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4 Supply, Demand and Freight Rates

The price of freight
Today is great
Because the ships, you'll understand,
Are high priced too,
Costing when new
Far more than they used to

If you'd know why
Their price is high,
Consider this, berth costs are great
Because the trade,
On which freight's paid
Grows faster than ships can be made

Only one thing left to know,
What it is that makes trade grow.
The world needs its grain and ore;
Sometimes less, but mostly more.
When judging if the price is high
What matters most is ... when you buy

(Martin Stopford 2007)

4.1 THE SHIPPING MARKET MODEL

The search for signposts

Now it is time to examine the economic mechanisms which control the shipping cycles discussed in the previous chapter. Shipowners have two jobs. One is to operate ships, a worthy task but not one that brings riches. The other is to be in the right place at the right time, to rake in the money at the peak of a cycle. Each twist of the cycle confronts shipping investors with a new opportunity or threat. In the space of a few months a shipowner's cashflow can swell from a trickle to a flood, and the market value of his fleet can change by millions of dollars. This is how the market manages investment in a difficult and uncertain world, and it presents shipping company management with quite a challenge.

The aim is to take advantage of the cycles to buy low and sell high. This is fair enough, as far as it goes, but this aspect of shipping is a game of skill and playing the cycles depends on being able to recognize – or, better still, predict – the peaks and troughs on the freight chart. Just being right is not enough. An investor may correctly predict a market peak, but if the charterers take the same view there will be no long-term contracts. Similarly, in market troughs owners may be ready to buy cheap ships, but who is willing to sell for a loss? As Michael Hampton pointed out, consensus is generally not a good signpost.[1] The best opportunities go to those who can judge when the other players in the market are wrong, and that means digging below the surface to understand the consequences of current developments (see Chapter 17 for a full discussion of forecasting).

From an economic viewpoint, each shipping cycle is unique. If we are to improve our understanding of what is going on in the market, we must now develop a theoretical explanation of how the freight market cycles are generated. To do this we will use the supply and demand model, a technique often used by economists to analyse commodity markets. The term 'model' is used here in just the same way as when we talk about a model ship – it is a smaller version of the real thing, leaving out those details that are not relevant to the present subject. The aim of the exercise, which is often referred to as 'fundamentals analysis', is to explain the mechanisms which determine freight rates in a consistent way.

4.2 KEY INFLUENCES ON SUPPLY AND DEMAND

The maritime economy is enormously complex, so the first task is to simplify the model by singling out those factors that are most important. This is not to suggest that detail should be ignored, but rather to accept that too much detail can hinder a clear analysis. In the initial stages at least we must generalize. From the many influences on the shipping market we can select ten as being particularly important, five affecting the demand for sea transport and five affecting the supply. These are summarized in Table 4.1.

Table 4.1 Ten variables in the shipping market model

Demand	Supply
1. The world economy	1. World fleet
2. Seaborne commodity trades	2. Fleet productivity
3. Average haul	3. Shipbuilding production
4. Random shocks	4. Scrapping and losses
5. Transport costs	5. Freight revenue

As far as the demand for sea transport is concerned (the 'demand function'), the five variables are the world economy, seaborne commodity trades, average haul, random shocks and transport costs. To explain the supply of shipping services (the 'supply function'), we focus on the world fleet, fleet productivity, shipbuilding deliveries, scrapping and freight revenues. The way in which these variables fit together into a simple model of the shipping market is shown in Figure 4.1. This model has three components, demand (module A), supply (module B), and the freight market (module C) which links the demand and supply by regulating the cashflow flowing from one sector to another.

How does the model work? The mechanics are very simple. In the demand module (A) the world economy, through business cycles and regional growth trends, determines

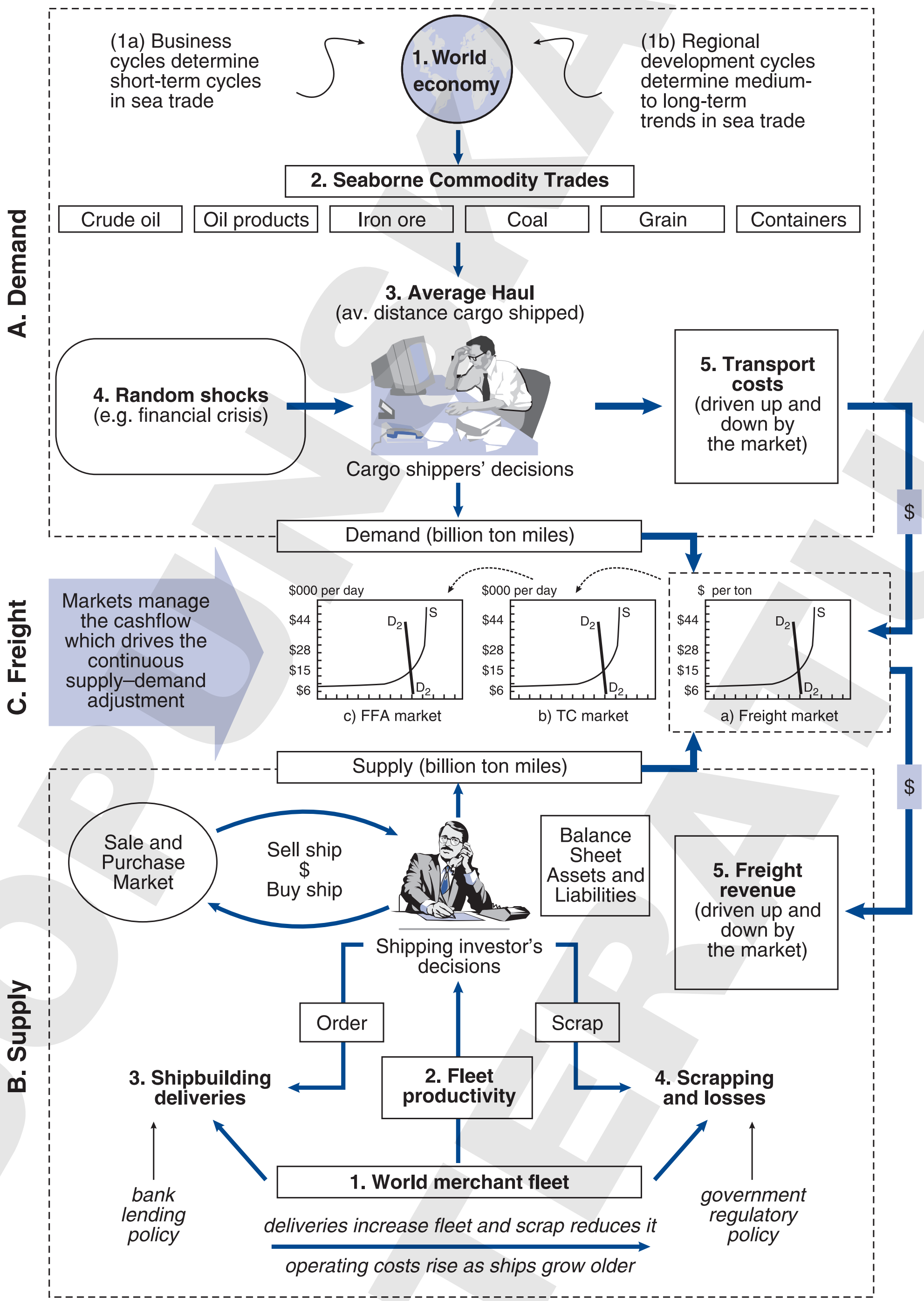


Figure 4.1
The shipping market supply and demand model
Source: Martin Stopford, 2008

the broad volume of goods traded by sea. Developments in particular commodity trades may modify the growth trends (e.g. development in the steel industry may influence the iron ore trade), as may changes in the average haul over which the cargo is transported. The final demand for shipping services measured in ton miles. (i.e. the tonnage of cargo multiplied by the average haul). The use of ton miles as a measure of demand is technically more correct than simply using the deadweight of cargo ships required, since it avoids making a judgement about the efficiency with which ships are used. That belongs more properly to the supply side of the model.

Turning to the supply module (B), in the short term, the world merchant fleet provides a fixed stock of transport capacity. When demand is low only part of this fleet may be trading and some ships will be laid up, or used for storage. The fleet can be increased by newbuilding and reduced by scrapping. The amount of transport this fleet provides also depends on the logistical efficiency with which ships are operated – in particular, speed and waiting time (see below). For example, a fleet of tankers steaming at 11 knots and returning from each cargo voyage in ballast carries less cargo in a year than the same size fleet of bulk carriers steaming at 14 knots and carrying a backhaul for all or part of its journey. This efficiency variable is generally referred to as 'fleet productivity' and is expressed in cargo ton miles per dwt per annum. Finally, the policies of banks and regulators have an impact on how the supply side of the market develops.

Dynamic links in the model

People play a central part in this shipping market model. At the heart of the demand module (A) are the *cargo shippers*. Their decisions over the sourcing of raw materials and the location of processing plant such as oil refineries determine how trade develops and, of course, they negotiate freight rates, time charters and FFAs. Many shippers are large corporations trading raw materials and manufactures, but in recent years they have been joined by commodity traders and operators who have cargo contracts for which ships are needed. The people who play a central part in supply module (B) are the *shipping investors*. The term 'shipping investor' is used because although many decision-makers will be private shipowners or shipping companies there are other important players – for example, German Kommanditgeseichllschaft (KG) companies which own containerships; oil traders which own tankers; and major oil companies with their own fleets. These shipping investors sit on the other side of the table from the cargo shippers in the freight negotiation and they also have the crucial task of ordering the new ships and scrapping old ones.

Imbalances between the supply and demand modules feed through into the third part of the model, the freight market (C), where freight rates are constantly adjusting in response to changes in the balance of supply and demand. This freight module is a 'switchbox' controlling the amount of money paid by shippers to shipowners for the transport of cargo, and it is this flow of money which drives the shipping market. For example when ships are in short supply, freight rates are bid up and the cash which flows into the bank accounts of shipowners affects the behaviour of both the cargo shippers and shipping investors (we discuss this 'behavioural' part of the model in more detail in Chapter 17). As the earnings of their ships rise, shipping investors rush to buy more second-hand ships, bidding up prices and then when second-hand ships become too expensive they turn to ordering new ships. As the new ships are delivered supply expands, but only after the time lag required to deliver the new ships – usually 18 months to 3 years. Meanwhile cargo shippers are responding to the high freight rates by looking for ways to cut transport costs by delaying cargoes, switching to closer supply sources or using bigger ships. But by this stage in the market cycle there is not a great deal they can do, and they have to grit their teeth and pay up.

When there are too many ships the process is reversed. Rates are bid down and shipowners have to draw on reserves to pay fixed costs such as repairs and interest on loans. As their reserves diminish, some owners are forced to sell ships to raise cash. If the downturn persists, eventually the price of older ships falls to a level where shipbreakers offer the best price and supply gradually reduces. Changes in freight rates may also trigger a change in the performance of the fleet, through adjustments to speed, or ships may be put into lay-up.

This model gives shipping market cycles their characteristic pattern of irregular peaks and troughs. Demand is volatile, quick to change and unpredictable; supply is ponderous and slow to change; and when the market is tightly balanced the freight mechanism amplifies even small imbalances at the margin. Thus the 'tortoise' of supply chases the 'hare' of demand across the freight chart, but hardly ever catches him. In a market with these dynamics we must expect 'balance', in the sense of steady earnings over several years, to be quite rare.

One final throught. At the heart of the model are people – shipping investors and cargo shippers. Their task is to negotiate the rate for each ship and inevitably the rates they agree vary depending on how the negotiating parties feel. A ship might be fixed for $20,000 per day on Monday, but the sister ship might be fixed for $30,000 per day on Tuesday because charterers got panicky overnight, perhaps due to some rumour they heard. Mathematical models cannot hope to simulate this sort of freight auction, so in the short term at least psychology is as important as fundamentals.

This, in summary, is the market model which controls shipping investment. In the remainder of this chapter we will examine the three sections of the model. Our main interest is not in the value of the variables themselves – we discuss this in later parts of the book. Rather it is to examine why each variable changes and the relationships between them. The model is dynamic in the sense that supply and demand are determined separately, with the two modules linked by the freight negotiation. But it is important to remember that the primary aim of the market mechanism is not to fix the freight rate, it is to coordinate the growth of supply and demand for sea transport in the hopelessly complex world in which shipping operates.

4.3 THE DEMAND FOR SEA TRANSPORT

We have suggested that ship demand, measured in ton miles of cargo, is mercurial and quick to change, sometimes by as much as 10–20% in a year. Ship demand is also subject to longer-term changes of trend. Looking back over the last two or three decades, there have been occasions when ship demand has grown rapidly over a sustained period, as happened in the 1960s, and others when ship demand stagnated and declined – notably, for example, the decade following the 1973 oil crisis.

The world economy

Undoubtedly, the most important single influence on ship demand is the world economy. It came up repeatedly in our discussion of shipping cycles in Chapter 3. Seventy years ago, in his review of the tramp market, Isserlis commented on the similar timing of fluctuations in freight rates and cycles in the world economy.[2] That there should be a close relationship is only to be expected, since the world economy generates most of the demand for sea transport, through either the import of raw materials for manufacturing industry or the trade in manufactured products. It follows that judging trends in the shipping market requires up-to-date knowledge of developments in the world economy. The relationship between sea trade and world industry is not, however, simple or direct. There are two different aspects of the world economy that may bring about change in the demand for sea transport: the business cycle and the trade development cycle.

