenos Aires many ships had recently arrived with coal from Britain and were looking for a backhaul, so supply exceeded demand. After waiting a couple of weeks it was eventually fixed at a slightly higher rate by a maize trader with an option to discharge in London, Rotterdam or Genoa, for each of which a freight was specified. The ship was to call for orders at St Vincent in the Cape Verde Isles, where the master learned he was to proceed to Rotterdam, then load coal for Genoa. From Genoa he was instructed to proceed to Algeria and load iron ore for the Tees. The permutations were endless, but at each stage owners and shipbrokers worked furiously to find the best cargo for the next leg and cable instructions to the ship's master and it is easy to see why the Baltic Exchange played such an important part in coordinating the activities of the tramp fleet.[87]

When not tramping, tramp ships would often be chartered to cargo liner companies in need of extra capacity, thus providing a link between the bulk and liner businesses. This was possible because both segments of the market used similar ships. Generally the tramp operators invested in basic multi-deck vessels of between 5,000 and 10,000 dwt, with a 'tween deck to stack general cargo and bottom holds designed to carry bulk. Some more expensive tramps were designed with liner charters in mind, with a slightly faster speed and special features such as refrigerated holds, deep well tanks to carry vegetable oils, cabins for 20 or more passengers and heavy lift cranes for awkward cargoes. However, the basic tramp design was instantly recognizable.

Regulation of shipping

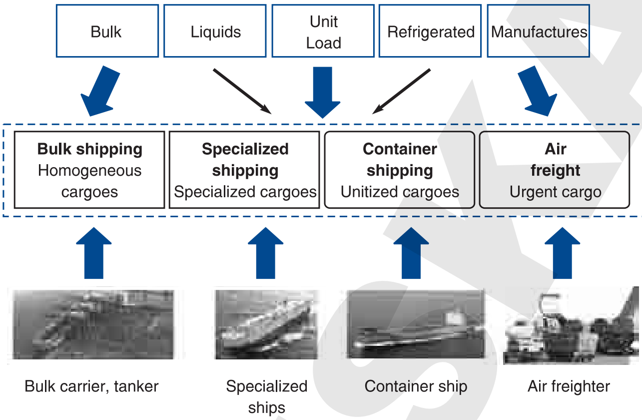
As the volume of business increased so did the framework of regulations imposed by the insurance industry. In the eighteenth century the London insurance industry developed a system to check that the ships they insured were soundly built and in good condition. By the early nineteenth century Lloyd's Register, which had started life in the 1760s as a register of ships, had assumed the role of setting standards and issuing classification certificates. After a major reorganization in 1834, 63 surveyors were appointed and they made a complete resurvey of the 15,000 ships in the Register. Any new vessel for which an A1 classification was sought must undergo 'a survey under construction', which meant in practice that its progress was closely inspected at least three times while its hull was on the stocks. In 1855 Rules for Iron Ships were issued by the Society, and subsequently committees were established to set construction standards for new ships and the network of surveyors monitored their implementation. Several other countries set up classification societies, among them the American Bureau of Shipping and Det Norske Veritas, and by the end of the nineteenth century the industry's technical regulatory system was in place.

Governments also became involved in regulating shipping, particularly the British government. After a series of scandals involving ships used in the emigrant trade, the Merchant Shipping Act 1854 was passed. This set out a legal framework for the registry of ships; tonnage measurement; survey of ships and equipment; carriage of dangerous goods; safety and seaworthiness of ships; protection of seamen; and inspection of provisions. From time to time it was extended, often in the face of opposition from the shipping industry; for example, the recommendation of the 1874 Royal Commission on unseaworthy ships that a load line (for many years known as the 'Plimsoll mark') should be introduced to prevent ships being overloaded was opposed by British owners who complained it would give them an unfair disadvantage. The body of maritime laws developed at this time, when Britain controlled half the world merchant fleet, was used by many other countries as the template for enacting their own maritime law providing the basis for a maritime legal system which was reasonably consistent between countries. The first formal step in this direction was the Law of the Sea conference held in Washington in 1896, listing an agenda of items to regularize shipping activities.

1.6 CONTAINER, BULK AND AIR TRANSPORT, 1950–2006

The rationale for sea transport integration

By 1950 the liner and tramp system had worked successfully for a century and it was hard to believe that it could suddenly disappear, but that is exactly what happened. Although it was immensely flexible, it was far too labour-intensive to survive in the post-1945 global economy where rising labour costs made mechanization inevitable. This meant replacing expensive labour with cheaper capital equipment and increasing the size of transport operations to take advantage of economies of scale.[88] As a result, 30 years later there was nothing left of the proud, conservative shipping industry which sailed confidently into the 1950s. The passenger liners disappeared in a decade, or were converted into cruise ships, and the cargo liners and tramps were gradually replaced by



The mechanization of sea transport lies at the heart of globalization. It involved splitting transport into four segments where investment could be applied.

Figure 1.10
The bulk and container shipping system after 1950

the new transport systems illustrated in Figure 1.10, using technology already well established in land-based industries such as car manufacture. The new system reduced costs by replacing expensive labour with cheaper and more efficient capital equipment and by treating sea transport as part of an integrated through-transport system. Standardization, automation of cargo handling, economies of scale, and developing ship designs adapted for efficient cargo stowage and handling all played a part in this process.

Homogeneous bulk cargoes were now carried by a fleet of large bulk carriers operating between terminals designed to mechanize cargo handling; general cargo was containerized and transported by a fleet of cellular container-ships; and five new specialized shipping segments evolved to transport chemicals, liquefied gases, forest products, wheeled vehicles, and refrigerated cargoes, each with its own fleet of specially designed ships. One side effect of automation was that shipping, which had previously been one of the world's most visible industries, became virtually invisible. The busy ports with miles of wharves were replaced by deserted deep water terminals handling cargo in hours, not weeks, and the shipping companies which had become household names were replaced by independent shipowners operating under 'flags of convenience'.

Many factors contributed to these changes. The airlines took over the passenger and mail trades from the passenger liners and the European empires were dismantled, removing two of the liner companies' most important revenue streams. American, European and Japanese multinationals relying on imported raw materials actively encouraged the new bulk shipping industry by offering time charters, and with this security it was easy to access investment funds from the emerging eurodollar market. Improved communications, including telex, fax, direct-dial phone calls and later e-mail and cheap inter-regional air travel, all helped to create an even more efficient global market place for shipping services. Thus the foundations were laid for a more efficient shipping business, combining economies of scale with an unprecedented ability to apply technology and logistics to the ever-changing pattern of seaborne trade.

