Sadržaj osnovne literature:

DOPUNSKA LITERATURA

Dopunska literatura:

- Benford, H. (1983a) A Naval Architect's Introduction to Engineering Economics (Ann Arbor, Mich.: University of Michigan, College of Engineering) No. 282.

- Čekić, Š., I. Bošnjak, MENADŽMENT U TRANSPORTU I KOMUNIKACIJAMA, Fakultet za saobraćaj i komunikacije Univerziteta u Zagrebu, Fakultet prometnih znanosti Sveučilišta u Zagrebu, Sarajevo, Zagreb, 2000.

- Dundović, Č., POMORSKI SUSTAV I POMORSKA POLITIKA, Pomorski fakultet u Rijeci i Glosa Rijeka, Rijeka, 2003.

Glavan, B., POMORSKI BRODAR – ORGANIZACIJA I POSLOVANJE, Istarska naklada, Pula, 1984.

- Hampton, M.J. (1989) Long and Short Shipping Cycles (Cambridge: Cambridge Academy of Transport), 3rd edition 1991.
- Haws, D. and Hurst, A.A. (1985) The Maritime History of the World, 2 vols (Brighton: Teredo Books Ltd).

- Jones, J.J. and Marlow, P.B. (1986) Quantitative Methods in Maritime Economics (London:
Fairplay Publications).

- Stopford, R.M. and Barton, J.R. (1986) 'Economic problems of shipbuilding and the state', Journal of Maritime Policy and Management (Swansea), Vol. 13(1), pp. 27–44.

- Volk, B. (1994) The Shipbuilding Cycle-A Phenomenon Explained (Bremen: Institute of Shipping Economics and Logistics).

DOPUNSKA LITERATURA

17 Maritime Forecasting and Market Research

The wretched boatmen do not know,
Their rudder gone at Yura Strait,
Where will their drifting vessel go.
And where my love, and to what fate?

(Sone no Yoshitada, *One Hundred Poems from One Hundred Poets*)

17.1 THE APPROACH TO MARITIME FORECASTING

For most shipping investors forecasting is not optional. It is how they earn their living. Whether it is an investment decision like ordering a ship, or deciding which charter to take, the better they anticipate the future, the more profit they make. In fact if they cannot do that, what is the point? But it is not just shipowners who are in the forecasting business. Bankers lending money, shipyards developing designs, engineering companies selling equipment, rating agencies calculating the risk of default on a bond and ports developing their facilities will all be more successful if they can predict the future better than their competitors.

The poor track record of shipping forecasts

Considering the importance of these decisions it is not surprising that shipping executives are preoccupied with the future. But to be realistic, maritime forecasting has a poor reputation, and the sense that forecasts are usually wrong is too widely held in the industry to be taken lightly. However, it is not just the maritime industry that has this problem. Peter Beck, Planning Director at Shell UK, came to the same conclusion when trying to find forecasts for the oil industry, commenting:

> When looking at forecasts made in the 1960s and early 1970s, one can find many failures but few successes. Indeed one may be shocked at the extent to which the most important forecasts and their surrounding assumptions had turned out to be wrong.[1]