The *business cycle* lays the foundation for freight cycles. Fluctuations in the rate of economic growth work through into seaborne trade, creating a cyclical pattern of demand for ships. The recent history of these trade cycles is evident from Figure 4.2, which shows the close relationship between the growth rate of sea trade and GDP over the period 1966–2006. Invariably the cycles in the world economy were mirrored by

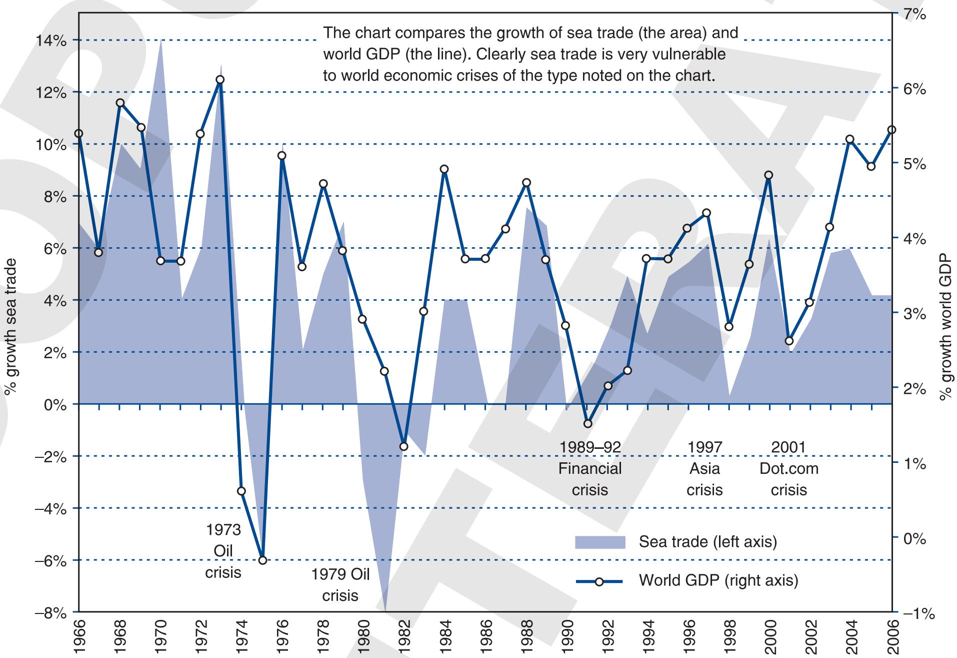


Figure 4.2
World GDP cycles and sea trade
Source: World Bank, *Fearnleys Review*

cycles in sea trade. Note, in particular, that the deep sea trade recessions in 1975, 1983 and 1988 coincided with recessions in the world economy. Since world industrial production creates most of the demand for commodities traded by sea, this is hardly surprising. Clearly the business cycle is of major importance to anyone analysing the demand side of the shipping market model.

Nowadays most economists accept that these economic cycles arise from a combination of external and internal factors. The external factors include events such as wars and sudden changes in commodity prices such as crude oil, which cause a sudden change in demand. Internal factors refer to the dynamic structure of the world economy itself, which, it is argued, leads naturally to a cyclical rather than a linear growth path. Among the more commonly quoted causes of business cycles are the following:

- *The multiplier and accelerator*. The main internal mechanism which creates cycles is the interplay between consumption and investment. Income (gross national product or GNP) may be spent on investment goods or consumption goods. An increase in investment (e.g. road building) creates new consumer demand from the workers hired. They spend their wages, creating even more demand (the investment multiplier). As the extra consumer expenditure trickles through the economy, growth picks up (the income accelerator), generating demand for even more investment goods. Eventually labour and capital become fully utilized and the economy over-heats. Expansion is sharply halted, throwing the whole process into reverse. Investment orders fall off, jobs are lost and the multiplier and accelerator go into reverse. This creates a basic instability in the economic 'machine'.[3]
- *Time-lags*. The delays between economic decisions and their implementation can make cyclical fluctuations more extreme. The shipping market provides an excellent example. During a market boom, shipowners order ships that are not delivered until the market has gone into recession. The arrival of the new ships at a time when there is already a surplus further discourages new ordering just at the time when shipbuilders are running out of work. The result of these time-lags is to make booms and recessions more extreme and cyclical.
- *Stockbuilding* has the opposite short-term effect. It produces sudden bursts of demand as industries adjust their stocks during the business cycle. The typical stock cycle, if such a thing exists, goes something like this. During recessions financially hard-pressed manufacturers run down stocks, intensifying the downturn in demand for sea transport. When the economy recovers, there is a sudden rush to rebuild stocks, leading to a sudden burst of demand which takes the shipping industry by surprise. Fear of supply shortages or rising commodity prices during the recovery may encourage high stock levels, reinforcing the process. On several occasions shipping booms have been driven by short-term stockbuilding by industry in anticipation of future shortages or price rises. Examples are the Korean War in 1952–3, the dry cargo boom of 1974–5, and the tanker mini-booms in 1979 and summer 1986, both of which were caused by temporary stockbuilding by the world oil industry.
- Some economists argue that cycles are intensified by *mass psychology*. Pigou put forward the theory of 'non-compensated errors.[4] If people act independently, their

> errors cancel out, but if they act in an imitative manner a particular trend will build up to a level where they can affect the whole economic system. Thus periods of optimism or pessimism become self-fulfilling through the medium of stock exchanges, financial booms and the behaviour of investors.

All of the above factors contribute to the cyclical nature of the world economy, but in terms of the shipping markets the peaks and troughs they produce are not generally severe enough to threaten the survival of well run businesses. The severe cycles shown in Figure 4.2 are almost all associated with 'random shocks' which fall outside the normal business cycle mechanism. From the analyst's viewpoint this distinction is important because the random shocks trigger extreme market conditions. We will discuss random shocks in more detail later in this section.

To help in predicting business cycles, statisticians have developed 'leading indicators' which provide advance warning of turning points in the economy. For example, the OECD publishes an index based on orders, stocks, the amount of overtime worked and the number of workers laid off, in addition to financial statistics such as money supply, company profits and stock market prices. It is suggested that the turning point in the lead index will anticipate a similar turning point in the industrial production index by about 6 months. To the analyst of short-term market trends such information is useful, though few believe that business cycles are reliably predictable. Two quotations serve to illustrate the point:

> No two business cycles are quite the same; yet they have much in common. They are not identical twins, but they are recognisable as belonging to the same family. No exact formula, such as might apply to the motions of the moon or of a simple pendulum, can be used to predict the timing of future (or past) business cycles.[5]
>
> A remark that can perhaps be made about industrial cycles in general is certainly applicable to the shipping industry: it is certain that these cycles exist; their periodicity – the interval from peak to peak – is variable; and their amplitude is variable; the position of the peak or of the trough of a cycle in progress is not predictable. An ad hoc explanation can usually be found for each period of prosperity and for each phase of the cycle if sufficient knowledge is available of the conditions at the time ... but it is impossible to predict the occurrence of the successive phases of a cycle which is in progress, and still more so in the case of a cycle which has not yet commenced.[6]

In conclusion, the 'business cycle' in world industry is the most important cause of short-term fluctuations in seaborne trade and ship demand. However business cycles, like the shipping cycles to which they contribute, do not follow in an orderly progression. We must take many other factors into account before drawing such a conclusion, in particular drawing a distinction between the business cycles and random shocks.

We now turn to the long-term relationship between seaborne trade and the world economy. Over a period of years does sea trade grow faster, slower, or at the same rate as industrial output? There are two reasons why, over long periods, the trade growth of individual regions will probably change.

One major reason is that the economic structure of the countries generating seaborne trade is likely to change over time – countries, like people, mature as they age! For example, changes in the industrial economies of Europe and Japan in the 1960s had a major impact on sea trade, producing a period of rapid growth from 1960 to 1970, followed by an equally sudden stagnation in the 1970s, as shown in Figure 4.3. A similar pattern occurred in the early 1990s, as South Korea and other Asian countries moved along the industrial path, producing the very high trade growth. By the early twenty-first century China was moving along the same path. These changes in trade are driven by changes in demand for bulk commodities such as iron ore. As industrial economies mature, economic activity becomes less resource-intensive, and demand switches from construction and stock-building of durables, such as motor cars, to services, such as medical care and recreation, with the result that there is a lower requirement for imported raw materials.[7] This contributed to the slower import growth of Europe and Japan during the 1970s and 1980s and will be important for China in the future. This sequential approach to development, known as the trade development cycle, is discussed in more detail in Chapter 10.

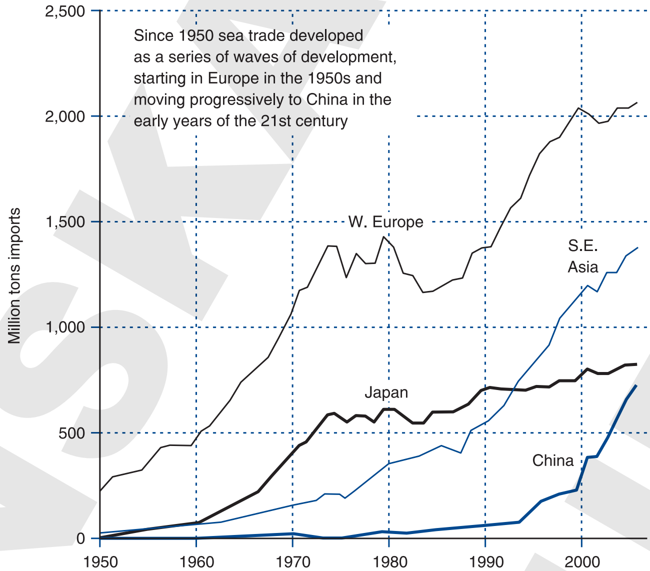


Figure 4.3
Regional trade development cycles, 1950–2005
Source: United Nations

The second influence the world economy has on trade concerns the ability of local resources of food and raw materials to meet local demand. When domestic raw materials are depleted users turn to foreign suppliers, boosting trade – for example, iron ore for the European steel industry during the 1960s and crude oil for the USA market during the 1980s and 1990s. Or the cause may be the superior quality of foreign supplies, and the availability of cheap sea transport.

Seaborne commodity trades

To find out more about the relationship between sea trade and the industrial economy we turn to the second demand variable, the seaborne commodity trades. The discussion falls into two parts: short-term and long-term.

An important cause of short-term volatility is the *seasonality* of some trades. Many agricultural commodities are subject to seasonal variations caused by harvests, notably grain, sugar and citrus fruits. Grain exports from the US Gulf reach a trough in the summer then build up in September as the crop is harvested. Trade may increase by as much as 50% between September and the end of the year. In the oil business there is also a cycle that reflects the seasonal fluctuation in energy consumption in the Northern Hemisphere, with the result that more oil is shipped during the autumn and early winter than during the spring and summer. Much the same seasonality is found in the liner trade, with seasonal peaks and troughs coinciding, for example, with major holidays such as the Chinese New Year and Christmas.

Seasonality has a disproportionate effect on the spot market. Transport of seasonal agricultural commodities is difficult to plan, so shippers of these commodities rely heavily on the spot charter market to meet their tonnage requirements. As a result, fluctuations in the grain market have more influence on the charter market than some much larger trades such as iron ore where tonnage requirements are largely met through long-term contracts. Some agricultural produce, such as fruit, meat and dairy produce, require refrigeration. For this trade, special ‘reefer’ ships and reefer containers are required.

Long-term trends in commodity trade are best identified by studying the economic characteristics of the industries which produce and consume the traded commodities. This is a topic we will examine in Chapters 11 and 12. Although every business is different, there are four types of change to look out for: changes in the demand for that particular commodity (or the product into which it is manufactured); changes in the source from which supplies of the commodity are obtained; changes due to a relocation of processing plant which changes the trade pattern; and finally changes in the shipper’s transport policy.

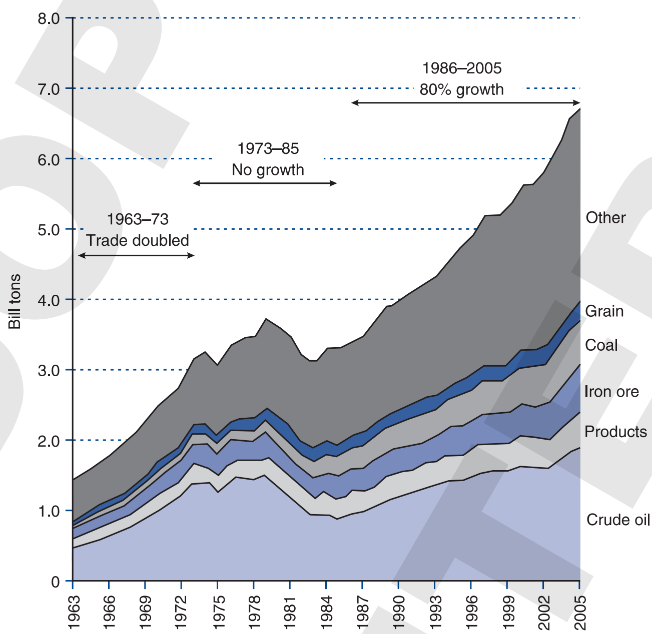


Figure 4.4
Major seaborne trades by commodity
Source: *Fearnleys Review*

A classic example of *changes in demand* is the trade in crude oil, which Figure 4.4 shows is the largest individual commodity traded by sea. During the 1960s, crude oil demand grew two or three times as fast as the general rate of economic growth because oil was cheap and the economies of western Europe and Japan switched from coal to oil as their primary energy source. Imported oil replaced domestic coal, and the trade elasticity was very high. However, with the increase in oil prices during the 1970s, this trend was reversed and the demand for crude oil first stagnated and then declined. Coal regained some of its original market share and the oil trade elasticity fell.

The oil trade also provides a good illustration of the importance of *changes in supply sources*. In the 1960s the main source of crude oil was the Middle East. However, in the 1970s new oil reserves near to the market, such as the North Sea and Alaska, came on stream, reducing the need for deep sea imports. Depletion of local resources provides another example of how changing supply sources affect seaborne trade. An example is provided by Chinese iron ore imports. Until the 1990s China relied on iron ore produced locally to supply its steel industry. However, with the expansion of the steel industry in the 1990s, it became increasingly difficult to meet demand from this source and, as high-grade iron ore was shipped in from Brazil and Australia, domestic supplies were progressively replaced by imports. This run-down of local supplies, combined with rapidly growing demand, resulted in spectacular growth of iron ore imports.