The new trade environment created at Bretton Woods

The change started with the new trade strategy adopted by the Western nations after the Second World War. Since the early 1940s the United States had been determined that after the war the restrictions of the colonial system should be removed, providing free access to global markets and raw materials. In July 1941 a memorandum from the US Council on Foreign Relations argued that to achieve this, the world needed financial institutions capable of 'stabilising currencies and facilitating programmes of capital investment in backward and underdeveloped regions'.[89] At the Bretton Woods Conference in 1944 the US Secretary of the Treasury, Henry Morgenthau, outlined the objective of creating 'a dynamic world economy in which the peoples of every nation will be able to realise their potentialities in peace and enjoy increasingly the fruits of material progress of an earth infinitely blessed with natural riches'.[90] By the end of the meeting the World Bank and the International Monetary Fund had been founded and the groundwork had also been laid for the General Agreement on Tariffs and Trade (GATT).

This policy had a profound effect on the maritime industry. By the end of the 1960s almost all of the European colonies had been given independence and they were encouraged to open their borders and transform their economies from self-sufficiency to export production. Trade agreements negotiated through GATT opened economies in both North and South to the free movement of goods and money. Capital flows were liberalized and multinational corporations systematically developed raw materials, manufacturing capacity and local consumer markets. Since the whole system depended on trade, efficient shipping played a central part in creating this new global economy and the imperially based liner system was not well positioned to meet the needs of the new order.

Growth of air transport between regions

During the same period the airlines became serious competitors for the passenger and mail markets, one of the mainstays of the liner system. In 1950 ships still carried three times as many passengers across the Atlantic as aircraft, and in 1952 Cunard-White Star had nine vessels in the New York trade, with another four working out of Southampton to Canadian ports.[91] However, with the arrival of passenger jets the economics moved decisively in favour of the airlines. A passenger liner needed 1,000 crew and 2,500 tons of fuel to deliver 1,500 passengers to New York once a week. Even a first-generation jet carrying 120 passengers could make eight or nine crossings in a week, delivering almost 1,000 passenger crossings, but with only 12 crew and burning only 500 tons of fuel.[92] The flight time of 6 hours was an added bonus for busy travellers. On these economic considerations there was no contest. In 1955 almost 1 million passengers crossed the Atlantic by sea and about 750,000 by air, but by 1968 over 5 million travelled by air but only 400,000 by sea.[93] When jumbo jets arrived in 1967 the longer routes followed, and between 1965 and 1980 air traffic increased from 198 billion passenger kilometres to 946 billion.[94]

The last great passenger liner, the *Queen Elizabeth 2*, was ordered at John Brown's shipyard on Clydeside in 1963 as a dual-purpose passenger and cruise vessel for the Atlantic service, but two years after it was delivered in 1968 the jumbo jets came into service and it mainly served as a cruise liner. The passenger liners of the 1950s, built for speed, either went to the scrapyard or were converted into cruise liners offering a mobile leisure environment in which speed is irrelevant, bringing to an end the era of the great passenger liner.

Growth of seaborne trade, 1950–2005

Meanwhile sea trade was growing faster than at any time since the early nineteenth century, with imports increasing from 500 million tonnes in 1950 to 7 billion tonnes in 2005 (Figure 1.11). This growth was led by Europe and Japan. Both had been badly damaged during the war, and set about the reconstruction of their economies. Released from their colonial empires, the European multinationals set about post-war reconstruction. Expansion of heavy industries such as steel and aluminium, combined with the substitution of imported oil for domestic coal in power stations, railway locomotives and rising car ownership, produced rapidly growing imports, particularly of bulk commodities. This growth persisted through the 1960s and the upward trend in imports was reinforced by the switch from domestic to imported sources for key raw materials such as iron ore, coal and oil. By the early 1970s the European economy was maturing and demand for raw material intensive goods such as steel, aluminium and electricity stabilized.

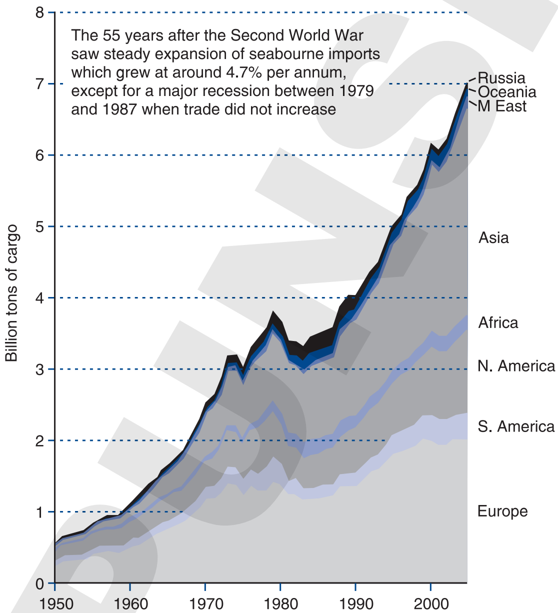


Figure 1.11
Sea trade by region, 1950–2005
Source: United Nations Statistical Yearbooks

The growth of Japan followed a similar pattern, but changed the focus of world shipping, because it was the first major industrial economy in the Pacific region. Development had started in the late nineteenth century, but after 1946 the Japanese economy was reorganized and the ‘trading houses’ took over the traditional coordinating role of the *zaibatsu*. Leading industries such as shipbuilding, motor vehicles, steel and shipping were selected by the Ministry of International Trade and Industry which coordinated growth for development, and during the 1960s the Japanese economy embarked upon a programme of growth which made it the world’s leading maritime nation. Between 1965 and 1972 Japan generated 80% of the growth of the deep-sea dry cargo trade, and by the early 1970s it built half the world’s ships and, taking account of open registry vessels, controlled the world’s largest merchant shipping fleet.

In the 1970s the two oil crises coincided with the end of the European and Japanese growth cycle and the lead in trade growth switched to the Asian economies – notably

South Korea, which embarked on a programme of industrial growth. Emulating Japan, it rapidly expanded its heavy industries such as steel shipbuilding and motor vehicles. Then, in the 1980s, after two decades of total isolation and many centuries of restricted contact with the West, the Chinese economy opened its doors to capitalism and trade. There followed a period of remarkable economic growth, coupled with a move towards a more Westernized capitalist economic system.

The world economy was entering a new consumer-driven era, and during the 1960s the flow of motor cars, electronic products and a host of others increased very rapidly and the framework of trade widened, bringing in Asian economies and a more extensive trade with Africa and South America. This turned sea trade into a complex network connecting the three industrial centres in the temperate latitudes of the Northern Hemisphere – North America, western Europe and Japan – which generated about 60% of the trade, and drawing in raw materials and exporting manufactures.

Shipping's 'industrial revolution'

Trade expansion on this scale would not have been possible without a major reform of the transport system. The new transport model that emerged gradually over 20 years had the three segments shown in Figure 1.10: bulk shipping, specialized shipping and containerisation. During the next 35 years many new ship types were developed, including bulk carriers, supertankers, liquefied gas tankers, chemical tankers, vehicle carriers, lumber carriers and, of course, container-ships.