DOPUNSKA LITERATURA

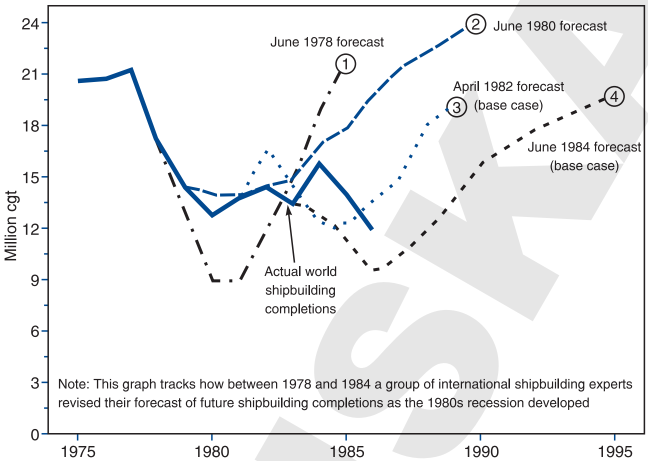

Figure 17.1
Comparison of forecasts of world shipbuilding completions

In the shipping and shipbuilding industries some forecasts have turned out to be wildly wrong, whilst others are right, but only by a fortunate combination of inaccurate assumptions. As an example, we can take four forecasts of the demand for new ships produced between 1978 and 1984, summarized in Figure 17.1. Each successive forecast predicted a different pattern of demand over the next seven years. The 1980 forecast predicted 50% more demand in 1986 than the 1982 forecast, and even this proved to be too optimistic. The line showing actual world shipbuilding completions barely touches any of the forecast lines. In defence of the experts who produced these forecasts, there were developments in the world economy and the oil trade that they could not reasonably have anticipated. However, the fact remains that the forecasts were a poor guide to what was about to happen in the shipbuilding industry.

Long-term forecasts do no better. Later in the chapter we will see how inaccurate some predictions for the 1980s made in the mid-1960s proved to be. They predicted widespread supersonic air travel but gave the computer only a passing mention and completely misjudged the two major economic developments of the 1970s, inflation and unemployment. Similarly, in 2002 the oil industry based its long-term oil demand forecasts on an oil price of $25 per barrel, only to see the price rise to $70 per barrel over the next three years. With such a poor track record it is difficult not to agree with Peter Drucker that, the further ahead we try to predict, the more tenuous the forecasts become:

> If anyone suffers from the delusion that a human being is able to forecast beyond a very short time span, look at the headlines in yesterday's paper, and ask which of them anyone could have possibly predicted a decade or so ago … we must start out with the premise that forecasting is not a respectable human activity and not worthwhile beyond the shortest of periods.[2]

The challenge of dealing with the unknown

The problem for maritime forecasters is that unfortunately Peter Drucker is right – there are important aspects of the future of the maritime industry that are not predictable. Future freight rates depend on how many ships are ordered, a behavioural variable which at the extremes of shipping cycles is totally unpredictable,[3] and developments in the world economy which, with its business cycles and crises, are far too complex for mere mortals to predict with any degree of certainty. In these circumstances even the most sophisticated scientific forecasting methods will have limited success.

This is not a new problem, and leaders of the ancient world developed all sorts of prophetic techniques to help them with imponderable decisions about how to conduct their lives and their military campaigns. Two thousand years ago there were oracles scattered all over Greece and Italy and some, such as Delphi and Trophonios, grew into large and wealthy organizations. Their sages would answer questions about what would happen in future, often as part of an elaborate ritual. For example a contemporary account of the Oracle of Trophonios, which was located underground at Lebadea in Greece in AD 150, describes the ritual an 'enquirer' went through to get a forecast. First, he spent several days in a special building purifying himself and making sacrifices. Then he was sent underground, feet first through a hole in the ground, to consult the oracle in a cavern full of smoke and mirrors. After the consultation he returned, again feet first, 'so possessed with terror he hardly knows himself or anything around him. Later he comes to his senses, no worse than before and can laugh again'.[4] Ancient decision-makers took their forecasts seriously!

The Babylonian, Greek, Roman and Etruscan civilizations used divination by entrails. The cuneiform literature of Mesopotamia in the twentieth century BC contains many accounts of divination in which a sheep's liver or other object (e.g. the behaviour of a drop of oil in a beaker of water) was used to make predictions: 'The king will kill his dignitaries and distribute their houses and property among the temples'; 'A powerful man will ascend the throne in a foreign city'.[5] Divination was a sophisticated skill. A Babylonian clay model of a sheep's liver in the British Museum, London, believed to have been used for training purposes, has 50 zones marked on it, each presumably with a different significance.