Relocation of the processing of industrial raw materials can also affect the volume of cargo shipped by sea and the type of ship required. Take, for example, the aluminium industry. The raw material of aluminium production is bauxite. It takes about 3 tons of bauxite to produce 1 ton of alumina and 2 tons of alumina to produce 1 ton of aluminium. Consequently, a commercial decision to refine bauxite to alumina before shipment reduces the volume of cargo shipped by sea by two-thirds. Alumina has a higher value and is used in smaller quantities than bauxite, so the transport requirement switches from larger vessels suitable for the bauxite trade to smaller bulk carriers suitable for alumina. Another example is the refining of crude oil to products before shipment by exporters. This does not affect the volume transported, but it affects the parcel size and the tank coatings required.

Sometimes processing does not actually reduce the volume of cargo but changes the shipping requirement. In the early days of the oil trade, crude oil was refined at source and transported as oil products in products carriers. In the early 1950s, the oil companies moved towards the transport of crude oil, locating their refineries at the market. This led to the construction of very large crude carriers. Similarly, forest products were originally shipped as logs, but with developing sophistication in the industry there has been a trend towards processing logs into sawn lumber, woodchips, panels or wood pulp prior to shipment. While this did not have a major impact upon the volume of cargo, it resulted in the construction of special forest product carriers.

Finally, we come to the fourth long-term item, the shipper's *transport policy*. This is well illustrated by the oil industry. Until the 1970s the major oil companies planned and controlled the sea transport of oil. The oil companies planned their tonnage requirements, building ships or signing long-time charters with shipowners. The oil trade grew regularly and any minor errors in their planning would quickly be corrected. In this highly structured environment the role of the spot market was relegated to less than 10% of total transport requirements. It was there to cover seasonal fluctuations, minor misjudgements in the speed of trade growth and the occasional mishap such as the closure of the Suez Canal.

After the 1973 oil crisis the oil trade became more volatile and oil company policy changed. Faced with uncertainty over trade volume, the oil shippers relied more heavily on the spot market for their transport requirements. By the 1990s the spot market's share of oil shipments had increased from 10% to almost 50%. This trend was reinforced by a change in the commercial structure of the oil business. After 1973 the control of oil transport changed. Producers, oil companies in industrializing areas such as South Korea and oil traders, who had less incentive to become directly involved in oil transport, started to play a bigger part.

The commodity developments outlined above are not usually of major significance when considering short-term cycles in ship demand, since changes of this type do not take place overnight. They are, however, of considerable importance when judging the medium-term growth of demand and the employment prospects for particular ship types. As a result, any thorough medium-term analysis of the demand for sea transport needs to consider carefully the development of the commodity trades. Further discussion of the major commodity trades can be found in Chapters 10 and 11.

Average haul and ton miles

Transport demand is determined by a precise matrix of distances which determine the time it takes the ship to complete the voyage. A ton of oil transported from the Middle East to western Europe via the Cape travels five times as far as a ton of oil shipped from Ceyhan in Turkey to Marseilles. This distance effect is generally referred to as the 'average haul' of the trade. To take account of average haul, it is usual to measure sea transport demand in terms of 'ton miles', which can be defined as the tonnage of cargo shipped, multiplied by the average distance over which it is transported.

The effect on ship demand of changing the average haul has been dramatically illustrated several times in recent years by the closure of the Suez Canal, which increased the average distance by sea from the Arabian Gulf to Europe from 6,000 miles to 11,000 miles. As a result of the sudden increase in ship demand there was a freight market boom on each occasion. Another example was the closure of the Dortyol pipeline from Iraq to Turkey when Iraq invaded Kuwait in 1990. As a result 1.5 million barrels per day of oil which had previously been shipped from the East Mediterranean had to be shipped from the Arabian Gulf.

In most trades we find that the average haul has changed over the last few decades. Figure 4.5 shows the average haul of crude oil, oil products, iron ore, coal and grain during the period 1963–2005. In the crude oil trade, the average haul jumped from 4,500 miles in 1963 to over 7,000 miles a decade later, fell precipitately back to 4,500 in 1985 and then increased to 5400 miles. The products trade was stable at about 3800 miles until the early 1980s when long-haul exports from Middle East refineries pushed the average up to 5,000 miles. There was also rapid growth in the average haul in the iron ore and coal trades, both of which increased steadily from about 3,000 miles in 1963 to over 5,000 by the early 1980s.

Analysing changes in the average haul of a commodity trade can be extremely complex, requiring information in the form of detailed trade matrices, but very often the key issue is simply the balance between long-haul and short-haul suppliers.

For example, in the oil trade some oil producers are located close to the major consuming markets: Libya, North Africa, the North Sea, Mexico, Venezuela and Indonesia are all located close to their principal markets in western Europe, Japan and the United States. Oil not obtained from these sources is, of necessity, shipped from the Middle East, which is about 11,000 miles from western Europe and the USA and about 6,500 miles from Japan. Consequently, the average haul in the oil trade depends upon the balance of output from these two groups of suppliers. The rapidly increasing haul during the 1960s can be explained by the growing share of the Middle East in total oil exports, while the declining haul during the mid-1970s reflected the cut-back in Middle East supplies as new short-haul sources such as Alaska, the North Sea and Mexico came on stream against the background of a declining oil trade.

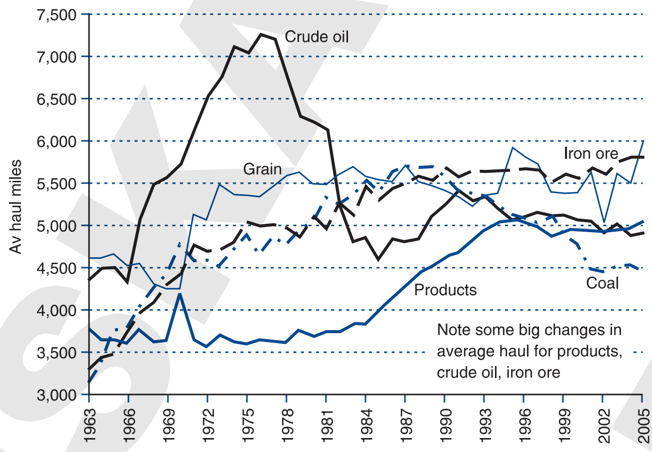


Figure 4.5
Average haul of commodity trades 1963–2005
Source: Fearnleys *World Bulk Trades*

A similar pattern can be found in the iron ore, and bauxite trades. In the early 1960s the major importers drew their supplies from local sources – Scandinavia in the case of iron ore and the Caribbean for bauxite. As the demand for imports increased, more distant supplies became available, the cost being offset to a large extent by the economies of scale obtainable from the use of large bulk carriers. Thus the European and Japanese iron ore markets came to be supplied principally from long-haul sources in Brazil and Australia and the bauxite market from Australia and West Africa.

The impact of random shocks on ship demand

No discussion of sea transport demand would be complete without reference to the impact of politics. *Random shocks* which upset the stability of the economic system may contribute to the cyclical process. Weather changes, wars, new resources, commodity price changes, are all candidates. These differ from cycles because they are unique, often precipitated by some particular event, and their impact on the shipping market is often very severe.

The most important influence on the shipping market are economic shocks. These are specific economic disturbances which are superimposed on business cycles, often with dramatic effects. A prominent example was the 1930s depression which followed the Wall Street Crash of 1929 and caused trade to decline. More recent examples, the effects of which are clearly visible in Figure 4.2, are the two oil price shocks which happened in 1973 and 1979. On both occasions, industrial output and seaborne trade suddenly declined, setting off a shipping depression. Some economists think the whole cyclical process can be explained by a stream of random shocks which make the economy oscillate at its 'resonant frequency'. The US financial crisis of the early 1990s, the Asia Crisis of 1997 and the stock market crash in 2000 are other examples. The singular feature of these economic shocks is that their timing is unpredictable and they bring about a sudden and unexpected change in ship demand.

In addition to economic shocks, from time to time political events such as a localized war, a revolution, the political nationalization of foreign assets or strikes can disrupt trade. Events of this type do not necessarily impact directly on ship demand; it is generally their indirect consequences that are significant. The various wars between Israel and Egypt had important repercussions, owing to the proximity of the Suez Canal and its strategic importance as a shipping route between the Mediterranean and the Indian Ocean. The more protracted and extensive war between Iran and Iraq had no such effect, and if anything probably reduced the demand for sea transport by encouraging oil importers to obtain their supplies from other sources, most of which were closer to the market. The impact of the Korean war in the early 1950s was felt through its effect on commodity stockpiling, while the invasion of Kuwait by Iraq in 1990 created a short tanker boom because speculators started to use tankers for oil storage.

Having made these reservations, the regularity with which political events have, by one means or another, turned the shipping market on its head is quite striking. Leaving aside the First and Second World Wars, since 1945 there have been at least nine political incidents that have had a significant influence on ship demand:

- The Korean War, which started in early 1950. Although cargo associated directly with the war was mainly transported by ships of the US reserve fleet, political uncertainty sparked off a stockbuilding boom in Western countries.
- The Suez crisis, the nationalization of the Suez Canal by the Egyptian government in July 1956 and the subsequent invasion of Egypt and closure of the canal in November. Oil tankers trading to Europe were diverted round the Cape, and this created a sudden increase in ship demand.
- The Six Day War between Israel and Egypt in May 1967 resulted in the closure of the Suez Canal. European oil imports were again diverted round the Cape.
- The closure of the Tap Line oil pipeline between Saudi Arabia and the Mediterranean in 1970 redirected crude oil previously shipped through the pipeline around the Cape.
- The nationalization of Libyan oil assets in August 1973 resulted in the oil companies turning to the more distant Middle East producers for oil supplies.
- The Yom Kippur War in October 1973 and the OPEC production cut-back triggered the collapse of the tanker market. The associated oil price rise had an effect on the world economy and the shipping market that was to last more than a decade.

- The 1979 Iran Revolution and the temporary cessation of Iranian oil exports precipitated a major increase in the price of crude oil, with significant repercussions for the world economy and the shipping market.
- The 1990–1 Gulf War which resulted in the closure of the Dortyol pipeline and a phase of short-term oil stockbuilding. Both increased tanker demand.
- The Venezuelan oil strike in 2002–3 which reduced Venezuela's exports to almost nothing for several months, requiring US imports to be sourced from more distant suppliers

Other political events have had a more localized effect on the shipping market. For example, the Falklands War in 1982 resulted in the British government chartering ships from UK owners. In the early 1960s, the Cuban crisis resulted in Cuban sugar exports being diverted to the USSR and China, while US importers obtained their supplies from other sources, again causing some disruption of the shipping market. The Iran–Iraq War of 1982 had localized effects on the tanker market.

On this evidence it is clear that any balanced view of the development of the shipping market must take account of potentially important facts of a political nature. Information of this type is often outside the experience of market analysts, with the result that few market forecasts take very much account of such factors. However, in this case, the facts speak for themselves in emphasizing the importance of this topic as a regular contributor to the mercurial behaviour of ship demand.

Transport costs and the long-run demand function

Finally, we come to the cost of sea transport. Many of the developments in sea trade of the type discussed in the previous section depend on the economics of the shipping operation. Raw materials will only be transported from distant sources if the cost of the shipping operation can be reduced to an acceptable level or some major benefit is obtained in quality of product. This makes transport costs a significant factor for industry – according to an EEC study, in the early 1980s transport costs accounted for 20% of the cost of dry bulk cargo delivered to countries within the Community.[8]

Over the last century, improved efficiency, bigger ships and more effective organization of the shipping operation have brought about a steady reduction in transport costs and higher quality of service. In fact the cost of shipping a ton of coal from the Atlantic to the Pacific, which hardly changed between 1950 and 1994, was achieved by using bigger ships (Figure 4.6). In 1950 the coal would have travelled in a 20,000 dwt vessel at a cost of $10–15 per ton. Forty years later a 150,000 dwt bulker would be used, still at $10–15 per ton. There can be little doubt that this has contributed materially to the growth of international trade. Developing this point, Kindleberger comments: 'what the railway did for the development of national markets in England and France the development of cheap ocean shipping has done for world trade. New channels of trade have been opened up, new links forged.'[9] Although transport costs may not appear to have such a dramatic influence upon seaborne trade as the world economy, their long-term effect on trade development should not be underrated.

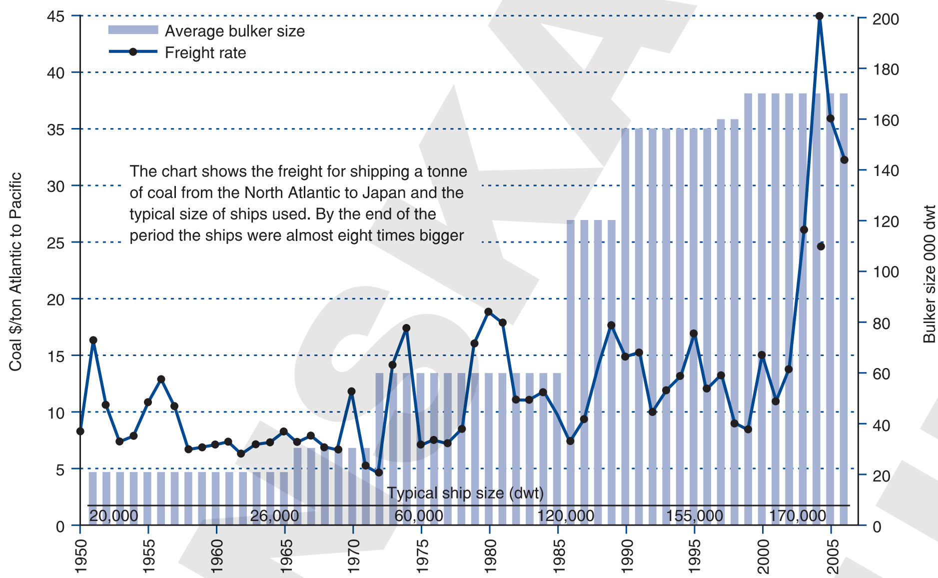


Figure 4.6
Coal transport costs from Hampton Roads to Japan, 1950–2006
Source: Compiled by Martin Stopford from various broker's reports

4.4 THE SUPPLY OF SEA TRANSPORT

In the introduction to this chapter we characterized the supply of shipping services as being slow and ponderous in its response to changes in demand. Merchant ships generally take about a year to build and delivery may take 2–3 years if the shipyards are busy. This prevents the market from responding promptly to any sudden upsurge in demand. Once built, the ships have a physical life of 15–30 years, so responding to a fall in demand is a lengthy business, particularly when there is a large surplus to be removed. Our aim in this section is to explain how this adjustment process is controlled.