The development of bulk transport systems

The new bulk shipping industry was mainly masterminded by the multinationals, especially the oil companies and steel mills. Until the early 1950s the oil trade was still quite small and oil was mainly shipped as products in small tankers. However, as markets grew the strategy changed to shipping crude in large volumes to refineries located near the market, and this allowed bigger ships to be used (see Section 12.2). At the same time the steel mills were moving to coastal sites and developing overseas iron ore and coalmines to supply them. For the new generation of bulk carriers constructed for this trade, the only restrictions on size were the size of cargo parcels and the depth of water at the terminals, both of which increased rapidly. Commodities like oil, iron ore and coal were used in sufficiently large quantities to make cargo parcels of 100,000 tons or more practical and cargo shippers built deep-water terminals with automated cargo-handling systems. By investing in big ships and high-speed cargo-handling systems, it was decisively cheaper to import raw materials by sea from suppliers thousands of miles away than by land from suppliers only a few hundred miles away – for example, the rail freight for a ton of coal from Virginia to Jacksonville, Florida, was almost three times the sea freight from Hampton Roads to Japan, a distance of 10,000 miles.

Tankers illustrate the evolution in ship size (Figure 1.12). The 12,500 dwt *Narraganset* was built in 1903, and this remained a very acceptable size of vessel until 1944 when the largest tanker was the *Phoenix* of 23,900 dwt. During the Second World War the T2

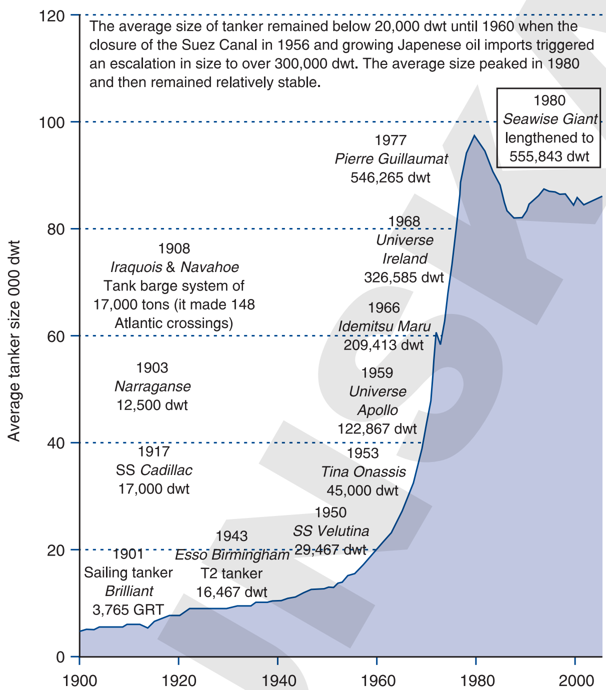


Figure 1.12
Average size of tanker, 1900–2005
Source: Complied by Martin Stopford from various sources

tanker, a 16,500 dwt vessel, had been mass-produced, and that remained the workhorse size, mainly shipping products from refineries based near the oil-fields. Then in the 1950s tanker sizes started to increase. By 1959 the largest tanker afloat was the *Universe Apollo* (122,867 dwt), and in 1966 the first very large crude carrier (VLCC), the *Idemitsu Maru* 209,413 dwt followed, just two years ahead of the *Universe Ireland* (326,585 dwt) the first ultra large crude carrier (ULCC) in 1968. This upward trend peaked in 1980 when the *Seawise Giant* was extended to 555,843 dwt. Overall the increase in ship size probably reduced unit shipping costs by at least 75%.

In dry bulk shipping, the move into large bulk vessels was equally pronounced. Although 24,000 dwt ore carriers were used in the 1920s, in 1950 most bulk cargo was still carried in tramps of between 10,000 and 12,000 dwt. The move to bigger ships followed the same pattern as tankers, and by the 1970s vessels of 200,000 dwt were widely in use on the high-volume routes, while the first generation of 300,000 dwt vessels started to come into service in the mid-1980s. There was also a steady upward movement in the size of ships used for the transport of commodities such as grain, sugar, non-ferrous metal ores and forest products. Taking the grain trade as an example, in the late 1960s most of the grain shipped by sea was in vessels under 25,000 dwt.[95] It seemed inconceivable to shippers in the business that vessels of 60,000 dwt could ever be used extensively in the grain trade, although by the early 1980s this is precisely what had happened.

Technical improvements, though less dramatic than previously, were significant. Hatch designs, cargo-handling gear and navigation equipment all improved in efficiency. During the 1980s the fuel efficiency of diesel engines increased by 25%. Shipbuilders became more adept at fine-tuning hull designs, with the result that for some ship types the steel weight was reduced by 30%; hull coatings improved to give the submerged hull better smoothness and improved longevity for tank structures.

Bulk shipping also benefited from improving communications. During this period the position of the Baltic Exchange as a central market for shipping was undermined by improved communications including direct-dial telephony, broadcast telex, fax and e-mail. It was no longer necessary to meet face-to-face to fix ships. Instead owners, brokers and cargo agents used telex messages to distribute cargo/position lists and negotiations were handled by phone. In the 1970s computerized work stations allowed telex or fax messages to be sent by the user and also provided access to databases of ship positions, vessel details and voyage estimating programs. PC networks, which appeared in the 1980s, made these facilities available cheaply to even the smallest companies, and modems gave access to the office workstation from home. The final link in the virtual market place was the cellular telephone, which allowed a broker to go out for lunch even while he was 'working' a ship – now that really *was* progress!

As the fleet of tankers and bulk carriers grew and the independent owners became more established, the multinationals gradually reduced their owned and chartered fleets, relying more on independent shipowners and the rapidly growing charter market. As information technology improved in the 1970s, the market started to segment by ship type – VLCCs, products tankers, Handy bulkers, Panamax, Capesize, chemicals, etc. Teams of specialist brokers developed an in-depth knowledge of their sector – its ships, charterers, ports and cargoes – and combined this with the 'soft' information gained from daily networking to gain negotiating leverage. By allowing market specialization, cheap, fast communications took the business a step forward in terms of logistic efficiency. The result was the highly efficient transport system for bulk cargoes we have today.