In the East equally sophisticated techniques were developed for predicting the future. Oracle bones were widely used in China three thousand years ago. The shoulder bone of an ox was trimmed to flatten it and several small cavities were gouged into its surface. Predictions were made by plunging a red hot iron into these cavities and interpreting the cracks which appeared on the underside of the bone. Nobody knows exactly how the cracks were interpreted, but over 1,15,000 oracle bones have been discovered, indicating the scale of this 'industry'.[6]

One of the most interesting ancient predictive systems is the Chinese 'Book of Change' or *I Ching*, which reduced the process of consulting fate to a system and the equally old 'Book of History' or *Shu Ching*. These classic books, written in China over 3000 years ago, focus on the process of change and include much that is relevant to the modern forecaster. Change is seen as continuous – 'Let him be wary and fearful, remembering that in one or two days there may occur 10,000 springs of things'[7] – and we are all responsible for our own actions: 'Calamities sent by Heaven may be avoided, but from calamities brought on by one's self there is no escape'.[8] The key issue is the right moment to act – 'The case is like that of sailing a boat; if you do not cross the stream at the proper time, you will destroy all the cargo'.[9] Once change has commenced we can sometimes tiptoe round it and get out of the way, or even manipulate it in our direction if it appears favourable.

In conclusion, the problems of making decisions about an uncertain future are as old as the shipping industry, and even Alexander the Great, a man of action whom any shipping magnate can admire, took divination very seriously.[10] Today's analysts with their computer models are the latest in a long line of intelligent individuals who minister to the needs of the decision-makers and perhaps we should not be too dismissive of these ancient rituals (or at least be more clear-sighted about our own). Strange though divination by bones or entrails may seem to us, are these rituals really any stranger then punching numbers into a plastic box and gazing at the digits which appear on a screen?

The forecasting paradox

Although this may seem a discouraging way to introduce a discussion of forecasting techniques, at least we are getting off on the right foot by accepting that our forecasts will often be wrong. It is a certainty because, paradoxically, forecasters are only called in when the future is unpredictable. When the future is predictable, which it often is, nobody bothers with forecasts. For example, investors in a liquid natural gas project secured by long-term cargo contracts do not hire a forecaster to predict future cargo volume; they hire engineers to work out how many ships will be required. But when there is no cargo contract and it is not clear how much LNG the project will be able to sell, the engineers are pushed aside and the forecasters are called in. They have a trickier task than the engineers because they are not dealing with the immutable laws of physics. If the LNG trade grows rapidly, new tankers will be needed and the investors will be able to charter the ships at high rates. But if there is some change in the world energy economy the ships will not be needed. How can they hope to predict that accurately every time?

Obviously they cannot, so their forecasts are bound to be wrong sometimes. Indeed a forecaster who was always right would be in a very strange position. So if by 'forecasting' we mean predicting *exactly* what will happen, Peter Drucker is right. Mortals cannot see into the future. But that is a bit like saying that if man were meant to fly he would have been given wings. Humans cannot fly themselves, but with a little lateral thinking they came up with airplanes which are almost as good (and much better on a transpacific trip!). In coming to terms with forecasting we need to do the same sort of lateral thinking.

Rational forecasting to reduce uncertainty

The first step in this process is to recognize that the goal of making precise predictions of the sort illustrated in Figure 17.1 is a red herring.[11] An interesting technical diversion but, like flapping your arms in an attempt to fly, it is unlikely to succeed. Shipping investors know very well that they are not dealing with certainty. In fact they are in much the same position as a poker player making an educated guess about his opponent's cards. The poker player knows he cannot identify the hand exactly, and the game would be pointless if he could. But a professional uses every scrap of information to make an educated guess about the range of possible hands. Although he will often be

DOPUNSKA LITERATURA

wrong, over a period of time this information helps him to come out ahead.[12] Shipping investors play the odds in much the same way – they know they will not win every hand but they also know that the right information plays an essential part in narrowing the odds.

That is where 'forecasters' come in, and one final example illustrates how information about the past can help decision-makers deal with the future. Suppose a driver wants to park in a restricted area. Nobody can predict for certain whether his car will be towed away, but accurate information about how often traffic wardens visit each street clarifies the risk – 'if you park there, you are almost certain to get a ticket because a traffic warden visits the street every ten minutes'. Quantifying the frequency with which traffic wardens visit the street clarifies the possible future outcomes and is precisely the type of relevant information analysts can provide. We are not talking about a precise forecast of the type 'your car will be towed away at 10.15 a.m.' Such a prediction would, as Peter Drucker points out, almost certainly be wrong and the driver would probably not believe it anyway. But knowing that the street is patrolled every ten minutes is believable and gives the decision-maker information to weigh up the risk of leaving his car for five minutes while he pops into a shop. So the purpose of *rational forecasting* is not to predict precisely, but to reduce uncertainty.