The decision-makers who control supply

We start with the decision-makers. The supply of ships is controlled, or influenced, by four groups of decision-makers: shipowners, shippers/charterers, the bankers who finance shipping, and the various regulatory authorities who make rules for safety. Shipowners are the primary decision-makers, ordering new ships, scrapping old ones and deciding when to lay up tonnage. Shippers may become shipowners themselves or influence shipowners by issuing time charters. Bank lending influences investment and it is often banks who exert the financial pressure that leads to scrapping in a weak market. Regulators affect supply through safety or environmental legislation which affects the transport capacity of the fleet. For example, the update to International Maritime Organization (IMO) Regulation 13G introduced in December 2003 requires single hull tankers to be phased out by 2010, leaving shipowners with no choice over the life extension of their ships.[10]

At this point, a warning is needed. Because the supply of shipping capacity is controlled by this small group of decision-makers, the supply-side relationships in the shipping model are behavioural. If we draw an analogy with a poker game, there are many ways of playing a particular hand. The player may be cautious, or he may decide to bluff. All his opponent can do is make the best judgement he can based on an assessment of character and how he played previous hands. Exactly the same problem faces shipping analysts trying to judge the relationship between, for example, freight rates and newbuilding orders. The fact that high freight rates have stimulated orders in the past is no guarantee that the relationship will hold in future. Market behaviour cannot be explained in purely economic terms. In 1973, when freight rates were very high, shipowners ordered more tankers than could possibly have been required to meet even the most optimistic forecast of oil trade growth. Similarly, in 1982–3 and 1999 when freight rates were low, there was an ordering boom for bulk carriers. It is in situations like this that clear-sighted analysts have something to say.

The merchant fleet

The starting point for a discussion of the supply of sea transport is the merchant fleet. The development of the fleet between 1963 and 2005 is shown in Figure 4.7. Although it was a bumpy ride, this was a period of rapid growth and the merchant fleet increased from 82 m.dwt in 1963 to 740 m.dwt in 2004. It was a period of great change, and over the forty years the ship type composition of the fleet changed radically.

In the long run scrapping and deliveries determine the rate of fleet growth. Since the average economic life of a ship is about 25 years, only a small proportion of the fleet is scrapped each year, so the pace of adjustment to changes in the market is measured in years, not months. A key feature of the shipping market model is the mechanism by which supply adjusts when ship demand does not turn out as expected. Looking back over the last three decades we find examples of the merchant fleet in both expansion and contraction phases. It can be seen in Figure 4.7 that the adjustment process involved changes in the type of ship within the fleet.

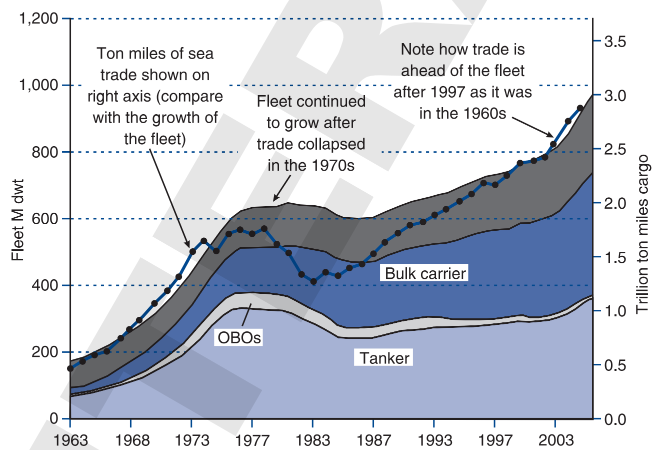


Figure 4.7
World fleet by ship type 1973–2006
Source: *Fearnleys Annual Review* (cargo)

Starting in the early 1960s, the *oil tanker fleet* went through a cycle of growth and contraction that took over 20 years to achieve. Between 1962 and 1974 the demand for seaborne oil transport, measured in ton miles, almost quadrupled and, despite the expansion of shipyard capacity, by the late 1960s supply could not keep up with demand (compare sea trade growth with fleet growth in Figure 4.7). As a result, there was an acute shortage of tanker capacity; in the early 1970s tankers were in such short supply that ships were sold 'off the stocks' for twice their original contract price – in the peak freight market of 1973 the profits on a few voyages were sufficient to pay off the investment in the ship. This led to record orders for new ships.

In the mid-1970s the whole process was thrown into reverse. Over the next decade tanker demand fell by 60% and the tanker market was confronted with the problem of bringing supply and demand into balance. It took about 10 years for supply to adjust to such a major change in demand. The fleet statistics in Figure 4.7 show what happened. After the collapse of the trade in 1975, the fleet continued to grow as the orders placed in 1973 were delivered, reaching a peak of 336 m.dwt in 1977. Scrapping did not start until the owners of the vessels became convinced that there was no future for them. This position was reached in the early 1980s when the second-hand price of VLCCs, some of which had cost $50–60 million to build in the mid-1970s, fell to $3 million. There was so little demand that sometimes ships put to auction did not attract a bid. The only buyers were shipbreakers. As scrap sales increased the fleet started to decline, reaching a trough in 1985. When the oil trade recovered in the late 1980s, supply and demand grew closer together, and freight rates increased. The whole cycle took about 14 years and by 2007 the tanker fleet was still only 354 m.dwt.

The *combined carrier fleet* links the wet and dry markets. Combination tonnage was pioneering in the early 1950s to obtain high cargo performance by carrying oil in one direction with a return load of dry cargo. However, real growth of the fleet was sparked off by the closure of the Suez Canal in 1967, when combined carrier owners, who had previously traded mainly in dry cargo, were able to take advantage of the very favourable oil freight market. Many orders were placed in the next few years and the fleet reached a peak of 48.7 m.dwt in 1978 and then declined to below 20 m.dwt in the 1990s. Most of the fleet is in the 80,000–200,000 dwt size group, which limits its activities in dry bulk to the larger bulk cargoes such as iron ore, or part cargoes of grain and coal.

Dry *bulk carriers* started to appear in the shipping market in the late 1950s, and between 1963 and 1996 the bulk fleet grew from 17 m.dwt to 237 m.dwt. The use of large bulk carriers played an integral part in the growth of major deep-sea bulk trades such as iron ore and coal, because economies of scale allowed these raw materials to be imported at very low cost. During the same period, there was a progressive switch of cargoes such as grain, sugar, minor ores, and steel products, which had previously been carried in'tweendeckers or as bottom cargo in liners, into dry bulk carriers. The market widening meant that the market share of bulk tonnage grew steadily during the 1960s and 1970s at the expense of the multi-deck fleet, with a progressive upward movement in ship size and none of the chronic overcapacity problems encountered in the oil market.

Table 4.2 The world cargo fleet at 1st January (m.dwt)

	Size of fleet (m.dwt)				% growth rate per annum		
	1980	1990	2000	2007	1980–90	1990–2000	2000–2007
Bulk carriers	140.7	203.4	266.8	369.7	4%	3%	5%
Oil tankers	339.3	262.9	307.0	363.9	–3%	2%	2%
Combined carriers	47.4	30.3	14.9	9.4	–4%	–7%	–6%
Containerships	9.9	26.3	64.7	128.0	10%	9%	10%
MPP	8.5	16.8	19.0	23.6	7%	1%	3%
Reefer	5.8	7.4	8.0	7.3	3%	1%	–1%
Car carriers	1.9	4.0	5.7	8.7	8%	3%	6%
Ro-Ro	3.7	6.6	8.1	9.5	6%	2%	2%
LPG	5.1	6.9	10.2	11.9	3%	4%	2%
LNG	2.9	3.9	7.1	15.2	3%	6%	11%
Sub total	565.1	568.6	711.6	947.2	0%	2%	4%
General cargo	—	—	42.8	38.9	—	—	–1%
Grand total	—	—	754.4	986.1	—	—	4%

Source: CRSL, *Shipping Review and Outlook*

In recent years the major change in the deep-sea liner trades was the replacement of traditional liners by cellular container ships. The first containership went into service in 1966. By 2007 the fleet had grown to 128 m.dwt, averaging 10% per annum growth during the previous 27 years (Table 4.2). The fleet of MPP vessels, which are specifically fitted for the carriage of containers, also grew at 3% per annum and the reefer fleet stayed about the same size. However, the general cargo fleet, which consists mainly of small multi-deck vessels being made obsolete by containerization, declined from 42.8 m.dwt in 2000 to 38.9 m dwt in 2007 (note that the definitions of ship type categories in Table 4.2 differ slightly from those in Table 2.5).

In practice, the different ship types discussed above do not operate in separate and self-contained markets. Although there is much specialization in the shipping market, there is also a high degree of substitution between ship types. In a volatile market, flexibility is desirable and some ships, such as'tweendeckers and combined carriers, are built with the objective of being flexible. This leads us to the important principle of lateral mobility (which is discussed further in Section 14.2): shipowners redeploy surplus vessels into more profitable applications in other sectors of the market. An example of the way this works in practice is provided by the following extract from a broker's report:

> Larger vessels of 40,000 dwt and above were particularly economical on the long hauls, and charterers now quoted substantially reduced rates for such trades. This pressed medium-sized bulk carriers of about 30,000 dwt into finding employment in trades previously serviced by vessels of 10–20,000 dwt and in the scrap trade from US to Japan units of 25–35,000 dwt were successfully introduced … with tankers and large dry cargo vessels taking care of the main part of the grain

> movements a new market was created for Liberty type vessels as barges in India and Pakistan where ports cannot accommodate large vessels.[11]

Thus ships move freely from one market sector to another. As we have noted, combined carriers are built for this purpose and were used very successfully in 1967 when the Suez Canal was closed, as the following quotation suggests:

> The improvement in freights was mainly brought about by the many combined carriers which switched to oil transportation as did the majority of tankers employed in the grain trades. Heavy demand for large conventional bulk carriers to replace the combined carriers caused a considerable number of this kind of newbuilding in the 50–100,000 dwt class to find a very favourable market when commissioned.[12]

Perhaps the most striking feature of the world merchant fleet during the last 30 years has been the rapid escalation of ship sizes, particularly in the bulk sector of the fleet. In the tanker market there was a steady increase in the average size of tankers until the early 1980s when the size structure stabilized. In bulk carriers there was a similar upward movement in ship size, but the pattern was more evenly spread between the different ship size groups with the fleets of Handy vessels (20,000–40,000 dwt), Panamax (40,000–80,000 dwt) and large bulk carriers over 80,000 dwt all expanding. Larger and more efficient ships have progressively pushed their way into the market and depressed rates for smaller sizes. At the same time investment for specialization, as in the case of car carriers and chemical tankers, played an important part in the development of the fleet. These apparently conflicting objectives emphasize the complexity of the investment decisions facing the modern shipowner.

Fleet productivity

Although the fleet is fixed in size, the productivity with which the ships are used adds an element of flexibility.[13] Past productivity statistics in Figure 4.8 show how much the productivity of the various sections of the fleet has changed over the past decade. For example, productivity expressed in terms of ton miles per deadweight reached a peak of 35,000 in 1973, but by 1985 this had fallen to 22,000; in other words, productivity had fallen by over a third. A few years later it had increased by nearly half to 32,000. The productivity in tons per deadweight shows a similar pattern, peaking at 8 in the early 1960s, falling to a trough of 4.6 in 1983, and then reaching 7.5 in 2005. The major swings in productivity in Figure 4.8 are mainly due to the deep recessions in the 1970s and 1980s when ships were very cheap and as a result were used inefficiently. In normal times the average ship carries about 7 tons of cargo per deadweight and does around 35,000 tanker ton miles.

The nature of these productivity changes becomes more apparent when we look in detail at what merchant ships actually do. Carrying cargo is just one small part of the story. As an illustration Figure 4.9 shows what the 'average' VLCC was doing during a typical year, 1991. Surprisingly, it spent only 137 days carrying cargo – little more than one-third of its time. What happened to the rest? Ballast time accounted for 111 days and cargo handling for 40 days. The remaining 21% of the time was spent in non-trading activities. This included incidents (i.e. accidents), repair, lay-up, waiting, short-term storage and long-term storage. When we analyse these activities more systematically, it becomes apparent that some are determined by both the physical performance of the fleet, and market forces. In a tight market the time on other activities would reduce, increasing supply, but even in the very tight market of 2007 an average of 200 days at sea per ship across a mixed fleet of tankers and bulk carriers was reported.[14]

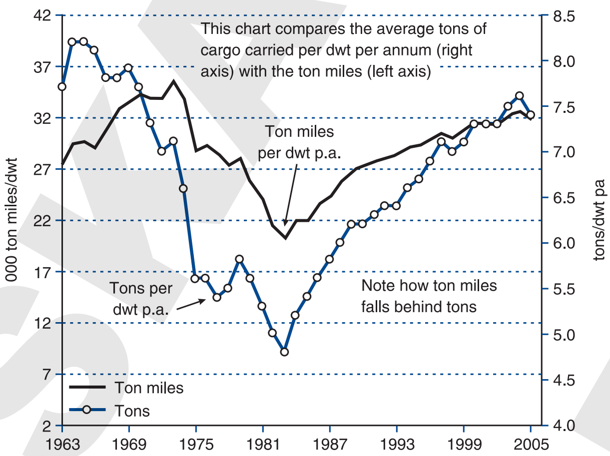


Figure 4.8
Performance of the world merchant fleet, 1963–2005
Source: *Fearnleys Review*

The productivity of a fleet of ships measured in ton miles per deadweight depends upon four main factors: speed, port time, deadweight utilization and loaded days at sea (see Section 6.5 for a more detailed discussion of productivity and its financial implications for the shipping company).