The containerization of general cargo

Developing a new system for shipping general cargo was left to the shipowners and it took much longer to get started. By the 1960s congested ports and labour difficulties were slowing transit times, and cargo shipped from Europe to the United States took months to arrive. Industry observers could see that 'the old methods had reached the end of the line',[96] but the way forward was not obvious. The problem facing the liner companies when they finally started to investigate unitization in 1960 was that liners had always been flexible in the cargo they carried and some cargoes were difficult to containerize. Containerization, which excluded all cargoes that would not fit in a standard 20-foot box, seemed an extreme solution, and even in 1963 the debate was not resolved. Companies experimented with flexible systems such as cargo palletization and ro-ro ships, which combined unitization with the flexibility to carry bulk cargoes like forest products. But in reality containerization was not just about ships. It was a completely new way of organizing transport, involving massive capital investment and an end to the control of trade by separate shipping companies working within a closed conference system.[97] The first transatlantic service was started on 23 April 1966 by Sea-Land, a new US company which had been developing the concept since 1956 (see Chapter 13). Transporting general cargo in standard boxes had a more fundamental impact than even its most ardent advocates anticipated. Just a few days after leaving the factory in the Midlands of England, a container wagon could be arriving at its destination in East Coast USA with its cargo safe from damage or pilferage and readily transferable to rail or barge with the minimum of delay and effort. By adopting containerization the industry opened the floodgates for global commerce (see Chapter 12 for more history).

Containerization was made possible by developments in communications and information technology. Until the 1960s, liner services were very fragmented, and managers in one service knew little of what was going on in others. When containerization arrived in the 1960s, the pendulum swung to the other extreme because it 'could not have been accomplished without computer control systems for controlling the movement of containers, taking bookings, printing out bills of lading and invoices and transmitting advice and information'.[98] Only large companies could afford the mainframe computer systems needed to run a container service, so 'the dominance of the mainframe computer, development of data bases and rationalisation of systems predicated central control for a major operator'.[99] By the mid-1990s the system for handling containers had become very sophisticated and was squeezing more value out of the transport business, pioneered by operators such as OCL in the 1970s. These developments were immensely productive, reducing cycle times by 40%, errors by 30% and saving $5 per document.[100] This was a great leap forward for those big enough to be able to afford it.

Transport of specialized cargoes

Some cargoes did not fit comfortably in either the container or the bulk shipping systems, and gradually specialized shipping services developed to carry them. The five commodity groups which became the focus for specialized shipping operations were: forest products; chemicals; refrigerated cargo; cars and wheeled vehicles; and liquefied gases. Previously these had all been carried in liners or tramps, often with the help of some special investment such as refrigerated holds and deep tanks for liquid chemicals and vegetable oil. However, the standard of service was often poor. For example, vehicles were very expensive to transport and were often damaged in transit. As the volume of these cargoes grew, shippers and owners often worked together to improve the economics of the service, creating a period of tremendous innovation in ship design. From 1950 onwards the innovations came thick and fast. The first chemical parcel tanker, the *Marine Dow Chem* was built in the United States in 1954, and this was soon followed by the first container-ship, a conversion, in 1956. In the same year Wallenius lines built the first car carrier, the *Rigoletto*, designed for the carriage of 260 cars, and the first open hatch bulk carrier, designed with wide hatches to carry pre-packaged timber was built in 1962, for use in the paper trade. The first purpose-built liquefied natural gas (LNG) tanker came in 1964 and the first liquefied petroleum gas (LPG) tanker in 1955.

Each of these pioneer ships eventually grew into a fleet, and a new business sector for the shipping industry arose. In most cases the mode of operation was dramatically different from the 'quayside to quayside' business of the preceding century. The defining feature of these specialized segments is that they focus on the transport of a single cargo which permits, or requires, specialist investment to improve efficiency. As a result, the ships are closely integrated with the industries they served, often a small group of charterers. Chemical tankers carried small parcels of chemicals between industrial plants; car carriers became an integral part of the international motor business; and LNG tankers are shuttled between specially built terminals. The investment and organization behind these projects created the new concept of specialized shipping which became one of the building-blocks of the post-war global economy.

Changing shipping company organization

As the shipping industry changed, so did the companies that ran it. Out of the top 10 UK liner companies in 1960, none remained 50 years later and there were no tramp companies left. The change in registration is very apparent from the fleet statistics in Table 1.9. In 1950, 71% of the world fleet was registered in Europe and the United States, and 29% under overseas flags. By 2005 the share of the European and US flags had fallen to 11%, whilst other countries, particularly flags of convenience such as Liberia and Panama, accounted for 89%. Part of this change is explained by the growth of new economies, particularly Japan, South Korea and China, whose national fleets grew rapidly. For example, the Japanese fleet grew from 1.9 million grt in 1952 and 18.5 million grt in 1997. However, a more important explanation is the growing importance of independent shipowners in the post-Bretton Woods world and their preference for open registries such as Liberia and Panama as a way of reducing costs.

Table 1.9 World merchant fleet by country (millions of tons)

Start of year	1902	1950	2005
W Europe & USA			
Britain	14.4	18.2	9.8
USA	2.3	16.5	12.5
US Reserve	0.3	11.0	n/a
Holland	0.6	3.1	5.7
Italy	1.2	2.6	11.1
Germany	3.1	0.5	9.1
Belgium	0.3	0.5	3.5
France	1.5	3.2	4.3
Spain	0.8	1.2	2.2
Sweden	0.7	2.0	3.6
Denmark	0.5	1.3	0.7
Danish International			6.9
Total	**25.7**	**60.0**	**69.4**
% world fleet	**80%**	**71%**	**11%**
Other flags			
Liberia	0.0	0.2	55.2
Panama	0.0	3.4	136.1
Greece	0.3	1.3	32.7
Japan	0.6	1.9	12.7
Norway	1.6	5.5	3.6
Others	4.0	12.3	342.8
Total	**6.5**	**24.6**	**583.1**
% world fleet	**20%**	**29%**	**89%**
WORLD	**32.2**	**84.6**	**652.5**

Source: *Lloyd's Register*, Clarkson Research

The independent shipowners of this new generation were descendants of the tramp operators who had served the liner companies for the last century, supplemented by a new generation of businessmen such as Onassis, Niarchos, Pao and Tung who saw the opportunities in shipping. As the established national shipping companies struggled to adapt, weighed down by wealth, tradition and the wrong ships, the 'tramp' operators of Norway, Greece and Hong Kong were quick to spot that their new clients were the multinational oil companies, steel mills, aluminium producers, etc. These large companies needed the raw materials available in Africa, South America and Australasia, and that meant cheap sea transport. Whilst the established and cash-rich shipping companies were not attracted by this risky, low-return business, the independents were only too willing. Using time charters from the multinationals as security to raise finance, they rapidly built up the fleets of tankers, bulk carriers and specialized ships that were needed. Since the charters were subject to intense competition, to keep costs low they used an invention of American tax lawyers, the ‘flag of convenience’. By registering the ships in a country such as Panama or Liberia, they paid only a fixed registration fee, and no further taxes were payable (see Chapter 16).