Over the last fifty years great progress has been made in developing rational forecasting systems. As data gathering improved in the decades after the Second World War and computers became available, forecasters developed economic models which could summarize the complex economic and behavioural relationships which determine what happens in the economy. This approach relies on recognizing patterns or trends in the past and capturing them in a model for making future projections. Sometimes forecasts focus on the short term, for example the spot tanker market, but they also need to deal with longer-term changes. Strategic decisions are among the most difficult to make, especially for companies well established in their business, but the brief history of shipping in Chapter 1 demonstrated that *I Ching* was right – things change, and when this happens inaction can be just as risky as action.

For decision-makers understanding and accepting analysis which indicates change requires vision and courage. For example, in the 1950s and 1960s liner companies were swept along by a tide of change caused by low-cost air travel, the independence of the colonies and containerization. In less than 20 years the economic framework of their business changed and companies which did not adapt disappeared. But it takes great resolve to abandon an apparently solid business and start building a new one. With or without forecasters, management can never be sure what is really happening. In such cases monitoring change is the key and acting hastily with the wrong information and analysis is as bad as doing nothing.

The importance of information

All of the foregoing suggests that forecasting is not about the future, it is about obtaining and analysing the right information about the present. The right information is not always easy to come by, but it is important. Few investors would be rash enough to buy

DOPUNSKA LITERATURA

a ship without the information provided by a physical inspection, and exactly the same is true of decisions which depend on economic developments.

An example illustrates the point. In Chapter 8 we left Aristotle Onassis at the height of a winning streak in 1956, with a profit of $80 million in the bank, thanks to the closure of the Suez Canal. But that was not the end of the story. Believing that the Egyptian government was not capable of reopening the Canal, Onassis expected it to be closed for several years, leading to a strong tanker market. When his aide Costa Gratsos urged him to take some time-charter cover, he told him: 'I'm hot, Costa, I'm in front of the parade. I've got the touch; I don't even have to breathe hard. Why the hell should we crap out now?' Costa Gratsos did not agree and secretly chartered 12 tankers to Esso for 39 months. When he found out, Onassis hit the roof, but he had misjudged the capability of the Egyptian government. The Canal was reopened only a few months later in April 1957, just as the US economy was slipping into its deepest recession since the 1930s and tanker rates slumped. Onassis had allowed himself to be caught up in a wave of market sentiment. Reluctantly he admitted, 'you read it right. I read it wrong'.[13] He had misjudged Egypt's ability to reopen the canal, a matter which the right information and analysis could have addressed (though to be fair this is more obvious with hindsight than it was at the time). The trouble is that information of this type is difficult to obtain and analyse, especially against the background of a booming market, so forecasters have to be versatile.

This example raises another issue, the interplay between sentiment and rational analysis in shipping decisions. Some economists now argue that economic theory should recognize the influence of emotions on decisions. They speculate that the section of the brain known as the amygdala – a source of emotional conviction – fights for supremacy with the more deliberative prefrontal cortex which controls analytical thought.[14] However the decision is arrived at, we should be realistic about these human aspects of the process.[15]

But the market does not really care how the decision was made. As economists we know that in the long term it rewards players who get it right, and although a few get lucky the long-term winners are the ones who do their homework. The market's goal is to make sure that the minimum resources are used to carry the world's trade. Companies which use information and analysis to achieve that goal are rewarded because they save valuable economic resources. And if they act irrationally and waste resources by, for example, ordering more ships than are needed they are punished. That is all there is to it – the law of the economic jungle rules! Information can help decision-makers find their way through the jungle, so they need forecasts and analysts, despite the fact that they are often wrong.

17.2 KEY ELEMENTS OF THE FORECAST

Three principles of forecasting

So how do we set about producing the right information for decision-makers? The first point to recognize is that if the results of the study are to be used in making a decision,

DO NOT DISTRIBUTE LITERATURE

and because there are so many different decisions to be made, no single methodology will produce a useful result in every case. There are, however, three principles that can be used to judge whether a forecast is likely to be useful.