First, *speed* determines the time a vessel takes on a voyage. Tracking surveys show that, owing to a combination of operational factors, even in good markets ships generally operate at average speeds well below their design speed. For example, in 1991 the fleet of tankers over 200,000 dwt had an average design speed of 15.1 knots, but the average operating speed between ports was 11.5 knots.[15] The speed of the fleet will change with time. If new ships are delivered with a lower design speed, this will progressively reduce the transport capacity of the fleet. Similarly, as ships age,

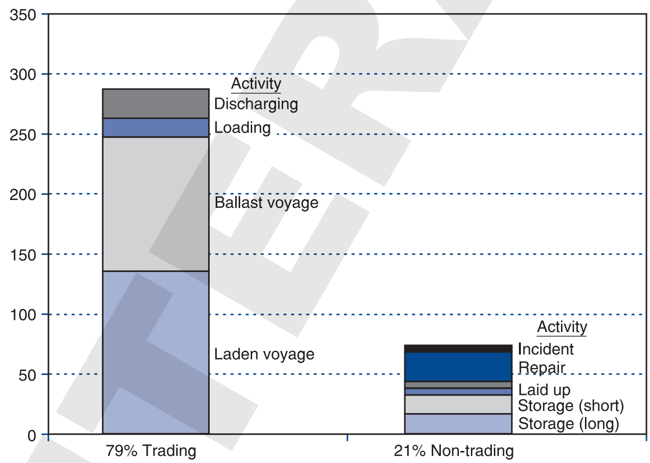


Figure 4.9
VLCC operating performance: time use of average VLCC
Source: Clarkson Research Studies, VLCC Quality Survey (1991)

unless exceptionally well maintained, hull fouling will gradually reduce the maximum operating speed.

Second, *port time* plays an important part in the productivity equation. The physical performance of the ships and terminals sets the upper limit. For example, the introduction of containerization dramatically reduced port time for liners. Organization of the transport operation also plays a part. After the oil crisis in 1973, changes in the oil industry reduced the opportunities for maximizing the efficiency of tanker operations by the transport planning departments of the major oil companies. Congestion produces temporary reductions in performance. Middle East port congestion absorbed large amounts of shipping in the mid-1970s, and in 1980 there was heavy congestion at Hampton Roads, USA, with queues of over 100 bulk carriers waiting to load coal. This congestion reduced the supply of ships available for trading.

Third, *deadweight utilization* refers to the cargo capacity lost owing to bunkers, stores, etc. which prevent a full load from being carried. A rule-of-thumb estimate of 95% for bulk carriers and 96% for tankers is derived from surveys. During the recessions of the 1970s and 1980s there was an increasing tendency for owners to carry part cargoes, reducing deadweight utilization to well below these levels. For example, *the World Tanker Fleet Review* estimated that at the end of 1986 about 16.6 m.dwt of tanker capacity was lost owing to part cargoes.

Finally, a vessel's time is divided between *loaded days at sea* and 'unproductive' days (in ballast, port, or off hire). A reduction in unproductive time allows an increase in loaded days at sea, and one can interpret changes in this variable in terms of changes in port time, etc. Vessels designed for cargo flexibility can improve their loaded time at sea because they are able to switch cargoes for backhauls. The fleet's operating performance changes in response to market conditions, as is clearly demonstrated by the changes in tanker productivity shown in Figure 4.8. Faced with a depressed freight market, the first response of the merchant fleet is generally to reduce its pace of operation. To save bunker costs, owners reduce the operating speed and, since cargoes are less readily available, waiting times increase. Eventually ships that are too expensive to operate are laid up. Tankers are frequently used for oil storage, either in port or in offshore installations. Bulk carriers may be used to store coal or grain. Some tankers in storage are on contracts lasting only a few months, after which they will become available for trading. Others used in offshore oil production may be employed on long contracts, so for practical purposes they are no longer part of the trading fleet.

Shipbuilding production

The shipbuilding industry plays an active part in the fleet adjustment process described in the previous paragraphs. In principle, the level of output adjusts to changes in demand – and over long periods this does happen. Thus, in 1974, shipbuilding output accounted for about 12% of the merchant fleet, whereas in 1996 it had fallen to 4.7%, but by 2007 it was back up to 9%. Adjustments in the level of shipbuilding output on this scale do not take place quickly or easily. Shipbuilding is a long-cycle business, and the time-lag between ordering and delivering a ship is between 1 and 4 years, depending on the size of orderbook held by the shipbuilders. Orders must be placed on the basis of an estimate of future demand and in the past these estimates have often proved to be wrong, most dramatically in the mid-1970s when deliveries of VLCCs continued for several years after demand had gone into decline. In addition, downward adjustments in shipbuilding supply may be seriously hampered by political intervention to prevent job losses.

From the point of view of the shipping industry, the type of ship built is important because peaks and troughs in the deliveries of specific ship types have an impact on their market prospects. In recent years there have been major changes in the product range of ships built by the merchant shipbuilding industry. These are illustrated graphically in Figure 4.10.

Tanker production illustrates the extreme swings which can occur in shipping investment. Tanker newbuilding dominated the period 1963–75, increasing from 5 m.dwt in 1963 to 45 m.dwt in 1975, when it accounted for 75% of shipbuilding output. The collapse of the tanker market after the 1973 oil crisis reversed this trend and tanker output fell to a trough of 3.6 m.dwt in 1984, accounting for only 1% of the tanker fleet. In the absence of VLCC orders, the tanker deliveries during the period 1978–84 were principally products tankers or 80,000–120,000 dwt crude oil tankers. As the

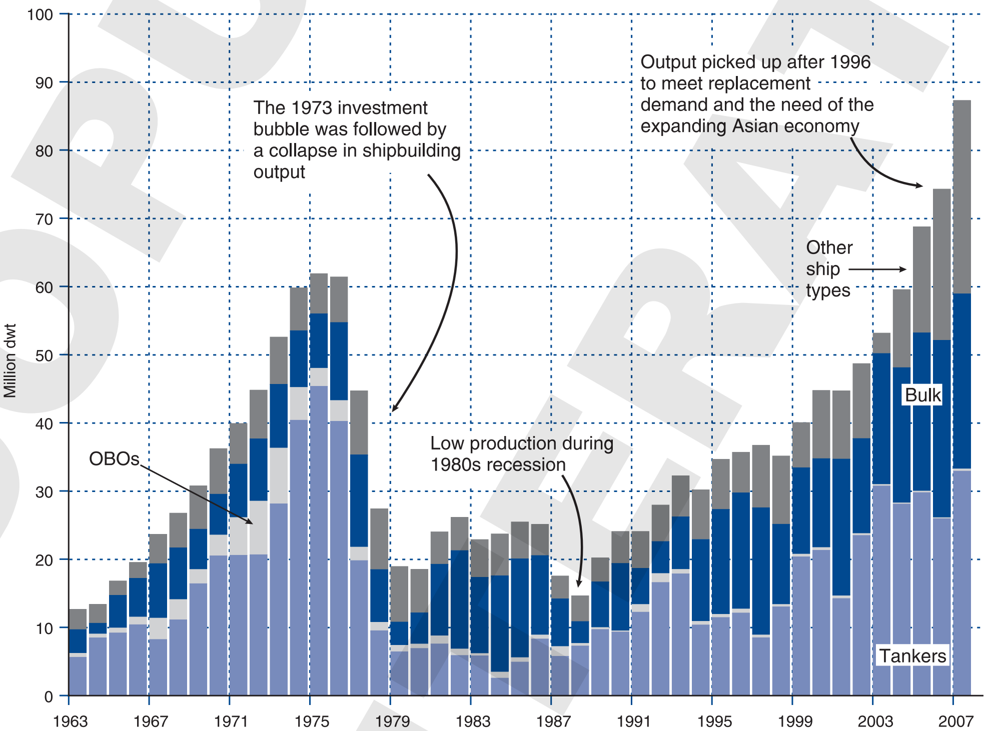


Figure 4.10
World shipbuilding deliveries by type, 1963–2007
Source: Fearnleys, Clarkson Research

tanker fleet built in the 1970s needed to be replaced the trend was again reversed, and by 2006 tanker production had increased to 25.8 m.dwt.

Compared with oil tankers, the dry bulk carrier newbuilding market has been comparatively stable since the mid-1960s. However, investment has been cyclical, with deliveries fluctuating between 5 and 15 m.dwt per annum. A very low output of 4 m.dwt in 1979 was followed by the 'mini-boom' in the dry cargo market during 1979–80. Heavy ordering resulted in peak deliveries of 14.7 m.dwt in 1985, accounting for 59% of total world shipbuilding output in deadweight tonnage terms. In a very real sense bulk carriers took over the dominant role in the shipbuilding market previously occupied by VLCCs, and by the mid-1980s were facing the same problems of overproduction and chronic surplus. One consequence of this heavy investment was a deep recession in the mid-1980s. Ordering stopped and deliveries of bulk carriers fell to 3.2 m.dwt in 1988. By 2006 deliveries were back up to 26 m.dwt, and so the cycles continued.

The remaining category of shipbuilding output comprises an enormous range of merchant cargo and service vessels – ro-ros, container ships, conventional general cargo vessels, fishing boats, ferries, cruise liners, tugs, etc. The total tonnage of deliveries in 2007 was 22.7 m.dwt, accounting for 32% of total output, and the newbuilding trend in this sector has been comparatively stable over the last two decades at about this level. Although these ship types account for only a third of the total merchant shipbuilding output in deadweight terms, in terms of work content they are much more important – for example, a deadweight ton of ferry tonnage may contain four or five times as much work as a deadweight ton of tanker tonnage. For this reason, the various ship types in this category are substantially more important to the shipbuilding industry than might appear at first sight.

Scrapping and losses

The rate of growth of the merchant fleet depends on the balance between deliveries of new ships and deletions from the fleet in the form of ships scrapped or lost at sea. This balance changed radically during the late 1970s, as can be seen from Figure 4.11. In 1973, only about 5 m.dwt of vessels were scrapped, compared with deliveries of over 50 m.dwt, with the result that the fleet grew rapidly. By 1982, scrapping had overtaken deliveries for the first time since the Second World War, accounting for 30 m.dwt compared with 26 m.dwt of deliveries. Thus scrapping, which appeared to be of little significance in 1973, was of major importance by the early 1980s.

Whilst it is clear that scrapping has a significant part to play in removing ships from the market, explaining or predicting the age at which a ship will actually be scrapped is an extremely complex matter, and one that causes considerable difficulties in judging the development of shipping capacity. The reason is that scrapping depends on the balance of a number of factors that can interact in many different ways. The main ones are age, technical obsolescence, scrap prices, current earnings and market expectations.

Age is the primary factor determining the tonnage of vessels scrapped. Ships deteriorate as they grow older and the cost of routine repairs and maintenance increases; thus the

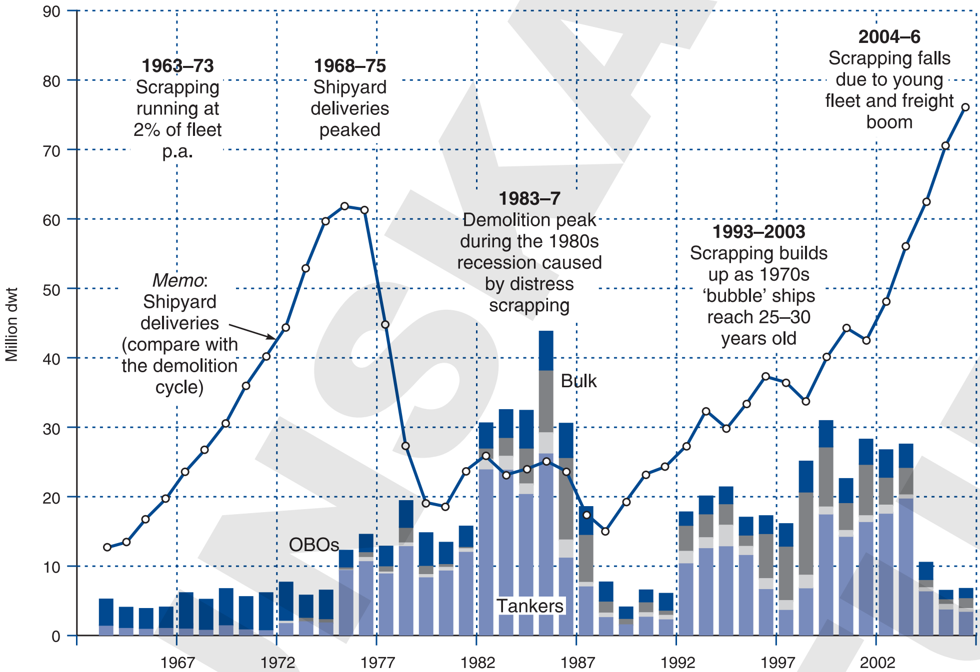


Figure 4.11
World ship demolition sales by type, 1963–2006
Source: *Fearnleys Review*, Clarkson Research

owners of elderly vessels face the combination of heavier costs and more time off hire for planned and unplanned maintenance. Because physical deterioration is a gradual process, there is no specific age at which a ship is scrapped; a look through *Lloyd's Demolition Register* generally reveals a few examples of vessels scrapped with an age of over 60 or 70 years, and at the other extreme tankers sold for demolition at as little as 10 years. In 2007, when 216 vessels were scrapped, the average scrapping age was 27 years for tankers and 32 years for dry cargo vessels. In each case there was a wide spread.

Technical obsolescence may reduce the age at which a particular type of vessel is scrapped because it is superseded by a more efficient ship type. For example, the high scrapping rate of multi-deckers in the late 1960s is attributable to these vessels being made obsolete by containerization. Obsolescence also extends to the ship's machinery and gear – tankers fitted with inefficient steam turbines were among the first to go to the scrapyard when prices rose in the 1970s.