So once again the character of the shipping industry changed. The shipping companies were transformed from high-profile pillars of imperial respectability into intensely private businesses run by entrepreneurs. The change was compounded during the long recession of the 1980s (see Chapter 4) when even the most efficient shipowners had to ‘flag out’ and cut corners to survive. To the reputation for privacy was added the image of running ships that were ‘old and corroded, structurally weak’.[101] By the 1990s governments, which had raised no real objection to the growth of the independent shipping industry during the earlier period, became concerned about the quality standards and the safety of the ships which operated in their national waters.

1.7 LESSONS FROM 5,000 YEARS OF COMMERCIAL SHIPPING

So that brings us to the end of the Westline. From the early sea trade in the Lebanon 5,000 years ago, the line has now arrived at China, and is heading through SE Asia to India, the Middle East, Central Asia, Russia and eastern Europe. The shipping industry has a unique opportunity to study its commercial history, and there are many lessons which we could draw, but three stand out.

The first is the central part which shipping has played in the global economy. At every stage in its development, sea transport has figured prominently, and the shipping industry, with its distinctive international flavour, has played a central role.

Second, the basic economics of the business have not changed all that much over the years. The messages gleaned from the Mesopotamian Maritime Code, the Roman bill of lading or even Captain Uring’s exploits in the eighteenth century all tell the same story of a business driven by the laws of supply and demand. The ships, technology and customers change, but the basic principals of maritime commerce seem immutable. Although there is continuity in the economic model, the circumstances can change with remarkable speed. The break-up of the Roman Empire; the voyages of discovery in the sixteenth century, steam and the colonial system in the nineteenth century, and the mechanization of shipping in the second half of the twentieth century all dramatically changed the world in which shipowners operated. In the process, shipping today has become more than ever before an integral part of the process of globalization.

Third, shipping prospers during periods of political stability when the world is prosperous and stable. For example, we saw how the Mediterranean trade prospered when the Roman Empire provided safe passage, and declined when the *Pax Romana* broke down in the third century. Similarly the stability provided by the European empires from 1850 to 1950 created a framework in which the liner and tramp system could operate. Then a new period of globalization in the post-Bretton Woods era following the Second World War did the same sort of thing and once again the shipping business had to adapt. So the lesson is that the starting-point for any future analysis is not economics but the geopolitical environment and where that is going.

But change was not always gradual. The step changes in knowledge and technology were often followed by longer transitional periods as the commercial infrastructure was developed to put the changes into practice. As a result, revolution was softened into a more gradual evolution. Thus the voyages of discovery at the end of the fifteenth century took just a couple of decades, but it took centuries for the new global commercial trading system to grow out of them. Similarly, the transition from sail to steam started in the 1820s but it was almost a century before steamships had completely taken over merchant shipping from sail. More recently, containerization started in the 1950s but it was 25 years before its full potential as a global transport system was felt in world trade. So although change is sudden, the implementation of change is often a long and tedious business.

Pulling all this together, our task as maritime economists is to understand where we are at any point of time, so that we can see where things might go next. We must also understand the evolutionary nature of change. The die may be cast, but it is often many years before the real consequences of change become apparent. Today we are in a phase of transition created by globalization which is, in its own way, as revolutionary as the voyages of discovery five hundred years ago.

1.8 SUMMARY

In this chapter we examined how shipping developed over the last 5,000 years. It turns out that today's trade network is just a snapshot taken as the world economy creeps jerkily along its evolutionary path. The pace is usually too slow for contemporaries to see the trend, but from a historical perspective the progress is evident. The central role of shipping in this process was obvious to early economists such as Adam Smith, who recognized that shipping offers the transport needed to promote economic development. Indeed, shipping, trade and economic development all go hand in hand.

We divided the history of trade into three phases. The first started in the Mediterranean, spreading west through Greece, Rome and Venice, to Antwerp, Amsterdam and London. During this phase a global trading network gradually developed between the three great population centres in China, India and Europe. At first this trade was by land and was slow and expensive, but when the voyages of discovery opened up global sea routes in the late fifteenth century, transport costs fell dramatically and trade volumes escalated.

The second phase was triggered by the industrial revolution in the late eighteenth century. Innovations in ship design, shipbuilding and global communications made it possible for shipping to be conducted as a global industry, initially through the Baltic Exchange, whilst reliable steamships and technical innovations such as the Suez Canal made it possible for liner companies to operate regular services. For the next century trade grew rapidly, focused around the colonial empires of the European states and the framework of sea trade was radically changed.

Finally in the second half of the twentieth century another wave of economic and technical change was triggered by the dismantling of the colonial empires which were replaced by the free trade economy initiated at Bretton Woods. Manufacturers set out to track down better sources of raw materials and invested heavily in integrated transport systems which would reduce the cost of transporting these goods. During this period we saw the growth of the bulk carrier markets, the containerization of general cargo and specialist shipping operations transporting chemicals, forest products, motor vehicles, gas, etc. An important part of this revolution was the move of shipping away from the nation states which had dominated previous centuries towards flags of convenience. This brought greater economies and changed the financial framework of the industry, but it also raised regulatory problems.

The lesson is that shipping is constantly changing. It is a business that grew up with the world economy, exploring and exploiting the ebb and flow of trade. Today it has become a tightly knit global business community, built on communications and free trade. Perhaps that will change. But it is hard to disagree with Adam Smith that, whatever the circumstances 'such therefore are the advantages of water transport that … this conveniency opens the whole world to the produce of every sort of labour'.[102]

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]		Growth 99–04 (% p.a.)	Share in 2004%
	1999	**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