1. *Relevance*. The first step in any forecast is to find out exactly what aspect of the future the decision-maker is interested in. For example, a forecast that predicts the level of shipbuilding output five years ahead may not be what a shipbuilder really wants to know. He may be much more interested in the prices at which ships will be sold so that he can calculate whether he can make a profit, and what share of the market he might win. In this case a relevant forecast would concentrate on price and competitor activity as well as the demand for new ships.
2. *Rationale*. There must be a convincing reason why the predicted developments may happen. Decision-makers have to decide how much weight to place on the analysis and they can only do this if there is some sort of rationale. Without it the forecaster is in the business of prophecy rather than economic analysis.[16] There are many ways of doing this. A quantitative forecast made with a model is appropriate in some cases and a set of scenarios in others. Or a credit-rating agency may insist on the probability of a particular event, say a default, being quantified in statistical terms.
3. *Research*. Information reduces uncertainty, so careful research is important. Although this sounds obvious, it is surprising how often decisions are taken without researching key variables. Like any other job in business, forecasting requires an adequate input of skilled man-hours. Referring back to the traffic warden example earlier in the chapter, it is not much help to tell a motorist parking his car in Kensington, London, that the number of traffic wardens in the UK went up by 2.8% last year. He needs specific data about Kensington.

These principles are not about accuracy; they are about establishing the ground rules for producing information and analysis which will be useful to a maritime decision-maker. Forecasting is part of the decision process and is about applying economic resources to reduce uncertainty.

Identifying the economic model

Identifying the underlying economic model is a vital part of the process because it tells us what information to collect and analyse. In fact we use this process all the time in our everyday life, using models founded on the principle of 'constant conjunction' first observed by the eighteenth-century philosopher, David Hume, in his *Treatise on Human Nature*. Hume concluded that we conduct our lives on the assumption that future events will generally follow the patterns we have observed in the past. As we gain experience we are constantly updating our range of constant conjunction models. For example, we expect rain because it is cloudy and we associate clouds with rain. In shipping, we may predict that trade will increase when the world economy recovers because this has always happened in the past. This form of verbal reasoning is the basis of most economic

DOCUMENTA LITERATURA

analysis and we often extend the model by taking account of additional information – are some cloud types more likely to produce rain than others?

Once we start asking questions like this, the problem becomes more complex. The first step is to specify the precise nature of the model by identifying the variables which we believe are related to the subject of the forecast and, from what we know, guessing the nature of the relationship between them. In the case of the weather model, one variable might be the percentage of blue sky visible in the morning and the other the hours of rain during the day. If we can quantify these two variables, for example by keeping records of their values every day for a year, we can analyse the data to measure the relationship (the number relating the variables is known as a parameter) and test it. The point of the test is to see whether the relationship between them is significant (are the variables really related?) and stable (will the parameter keep changing?). If the model does not pass these tests we might try a different specification. Other variables affecting the weather might be the temperature and the barometric pressure. If a more consistent relationship emerges, we have the basis for making a more authoritative forecast: 'If the pressure is falling and there is 100% cloud cover, we can expect rain'. Although they are not always correct, such forecasts can be helpful to us in taking day-to-day decisions like whether to wear a raincoat. Precisely the same principles apply in making business forecasts, but the time-scale is longer and there are many more variables to analyse.

Types of relationships and variables

Successful modelling depends on recognizing the nature of the variables and applying the appropriate analytical techniques. There are four different types, which we can refer to as 'tangible', 'technological', 'behavioural' and 'wild card'. Each of these has a different character. *Tangible* variables are physically verifiable and thus, in theory, have a high degree of predetermination. For example, the distance from the Middle East to China or India and the maximum operating speed of an oil tanker can all be precisely defined. For this reason, tangible variables tend to be reasonably predictable provided sufficient research is carried out – we are talking here about predicting such factors as the tonnage of tankers needed to carry China and India's imports. Unfortunately, the information about this type of variable can sometimes be inaccurate or misleading. The register book may say a tanker's speed is 15.5 knots, but in service it may only average 13 knots.