The decision to scrap is also influenced by the scrap prices. Scrap ships are sold to shipbreakers, who demolish them and sell the scrap to the steel industry. Scrap prices fluctuate widely, depending upon the state of supply and demand in the steel industry and the availability of scrap metal from sources such as shipbreaking or the demolition of vehicles, which form the largest sources of supply. A period of extensive ship scrapping may even depress prices of scrap metal – a process that is accentuated by the fact that shipping surpluses often occur simultaneously with trade cycle downswings in the industrialized regions when demand for steel is also depressed.

Most importantly, the scrapping of a ship is a business decision and depends on the owner's expectations of the future operating profitability of the vessel and his financial position. If, during a recession, he believes that there is some chance of a freight market boom in the reasonably near future, he is unlikely to sell unprofitable ships for scrap because the possible earnings during a freight market boom are so great that they may justify incurring a small operating loss for a period of years up to that date. Naturally the oldest ships will be forced out by the cost of repairs but, where vessels are still serviceable, extensive scrapping to remove surplus capacity is only likely to occur when the shipping community as a whole believes that there is no prospect of profitable employment for the older vessels in the foreseeable future, or when companies need the cash so urgently that they are forced into 'distress' sales to shipbreakers. It follows that scrapping will occur only when the industry's reserves of cash and optimism have been run down.

Freight revenue

Finally, the supply of sea transport is influenced by freight rates. This is the ultimate regulator which the market uses to motivate decision-makers to adjust capacity in the short term, and to find ways of reducing their costs and improving their services in the long term. In the shipping industry there are two main pricing regimes, the freight market and the liner market. Liner shipping provides transport for small quantities of cargo for many customers and is essentially a retail shipping business[16], accepting cargo from a wide range of customers and a very competitive one. In contrast bulk shipping is a wholesale operation, selling transport for shiploads of cargo to a small number of industrial customers at individually negotiated prices. By standardizing the cargo units containerization has brought the two segments closer together in economic terms, and in both cases the pricing system is central to the supply of transport. In the short run, supply responds to prices as ships adjust their operation speed and move to and from lay-up, while liner operators adjust their services. In the longer term, freight rates contribute to the investment decisions which result in scrapping and ordering of ships. How this works in the bulk market is the subject of the next section. Liner pricing, which has a different economic structure, is discussed in Chapter 13.

4.5. THE FREIGHT RATE MECHANISM

The third part of the shipping market model, labelled C in Figure 4.1, is the freight market. This is the adjustment mechanism linking supply and demand. The way it operates is simple enough. Shipowners and shippers negotiate to establish a freight rate which reflects the balance of ships and cargoes available in the market. If there are too many ships the freight rate is low, while if there are too few ships it will be high. Once this freight rate is established, shippers and shipowners adjust to it and eventually this brings supply and demand into balance. We will use the perfect competition model to analyse the shipping market, and the economic concepts we will use to analyse this process more formally are the supply function, the demand function and the equilibrium price.[17]

The supply and demand functions

The *supply function* for an individual ship, shown in Figure 4.12a, is a J-shaped curve describing the amount of transport the owner provides at each level of freight rates. The ship in this example is a 280,000 dwt VLCC. When the freight rate falls below $155 per million ton miles the owner puts it into lay-up, offering no transport. As freight rates rise past $155 per million ton miles he breaks lay-up but, to save fuel, steams at the lowest viable speed of 11 knots per hour. If he trades loaded with cargo at this speed for 137 days per annum (the loaded operating days we discussed in Figure 4.9), he will supply 10.1 btm of transport in a year (i.e. 11×24×137×280,000). At higher freight

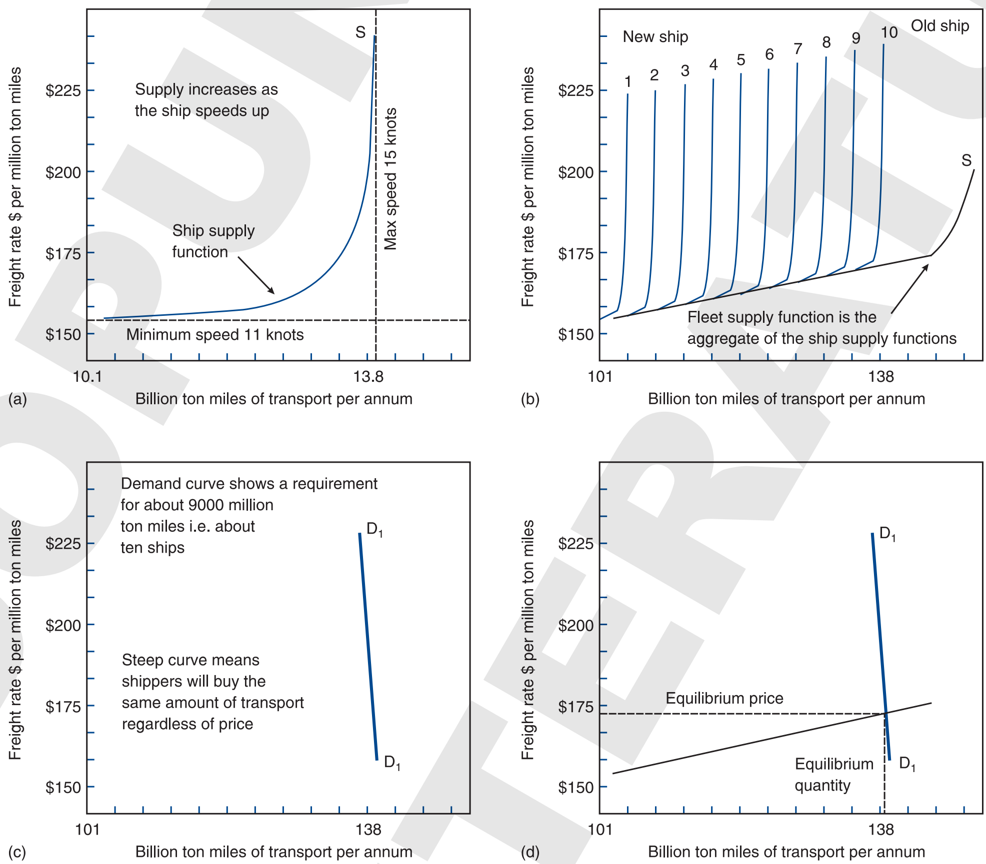


Figure 4.12
Shipping supply and demand functions: (a) supply function for single ship (VLCC); (b) supply function for fleet of ten VLCCs; (c) oil transport demand function; (d) supply–demand equilibrium
Source: Martin Stopford 2005

rates he speeds up until at about $220 per million ton miles the ship is at full speed of 15 knots and supplying 13.8 btm of sea transport per year (a lot of transport for just one ship!). Thus by increasing freight rates the market has obtained an extra 36% supply. Evidence of this process at work can be seen in Figure 4.8, which shows how the productivity of the world fleet peaked in 1973 when freight rates were very high, fell in the early 1980s when freight rates were very low, and then increased again in the 1990s as freight rates improved.

Economic theory can help to define the shape of the supply curve. Provided the market is perfectly competitive, the shipowner maximizes his profit by operating his ship at the speed at which marginal cost (i.e. the cost of providing an additional ton mile of transport) equals the freight rate. The relationship between speed and freight rates can be defined as follows:[18]

$$S = \sqrt{\frac{R}{3p.k.d}} \tag{4.1}$$

where S is the optimum speed in miles per day, R the voyage freight rate, p the price of fuel, k the ship's fuel constant, and d = distance. This equation defines the shape of the supply curve. In addition to freight rates the optimum speed depends on the price of fuel, the efficiency of the ship and the length of the voyage. We will discuss these costs in Chapter 6.

In reality the supply function is more complex than the simple speed–freight rates relationship described in the previous paragraphs. Speed is not the only way supply responds to freight rates. The owner may take advantage of a spell of low freight rates to put his ship into dry dock, or fix a short-term storage contract. At higher rates he may decide to ballast back to the Arabian Gulf through the shorter Suez Canal route rather than taking the longer 'free passage' round the Cape. All of these decisions affect supply. Similarly, freight rates are not the only way the market adjusts shipowners' revenue. During periods of surplus ships have to wait for cargo or accept small cargo parcels. This reduces the operating revenue in just the same way as a fall in freight rates, a factor often forgotten by owners and bankers doing cashflow forecasts on old ships. They may predict freight rates correctly but end up with an embarrassing cash deficit due to waiting time and part cargoes.

The next step is to show how the market adjusts the supply provided by a *fleet of ships*. To illustrate this process, the supply function for a fleet of 10 VLCCs is shown in Figure 4.12b. The fleet supply curve (S) is built up from the supply curves of individual ships of varying age and efficiency. In this example the age distribution of the fleet ranges from 2 to 20 years in intervals of 2 years. Ship 1 (the newest ship) has low daily operating costs and its lay-up point is $155 per million ton miles. Ship 10 (the oldest) has high operating costs and its lay-up point is $165 per million ton miles.

The *fleet supply function* works by moving ships in and out of service in response to freight rates. If freight rates fall below the operating costs of ship 10, it goes into lay-up and supply is reduced by one ship. Ship 9 breaks even and the other eight ships make a margin over their fixed expenses, depending on how efficient they are. If shippers only need five ships they can drop their offer to $160 per million ton miles, the lay-up point of ship 5. In this way supply responds to movements in freight rates. Over a longer period the supply can be increased by building new more efficient ships and reduced by scrapping old ones.

The slope of the short-term supply curve depends on three factors which determine the lay-up cost of the marginal ship. First, old ships generally have higher operating costs so the lay-up point will occur at a higher freight rate. We discuss this in Chapter 5. Second, bigger ships have lower transport costs per ton of cargo than small ships, so if big and small ships are competing for the same cargo, the bigger ship will have a lower lay-up point and will generally drive the smaller ships into lay-up during recessions. If the size of ships has been increasing over time, as has happened for most of the last century, the size and age will be correlated and there will be quite a steep slope to the supply curve which becomes very apparent during recessions. Third, the relationship between speed and freight rates is described in equation (4.1) above.

The *demand function* shows how charterers adjust to changes in price. The demand curve (D_1) in Figure 4.12c is almost vertical. This is mainly supposition, but there are several reasons why this shape is likely for most bulk commodities. The most convincing is the lack of any competing transport mode. Shippers need the cargo and, until they have time to make alternative arrangements, must ship it regardless of cost. Conversely cheap rates will not tempt shippers to take an extra ship. The fact that freight generally accounts for only a small proportion of material costs reinforces this argument.[19]

Equilibrium and the importance of time

The supply and demand curves intersect at the equilibrium price. At this point buyers and sellers have found a mutually acceptable price. In Figure 4.12d the equilibrium price is $170 per million ton miles. At this price buyers are willing to hire 10 ships and owners are prepared to make 10 ships available. The equation balances.

But that is not the end of the story. If our aim is to understand why freight rates behave the way they do, it is just the beginning. We must be precise about *time-frame*. It is an additional dimension present in every decision because market, prices are a blend of the present and the future expectations, the short run and the long. In the real world the price at which buyers and sellers are prepared to trade depends on how much time they have to adjust their positions. There are three time periods to consider: the *momentary* equilibrium when the deal must be done immediately; the *short run*, when there is time to adjust supply by short-term measures such as lay-up, reactivation, combined carriers switching markets or operating ships at a faster speed; and there is the *long run*, when shipowners have time to take delivery of new ships and shippers have time to rearrange their supply sources. We will look at each of these in turn.

MOMENTARY EQUILIBRIUM

Momentary equilibrium describes the freight rate negotiated for 'prompt' ships and cargoes. It is the spot market that owners and charterers deal with day by day. The ships are ready to load, the cargoes are awaiting transport and a deal must be done. The shipowner

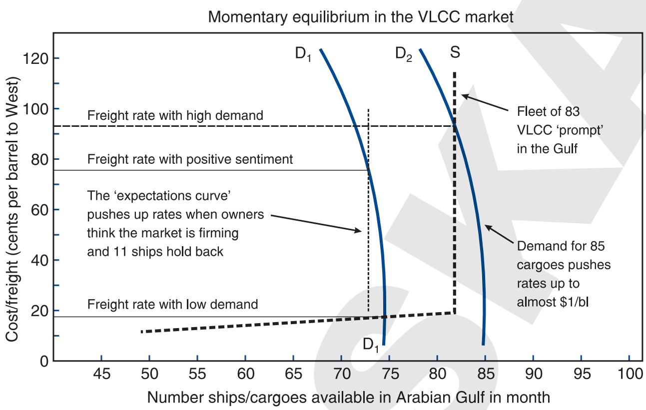


Figure 4.13
Momentary equilibrium in the VLCC market
Source: Martin Stopford 2007

is in the same position as a farmer when he arrives at market with his pig (see Section 5.8). Within this time frame the shipping market is highly fragmented, falling into the regions so familiar in brokers' reports – the Arabian Gulf, the Caribbean, the United Stated Atlantic Coast, the Pacific, and the Atlantic, etc. Local shortages and surpluses build up, creating temporary peaks and troughs which show up as spikes on the freight chart. This is the market that owners are constantly trying to anticipate when selecting their next cargo, or deciding whether to risk a ballast voyage to a better loading point.

Once these decisions are taken and the ship is in position, the options are very limited. The owner can 'fix' at the rate on offer, or sit and lose money. Charterers with cargoes face the same choice. The two parties negotiate to find a price at which supply equals demand. Figure 4.13 illustrates how this works out in practice. Suppose there are about 75 cargoes on offer in the loading zone during the month. The demand curve, marked D_1, intercepts the horizontal axis at 75 cargoes, but as the freight rate rises it curves to the left because at very high freight rates a few cargoes may be withdrawn or perhaps amalgamated to allow a different size of ship to be used.

There are 83 ships available to load and the supply curve S (the dotted line) slopes gently up from 15 cents a barrel to 21 cents a barrel until all 83 ships are contracted and then it goes vertical. In this case demand is only for 75 ships, so there are more ships than cargoes. Since the alternative to fixing is earning nothing, rates fall to operating costs, which for 75 cargoes equates to 20 cents a barrel, shown by the intersection of S and D_1. If the number of cargoes increases to 85 (D_2) there are more cargoes than ships. Charterers bid desperately to find a ship and the freight rate shoots up to almost $1 per barrel. A swing of 10 cargoes is quite common, but the effect on rates is dramatic.