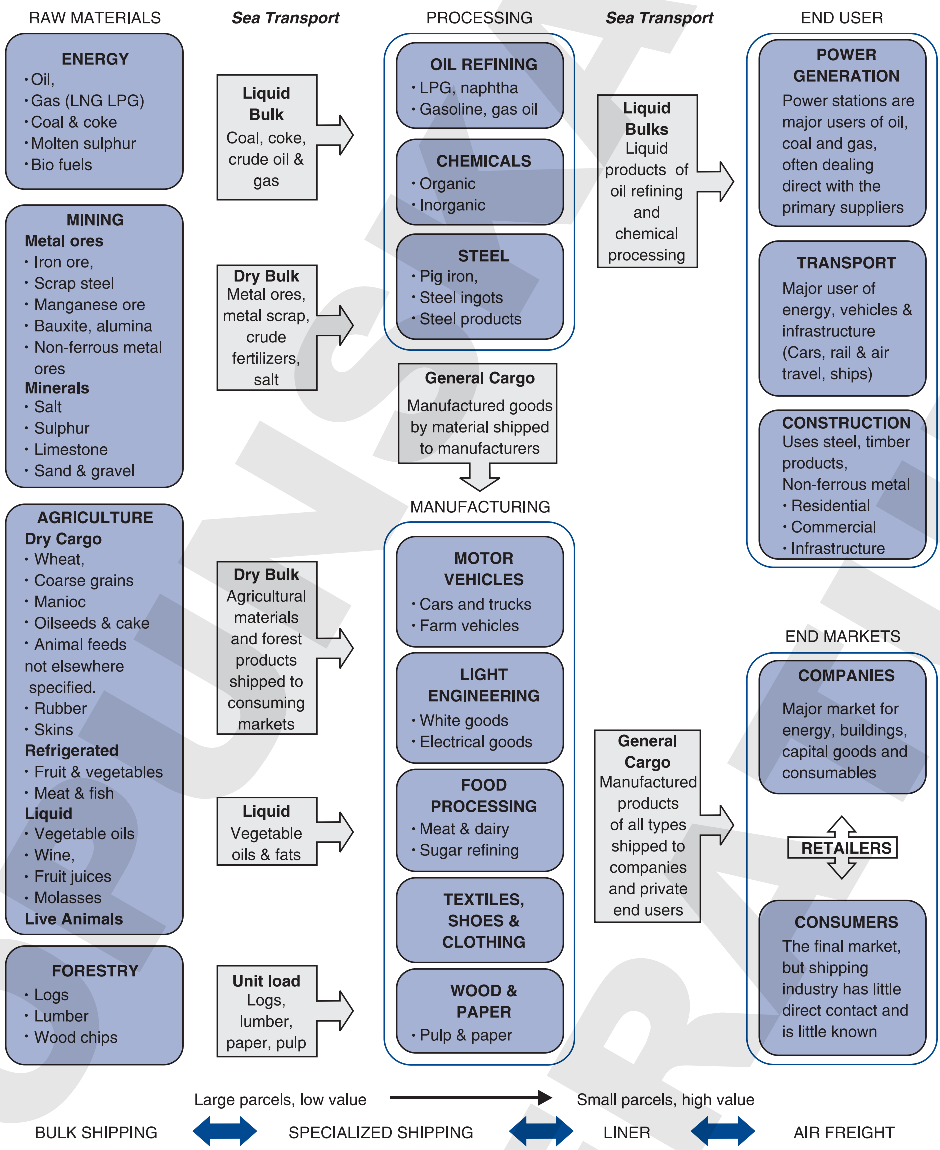


Figure 2.1
International transport system showing transport requirements
Source: Martin Stopford, 2007

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				
	1995	2000	2005	2006	% growth p.a. 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

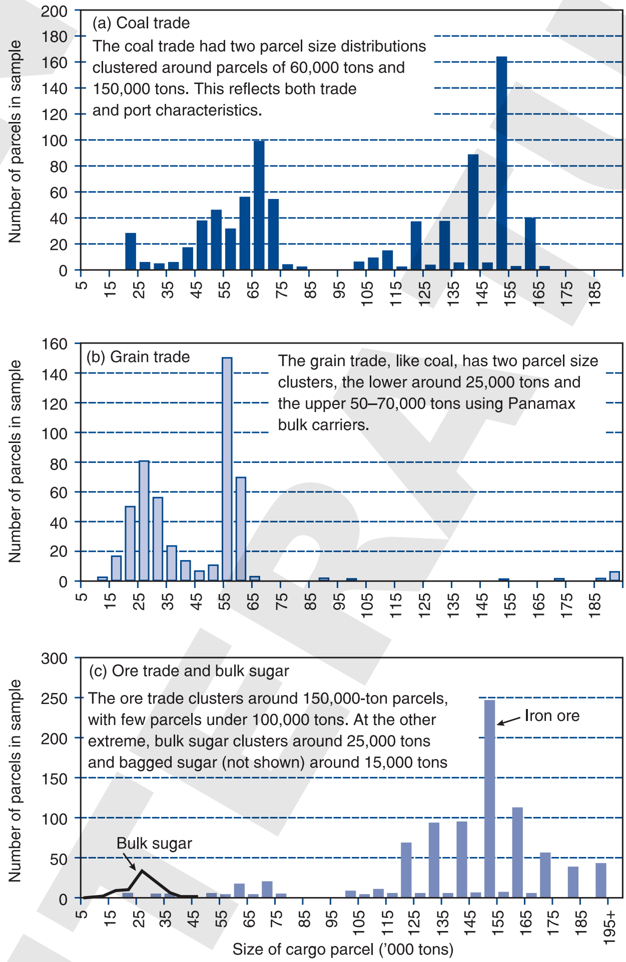


Figure 2.2
Parcel size distribution for coal, grain, ore and bulk sugar
Source: Sample of 7,000 dry cargo fixtures 2001–2

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.

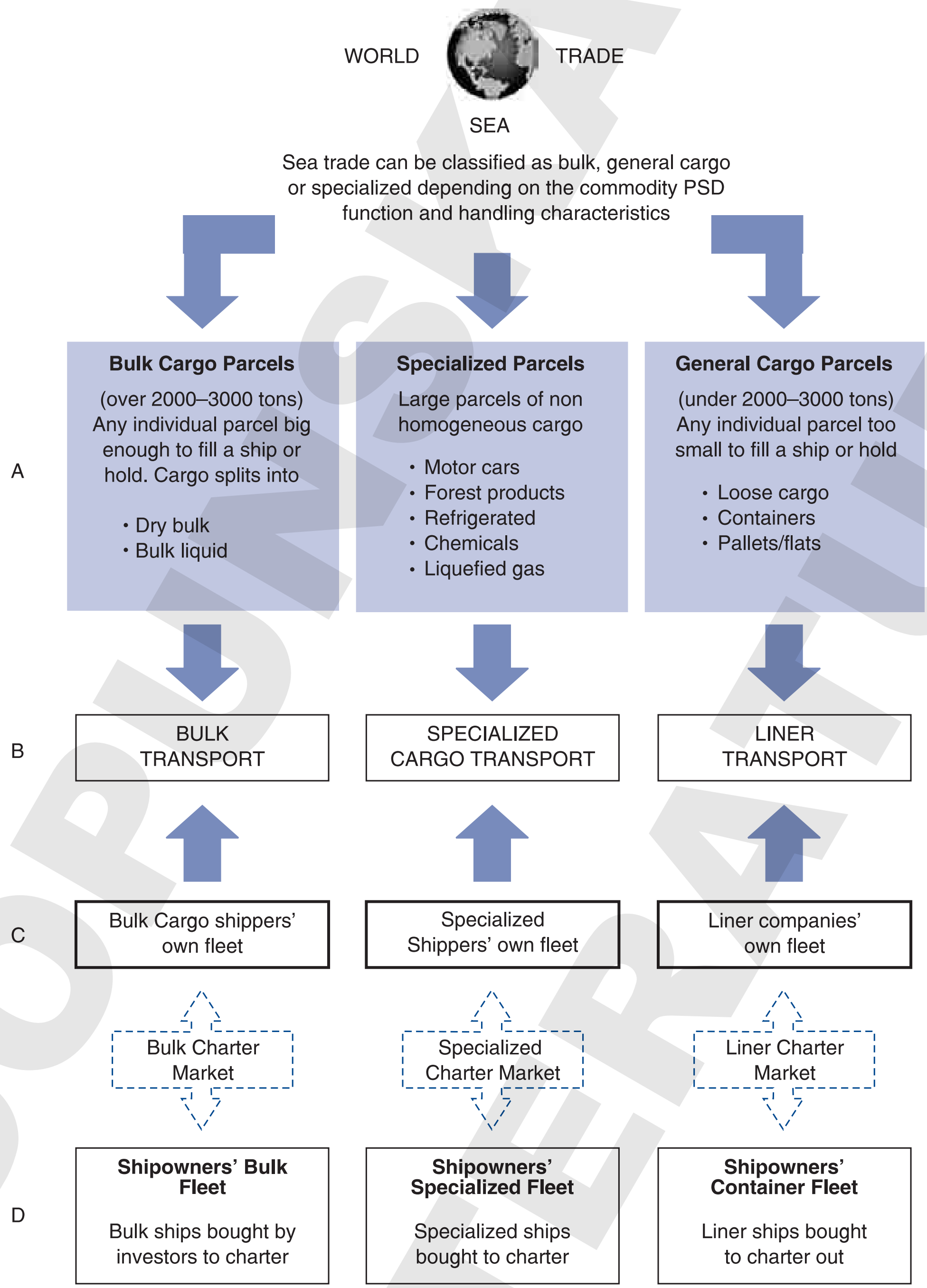
Together these introduce an element of differentiation into the business.