But never forget that this is an auction and in this very short-term situation market sentiment is often the real driver. If there are a few more ships than cargoes, but owners believe that rates are rising, they may decide to wait. Suddenly there are more cargoes than ships and rates rise, at which point the reticent owners enter the market and fix at 'last done'. This is shown by the 'expectation curve' in Figure 4.13. Sometimes owners attempt to hide their ships from charterers by reporting the presence of only one ship in their fleet, or waiting outside the loading area. But the fundamentals have the last word. If the surplus of ships persists, the owners holding back may be unable to fix at all and as they start to haemorrhage cash, rates quickly collapse. So when supply and demand are roughly balanced the shape of the supply curve is determined by sentiment rather than fundamentals, a problem that sometimes misleads analysts and traders.

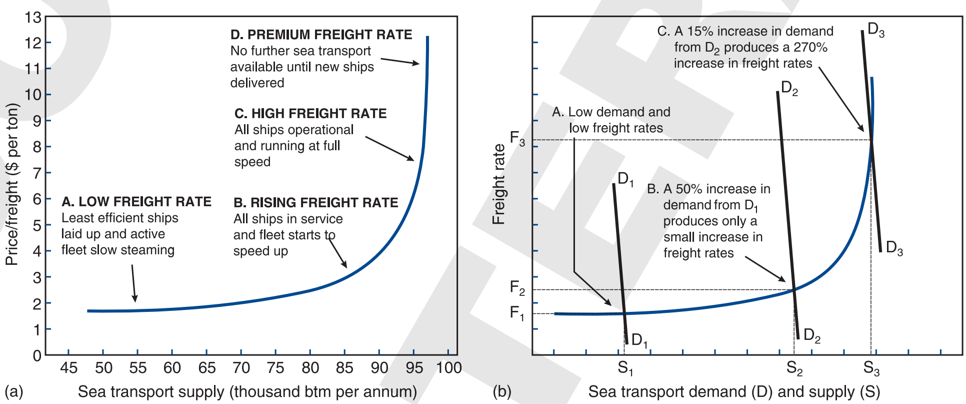
THE SHORT-RUN EQUILIBRIUM

In the 'short run' there is more time for owners and charterers to respond to price changes by moving ships in and out of lay-up, so the analysis is a little different.

The short-run supply curve shown in Figure 4.14a plots, for a given size of fleet, the ton miles of transport available at each level of freight rates. The transport supply is measured in thousands of billion ton miles per annum and the freight rate in dollars per thousand ton miles of cargo transported.

At point A, the supply offered is only 50,000 btm per annum because the least efficient ships are laid up; at point B, all ships are back in operation and the supply has risen to about 85,000 btm per annum; at point C, the fleet is at maximum speed and the whole fleet is at sea; finally, at point D, no further supply is obtained by increasing freight rates and the supply curve becomes almost vertical. Very high freight rates may tempt out a few remaining unutilized ships. For example, during the 1956 boom, 'A number of vessels half a century old and barely seaworthy obtained freights of up to five times the rate obtained a year earlier.'

If we now bring the *short-run demand curve* into the picture we can explain how freight rates are determined. The market settles at the freight rate at which supply equals demand. Consider the three different equilibrium points marked A, B and C in Figure 4.14b. At point A demand is low and the freight rate settles at point F_1. A major increase in demand to point B only pushes the freight rate up slightly because ships immediately come out of lay-up to meet increasing demand.[20] However, a small increase in demand to point C is sufficient to treble the level of freight rates because the



Note: The supply function shows the amount of sea transport offered at each freight rate

Figure 4.14
Short-run equilibrium: (a) short-run supply function; (b) short-run adjustment
Source: Martin Stopford 2007

market rate is now set by the oldest and least efficient ships which need very high freight rates to tempt them into service. Finally, with no more ships available charterers bid against each other for the available capacity. Depending on how badly they need transport, rates can go to any level. However, this is an unstable situation. Shippers look for cheaper supply sources and the high freight rates almost always trigger frenzied investment activity by owners and shippers.

THE LONG RUN

Finally, we must consider the long run during which the size of the fleet can be adjusted by ordering new ships and scrapping old ones. The longer-term adjustment mechanism balances supply and demand through the three other markets we will discuss in Chapter 5: the sale and purchase market, the newbuilding market and the demolition market. As freight rates fall during a recession, the profitability of ships – and, consequently, their second-hand value – also falls. Eventually the price of the least efficient ships falls to the scrap price. Ships are scrapped, removing them permanently from the market and reducing the surplus. Falling second-hand prices also make new uses of the surplus tonnage financially viable; the use of supertankers for oil storage and the conversion of single hull tankers to ore carriers or offshore vessels are examples. In these ways the price mechanism gradually reduces the supply of ships to the market. Conversely, when a shortage of ships pushes up freight rates this works through to the sale and purchase market. Shipowners are keen to add to their fleets and, because there is a shortage of ships, shippers may decide to expand their own shipping operations. With more buyers than sellers, second-hand prices rise until used ships become more expensive than newbuildings. Frustrated shipowners turn to the newbuilding market and the orderbook expands rapidly. Two or three years later the fleet starts to grow.

To illustrate this process we can take the example of the adjustment of the tanker market over the period 1980–1992. Figure 4.15 shows the position of the supply–demand chart in 1980 (a), 1985 (b), 1991 (c) and 1992 (d). The freight rate is shown on the vertical axis measured in dollars per day and as an indicator of transport supply the tanker fleet is shown on the horizontal axis, measured in millions of tons dead weight. Neither of these units of measurement is strictly correct[21] but they illustrate the point. Figure 4.15e is a freight chart which shows the level of freight rates in each of the four years. Our aim is to explain how the supply and demand curves moved between the 4 years. In 1980 (Figure 4.15a) freight rates were moderately high at $15,000 per day, with the demand curve intersecting the ‘kink’ of the supply curve. By 1985 (Figure 4.15b) the supply curve has moved to the left as heavy scrapping reduced the tanker fleet from 320 m.dwt to 251 m.dwt, but demand had fallen even more to below 150 m.dwt due to the collapse in the crude oil trade after the oil price rises in 1979. This left 60 m.dwt of tankers laid up, extensive slow steaming, and the demand curve intersecting the supply curve way down its span at D_{85}. Freight rates averaged about $7,000 per day, close to operating costs.

Between 1985 and 1991 (Figure 4.15c), despite heavy scrapping, the tanker fleet fell by only 7 m.dwt, due to increased newbuilding in the late 1980s. As a result the supply

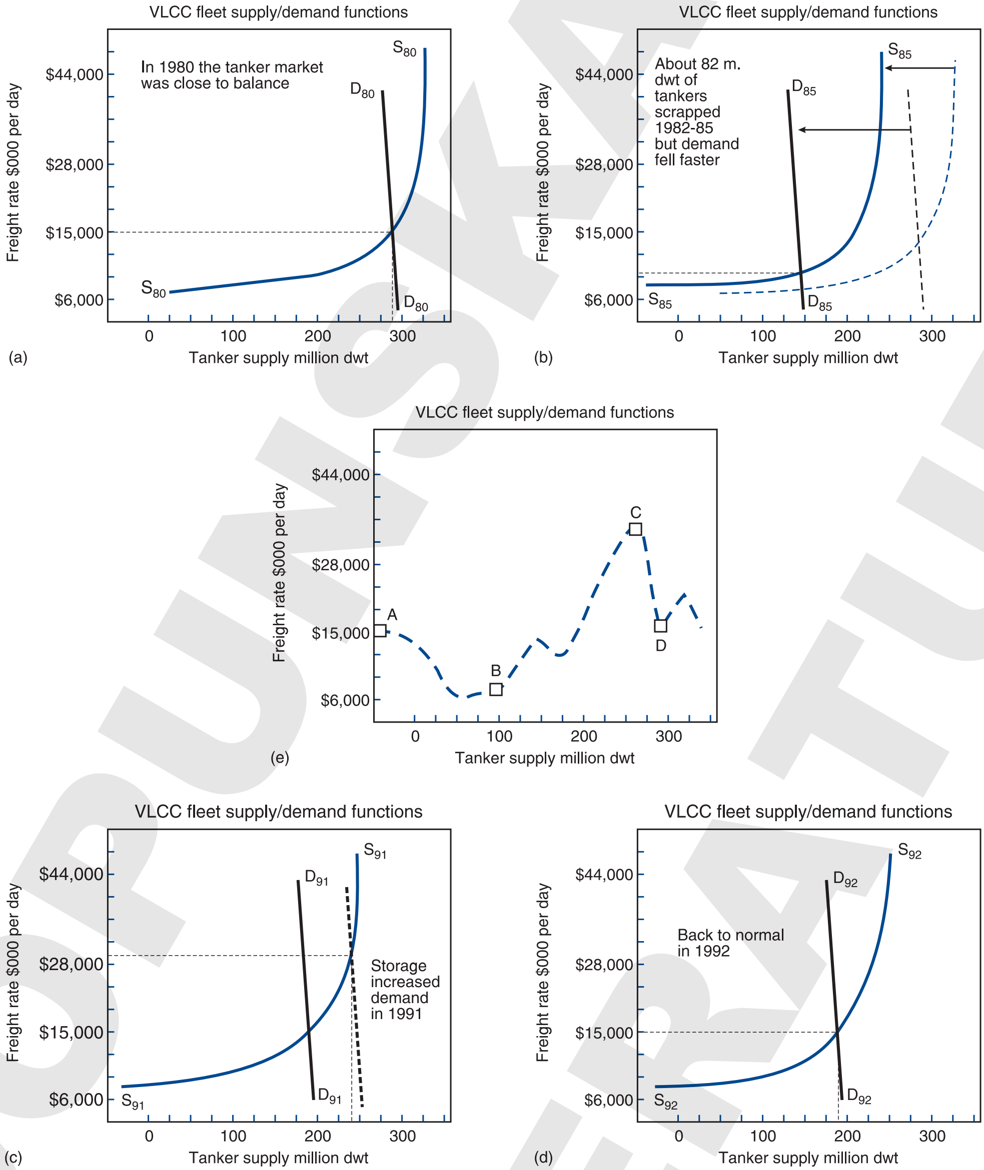


Figure 4.15
Long-term adjustment of supply and demand, 1980–92
Source: Martin Stopford 2004

curve moved very slightly to the left to S_{91}, but a growing oil trade increased demand by 30% to D_{91}, suggesting an equilibrium freight rate of about \$15,000 per day. However, in 1991 another factor intervened. After the invasion of Kuwait in August 1990 oil traders used tankers as temporary storage, moving the demand curve temporarily to the right, shown by the dotted line in Figure 4.15c. Freight rates increased to \$29,000 per day. Then in 1992 supply increased due to heavy deliveries and the demand curve moved back to its 'normal' position as the temporary storage market disappeared. This was enough to drive freight rates down to $15,000 per day (Figure 4.15d).

It is the combination of volatile demand and a significant time-lag before supply adjusts to demand that creates the framework for shipping market cycles. Shipowners tend to base investment on the current state of the market – they order more ships when freight rates are high and fewer when freight rates are low. The delay in delivering these ships means, however, that demand may have changed by the time the ships are delivered so any cyclical tendency is amplified.[22] Our analysis of the length of shipping cycles in Chapter 3 showed that over half a century the average cycle was about 8 years long, which is about the length you would expect in a market with the adjustment mechanism we have discussed. It takes 2–3 years for new orders to be delivered, 2–3 years for scrapping to catch up, and 2–3 years for the market to build up a head of steam for the next round of ordering. In the 1930s Jan Tinbergen noticed this relationship and thought it might be modelled using a periodic model.[23]

The effect of sentiment on the supply curve

There is a final issue to consider, the effect of sentiment on the supply function. The supply curves we have discussed so far (for example in Figure 4.15) move *horizontally* backwards and forwards, driven by the physical fundamentals as ships are scrapped and delivered. But changes in sentiment during the ongoing freight auction between charterers and shipowners can also move the curve *vertically*. For example if charterers are strong, confident and well informed they may be able to drive the curve down, whilst if owners are more confident, better informed and ready to hold back ships they may be able to drive the curve up so that for any given balance of supply and demand they get higher earnings.

To illustrate how this works in practice, Figure 4.16 plots Aframax tanker earnings against a rough estimate of the shipping capacity balance, measured as percentage surplus or deficit, between 1990 and 2007. The points are shown as diamonds, linked by a dotted line. The supply curve S1 is fitted to these points as a polynomial function. But the fit is not good. The years 1998, 1999, 2002 and 2003 (all weak years in the market) fall well below S1, whilst the good years 2000, 2005, 2006 and 2007 are way above. Linking the low points, which correspond to years of recession, produces a second supply curve S2. Similarly linking the high points, which occurred in strong markets, produces supply curve S3. It suggests that in the recession the supply curve moved down to S1, whilst in the boom it moved up to S2. Note also that in the very strong year 2004 the curves converged.