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?

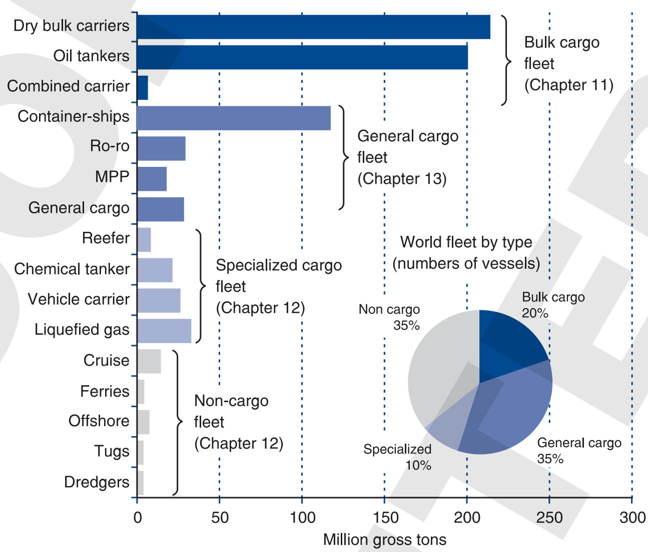


Figure 2.4
Merchant fleet classified by main cargo type. July 2007
Source: Clarkson Register, July 2007, CRS London

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

Table 2.5 Commercial shipping fleet by ship type, July 2007

No.	Name	Size	Numbers	Mill. GT	Mill. Dwt	Dwt/GT	Age	Comment
				Fleet size				
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

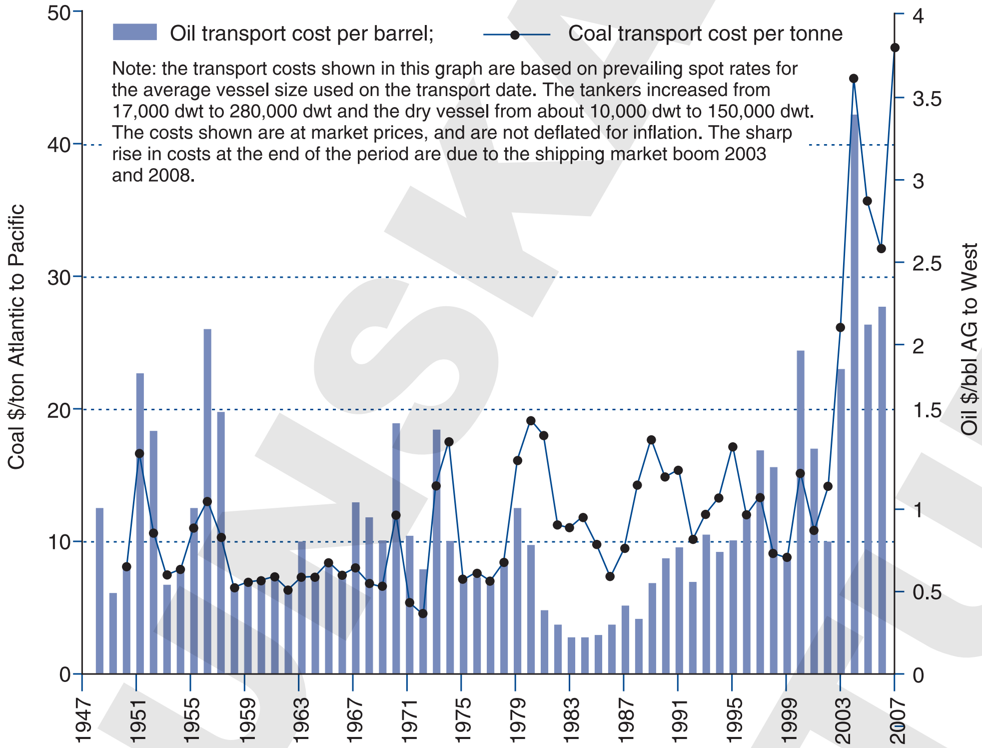


Figure 2.5
Transport cost of coal and oil, 1947–2007
Source: Compiled by Martin Stopford from various sources

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

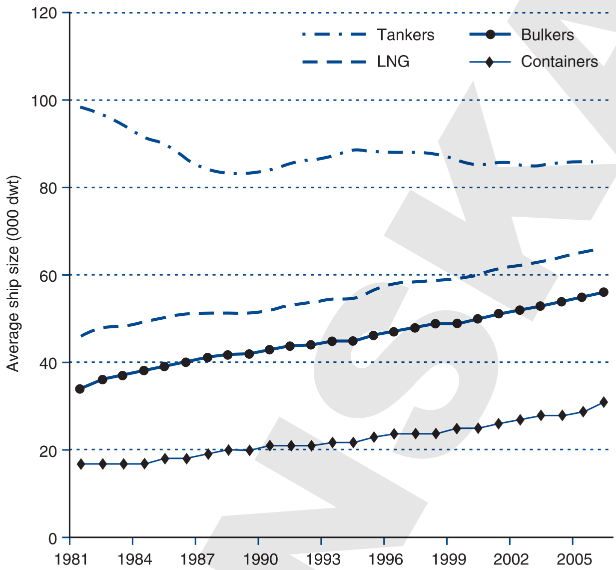


Figure 2.6
Ship size trends, 1980–2006
Source: Compiled from fleet data

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).

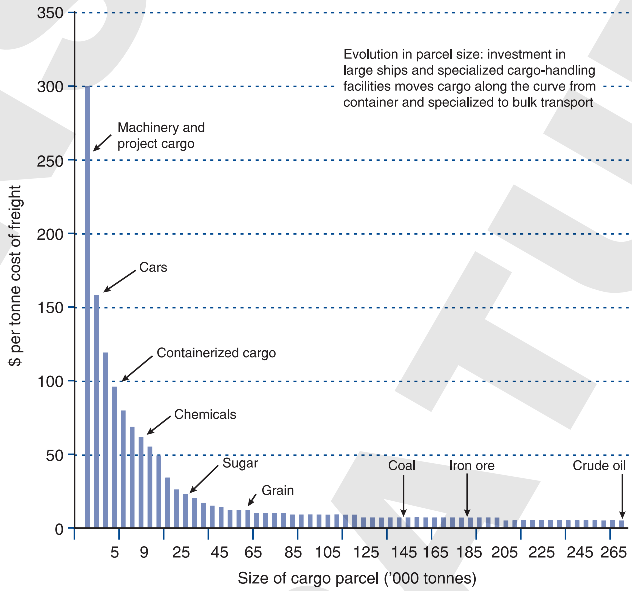


Figure 2.7
Shipping unit cost function: parcel size and transport cost
Source: Compiled by Martin Stopford from various sources

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.

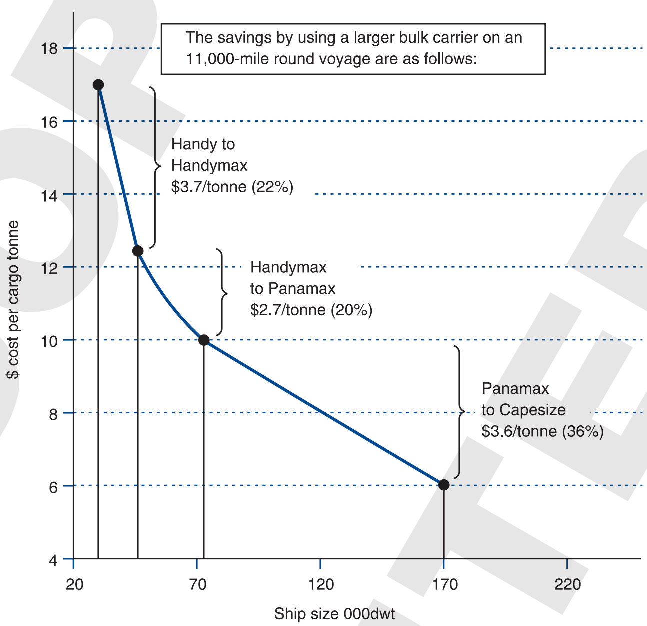


Figure 2.8
Economies of scale related to ship size for bulk carriers
Source: based on 11,000-mile round voyage from Table 10.5, Chapter 10

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.

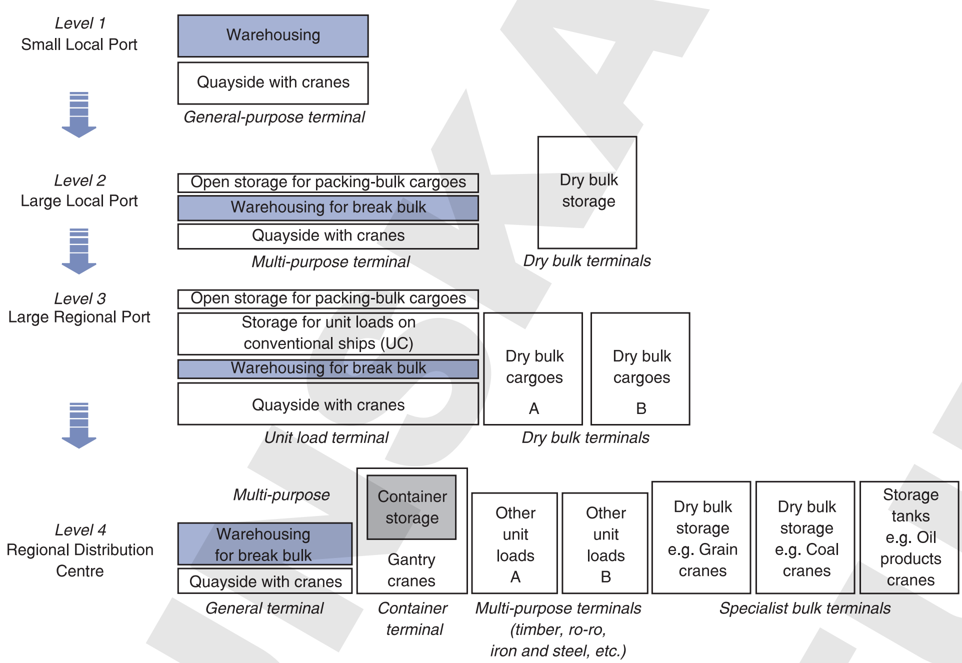


Figure 2.9
Four levels of port development
Source: Compiled by Matin Stopford from various sources

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

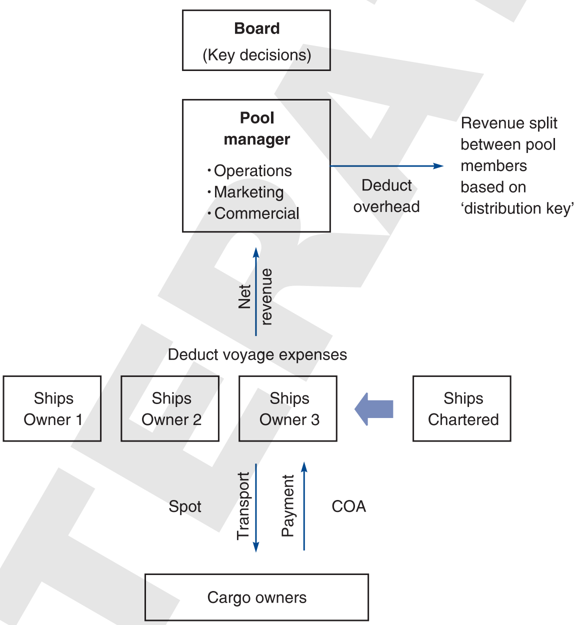


Figure 2.10
Structure of typical shipping pool
Source: Martin Stopford 2007

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.