This complicates the freight model because the assumption in Figure 4.15 that earnings are uniquely defined by the percentage of surplus capacity is not necessarily correct. We now have two different supply curves S2 and S3, each giving different earnings levels for a given market balance. For example when the market is exactly in balance on the horizontal axis of Figure 4.16, S2 shows owners earning $19,000 per day whilst S3 says $37,000 per day, almost twice as much. This significant difference has a simple explanation. In years of recession the negotiation goes in the charterer's favour whilst in the boom the owners get the upper hand. During a sequence of good or

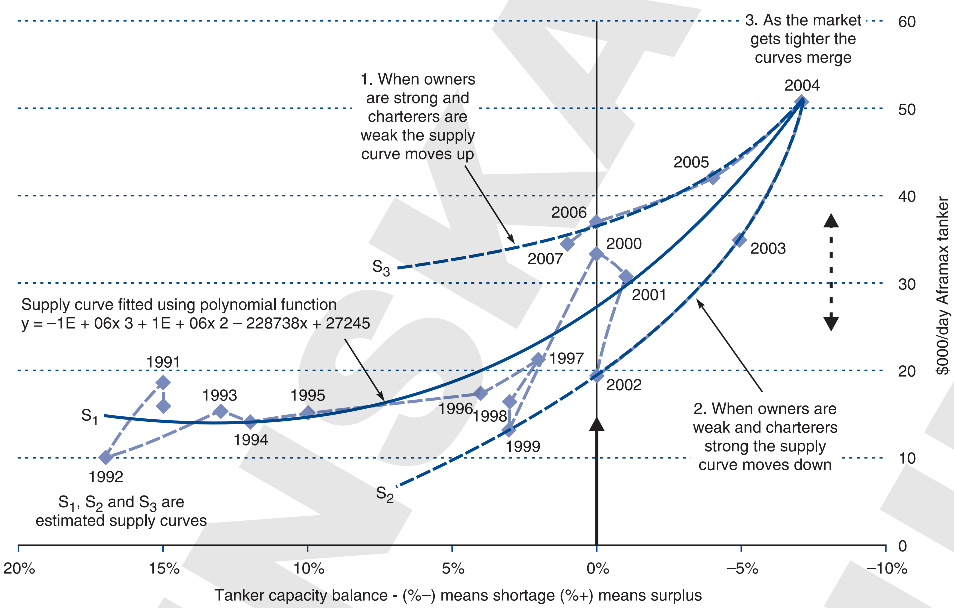


Figure 4.16
Analysis of vertical movement of the shipping supply curve
Source: Aframax earnings CRSL SRO Autumn 207; tanker capacity balance calculated by Martin Stopford for the tanker market as a whole

bad years the prevailing sentiment becomes part of the supply curve and continues to determine its shape until something changes sentiment, for example an economic shock. This happens in booms and recessions, so to predict earnings we need to know how sentiment has moved the supply curve. Unfortunately this makes forecasting freight rates a much more complex task because sentiment is harder to predict and changes much more quickly than the physical supply and demand fundamentals

The shipping cycle model

Although periodic cyclical models of the type proposed by Tinbergen are theoretically attractive, the review of almost three centuries of cycles in Chapter 3 and the underlying economics make it unlikely that this sort of model will be very helpful in practical situations. In the course of this discussion we mentioned many of the factors which contemporaries thought were important. The same factors tend to appear time and again but rarely in the same form. Business cycles in the world economy, economic shocks, misjudgements by shipowners, shipyard overcapacity, and most importantly sentiment. Our task as economists is to reduce this apparently disorganized jumble of causes and effects to a more structured form which will help us to analyse the influences on cycles, and if we are lucky predict what might happen next.

One of the main reasons why shipping cycles are irregular is that they are not driven by a single economic model; they are produced by the interaction of five separate models, described in Figure 4.17. We will describe this as the shipping cycle

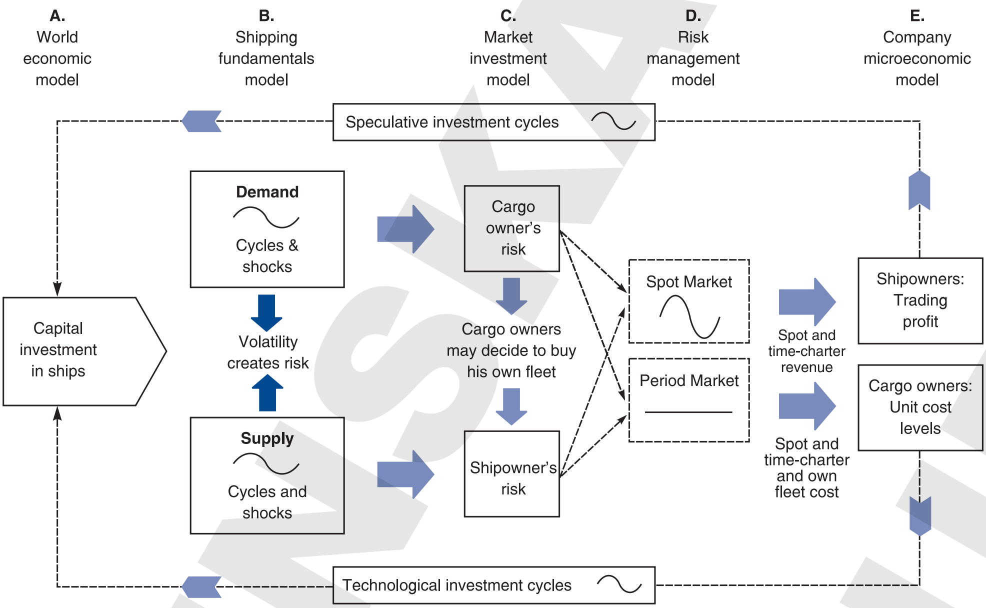


Figure 4.17
The shipping cycle composite mode
Source: Martin Stopford 2007

composite model. Segment A is the world economic model, segment B the shipping fundamentals model; segment C the market investment model; segment D the risk management model and Segment E the company microeconomic model. We will briefly discuss each of these in turn to show how it fits into the composite model.

The world economic model provides the main stimulus to the shipping cycles. Shipping is about sea transport, and the main purpose of the shipping cycle, as was discussed in Section 4.1, is to adjust the fleet to changes in the volume and composition of world seaborne trade. Thus segment A of the model simply recognizes that if we are to come to terms with shipping cycles, we must recognize the factors which may change demand for the product. This is a micro-economic model, and so we are less interested in the finer points of demand, which are dealt with in segment B, than with the overall changes. It is convenient to divide these changes into three types. Firstly there are business cycles. Unfortunately (or fortunately for shipping, depending on how you look at it) the world economy does not go in a straight line, as we saw in Figure 4.2. Over the last century it has experienced cycles rather similar to those in shipping, with periods of boom alternating with periods of bust. This gives rise to short-term changes in the demand for sea transport, and is a major contributor to shipping cycles. Secondly, there are economic shocks. These are important because they generally produce major changes of trend, and extreme changes in shipping demand. Wars, political crisis, and sudden changes in the economics of some major commodity such as oil have all contributed to major shifts in the demand for sea transport. Finally, there are the 'secular trends'. These are the major economic changes of direction which may accompany the development of a new technology (steam, electricity, information technology) or the emergence of a new major region (e.g. Japan, South Korea, China), so secular trends are the ones which underlie the long-term cycles and are perhaps the most neglected of the three. Partly it is because such trends are concealed due to their slow development. All three of these contributors to the changes in sea trade represent major topics in their own right, and they often seem too distant from the more specialist world of shipping to be of great importance. However, ultimately this is the focal point of the shipping cycle. Its purpose is to compensate for these changes in the world economy, so understanding this segment is a task that must be taken seriously.

Segment C of the model brings together the economic forces which press cargo owners and ship owners to adjust their behaviour in response to market circumstances with sentiment which, in the absence of reliable forecasts, is one of the main business drivers. This section of the shipping cycle composite model is well defined, and forms the main subject of Chapter 5 where we will discuss the factors which contribute to demand, supply and the all-important freight rates model. Parts of this model are so well documented in terms of shipping data that it is possible to develop a deterministic model which shows how the variables interact. But the role of sentiment is not well documented.

Finally stage D in the model introduces risk management. Of course shipping risk is intimately connected with the market investment model discussed under segment C, but it is such an important area that it deserves separate attention in the discussion of shipping cycles. Because the world economy generates uncertainty about how much trade will be carried in future years, somebody has to carry that risk. To take an extreme case, between 1979 and 1983, as we will see in Chapter 11 page 437, the demand for crude oil tankers fell by almost 50%. Such events do not occur frequently, but when they do they are very expensive. Who should take the risk, and how should they be rewarded for doing so? These are the issues which the shipping risk model addresses. If, for example, charterers decided that it is cheaper to take the risk themselves, they may decide to purchase large fleets and award secure time charters to shipowners. That reduces the size of the spot market, and creates a business which is more concerned with 'industrial shipping' than shipping market cycles. However, if charterers decide that they do not want a long-term commitment to shipping, then they may decide to use the charter market. During the 1990s the tonnage of container ships chartered by the 30 top liner companies increased from 15% to almost 50% of the fleet. This resulted in the rapid growth of the charter market for container ships, and a completely different market structure. Segment D is concerned with explaining these structural shifts which take place from time to time in the shipping market.

The dynamic adjustment process

Although this is straightforward, there are four aspects of the adjustment process which result in a complex process. First, the shipbuilding time-lag complicates the adjustment process. Orders placed at the top of the cycle, when rates are very profitable, have no effect on current rates, so investors keep on ordering. But when the ships are delivered a couple of years later the surge of supply drives down rates, encouraging owners to under-order. Second during the delivery time-lag ship demand often changes direction in a way investors did not anticipate when they placed their orders, so by the time the new ships hit the market they upset the balance even more. Third, the peaks and troughs of the cycles are fraught with emotion, leading to a tendency for investors to react to the violent and often unexpected swings in freight rates. Fourth, every so often a major crisis creates the need for a much greater adjustment in the supply of ships than can be achieved by these minor adjustments in the tonnage of ships delivered or scrapped. This dynamic economic adjustment model is well known to economists.

Long-run prices and costs

What determines the long-run freight rate in the shipping market? Where will earnings average out? Will the average be high enough to pay for a new ship? This is a matter of great interest to investors who, quite reasonably, want to know what return they can expect in the long term, taking one cycle with another.

The early economists argued that there is a built-in tendency for prices to cover costs. For example, Adam Smith distinguished between the *market price*, which could be very variable, and the *natural price* which just covered the cost of production. He argued that the natural price is 'the central price towards which the prices of all commodities are continually gravitating'.[24] This is a comforting idea for investors, since it suggests that if they wait long enough the market will ensure that they will earn a proper return. It is, however, a very dangerous concept.

Marshall warned against placing too much faith in the idea of a 'natural' price which, in the long run, covers costs. It is not that the theory is wrong, but that it only works 'if the general conditions of life were stationary for a run of time long enough to enable [economic forces] to work out to their full effect.[25] The natural price is unlikely to prevail because the world is constantly changing. Demand and supply schedules are constantly on the move as technology and events change and the unexpected intervenes long before the 'natural' price has been achieved. This is the common-sense view. The world is far too mercurial for the concept of a long-run equilibrium price to be significant in an industry where the product has a life of 20 years or more. Investors cannot expect any comfort from this quarter. They must back their judgement that on this occasion prices will cover their real costs. Economic theory offers no guarantees, and, as we saw in Chapter 2, the returns have, on average, tended to be rather low. This discussion of the Return on Shipping Investment (ROSI) model is developed in Chapter 8, pages 325–338.

4.6 SUMMARY

We started this chapter with the idea that shipping companies should approach the shipping market from a competitive viewpoint, 'i.e. playing other players'. The rules of the shipping market game are set by the economic relationships which create freight cycles. To explain them we discussed the economic 'model' of the shipping market. This model has two main components, supply and demand, linked by freight rates which, through their influence on the actions of shippers and shipowners, bring supply and demand into balance. Because the demand for ships changes rapidly but supply is slow and ponderous, freight cycles are generally irregular.

We identified five key demand variables: the world economy, commodity trades, average haul, political events and transport costs. The demand for ships starts with the world economy. We found that there is a close relationship between industrial production and sea trade, so close scrutiny of the latest trends and lead indicators for the world economy provide some warning of changes in the demand for ships. The second important demand variable is the structure of the commodity trades, which can lead to changes in ship demand. For example, a change in the oil price in the 1970s had a major impact on the oil trade. Distance (average haul) is the third demand variable and here again we found that there have been substantial changes in the past. Political events were the fourth variable, since wars and disturbances often have repercussions for trade. Finally transport costs play an important part in determining the long-term demand.

On the supply side we also singled out five variables: the world fleet, productivity, shipbuilding production, scrapping and freight rates. The size of the world fleet is controlled by shipowners who respond to the freight rates by scrapping, newbuilding and adjusting the performance of the fleet. Because the variables in this part of the model are behavioural, the relationships are not always predictable. Market turning points depend crucially on how owners manage supply. Although the orderbook provides a guide to the size of the world fleet 12–18 months ahead, future ordering and scrapping are influenced by market sentiment, and are very unpredictable. Because shipping investors sometimes do things which economists find difficult to understand, relying too much on economic logic can be dangerous.

Freight rates link supply and demand. When supply is tight freight rates rise, stimulating shipowners to provide more transport. When they fall, it has the opposite effect. We looked in detail at the dynamics of the mechanism by which freight rates are determined and found that time-scale is important in reaching an equilibrium price. Momentary equilibrium describes the day-to-day position as 'prompt' ships in a particular loading area compete for the available cargoes. Short-run equilibrium describes what happens when ships have time to move around the world, adjust their operating speed or spend time in lay-up. In shipping the long-term is set by the time taken to deliver new ships – say, 2–3 years. This characteristic certainly influences the 7–8 year duration of freight cycles.

Our analysis of supply–demand charts showed that the short-term supply function has a characteristic J shape, and in the short term demand is inelastic. Freight cycle peaks and troughs are produced by the inelastic demand curve moving along the supply curve. When it arrives at the 'kink' of the supply curve, freight rates move above operating costs and become very volatile. Beyond this point economics can tell us little about the level of freight rates; it is entirely based on the auction between buyers and sellers for the available capacity.

In the long term the volatile freight cycles ought to average out at a 'natural' freight rate which gives investors a fair return on capital. Although this is true in theory, Alfred Marshall warned that we should not rely on it. In a constantly changing world long-term average earnings are not subject to rules. In the past the over-eagerness of shipping investors has tended to keep market returns low, as we saw in Chapter 2, yet enough shipping fortunes have been made to keep hopeful investors in the business. We will discuss the return on shipping assets more fully in Chapter 8, where we introduce the risky assets pricing (RAP) model.

No amount of statistical analysis can reduce this complex economic structure to a simple predictive 'rule of thumb'. The requirements of success in the shipping cycle game are a lifetime's experience in the shipping industry, a direct line to the world economic and political grapevine, and a sharp eye for a bargain. Decision-makers without the advantage of experience must rely on what they can glean from books.