A typical *technological* variable is the amount of energy used per unit of industrial output. These relationships are often treated as parameters in forecasting models, but they can change substantially over time. Thus forecasters confronted with the problem of predicting how the world economy would respond to higher oil prices face questions such as whether the automobile industry will be able to make vehicles more fuel efficient. The rate at which innovation could be introduced in response to a major price change is difficult to predict; nevertheless, with careful research, it is possible to form a reasoned view.

Behavioural relationships depend on the way people behave. Suppose a forecasting agency predicts a boom in tanker freight rates. Shipowners see the forecast and order

DO NOT DISTRIBUTE

more tankers, and the resulting oversupply drives down freight rates. The forecast is wrong simply because shipowners are free to change their behaviour after the forecast has been made, so attempts to predict them can be are self-defeating. Consequently, behaviourals of this type are not reliably predictable.

Finally, there are *wild cards*. There can be sudden departures from the established 'norm', for example hurricanes or revolutions. By definition they are unpredictable and there is really very little that can be done about them – life is, by its nature, a risky business.

17.3 PREPARING FOR THE FORECAST

Three practical steps must precede the forecast. The first is to define the decision to be made; the second is to determine who is qualified to make the forecast; and the third is to establish that the things we are trying to forecast really are predictable.

Defining the decision

What exactly do shipping decision-makers want from their forecasters? That depends on who they are and what decisions they are making. There are many different decision-makers in shipping, each with a different forecasting requirement. Some of the more prominent ones are listed below.

- *Shipping companies* make decisions about the sale and purchase of ships; ordering newbuildings and whether to enter into long-term charters or COAs. These decisions depend on future freight rates, newbuilding prices and second-hand prices.
- *Cargo owners* are interested in the future cost and availability of suitable transport. Companies which ship cargo in sufficient volume will be concerned about future transport costs. For example, shippers may choose to cover a proportion of their shipping requirements by running their own ships, and using the charter market to meet fluctuations in demand. Once this approach has been adopted, the companies are faced with decisions about the size and type of fleet to maintain.
- *Shipbuilders* have to decide whether to expand or reduce capacity and whether to invest in new product development in certain areas. This involves the future demand for new ships, prices, currencies, subsidies, the demand for specific ship types and competition from other shipbuilders.
- *Bankers* make decisions about whether to approve a loan application and the level of security required. This involves decisions about future cashflow and whether the shipowner has the financial and managerial skills to survive recessions; often the question being asked is how bad things could get. If, in due course, the shipowner fails to service his loan owing to a protracted depression, then the banker faces another decision: whether to foreclose now and take a loss on the ships or wait in the hope that the market will improve.

DOWNSIDE LITERATURE

- *Governments* are often confronted by difficult decisions about the shipbuilding industry. These decisions involve issues such as whether or not to provide subsidy and whether or not to cut capacity. Governments may also be involved in shipping decisions such as whether or not to set up an international shipping register and how to manage it. All these decisions involve weighing short-term benefits against long-term risks. If a minister decides to subsidize a shipyard rather than allow it to close, he avoids a short-term political problem, but ties himself into a longer-term problem if, in fact, the shipyard remains unprofitable.
- *Port authorities* are concerned with port development. There is intense competition between ports to attract cargo by offering advanced cargo-handling facilities for containers, large bulk carriers and specialist product terminals. The provision of these facilities involves major capital investment in terms of civil engineering, cargo-handling equipment and dredging. As a result, decisions about port development depend crucially on traffic forecasting to find out the volume of cargo, the way it will be packed and the ship types used. For example, the decision on whether or not to invest in a specialist container terminal involves such questions as: How much container cargo will be moving through our part of the coast? What volume of this cargo can we attract through our port? What facilities will we need to offer in future to attract this share of the cargo?
- *Machinery manufacturers* are faced with decisions about what type of products to develop and how to manage their capacity. Merchant ships are massive engineering structures and, with a total fleet of 72,000 vessels, there is an enormous industry world-wide manufacturing components for fitting into new ships – engines, generators, winches, cranes, navigation equipment, etc. – and spare parts and equipment to upgrade the existing fleet. Manufacturers must look at trends in ship construction, future developments in operational management of ships, ship operating economics and the activity of competitors.
- *International organizations* such as the OECD, EU and the IMO do not actually make commercial decisions, but they are invariable drawn into the discussion of maritime policy. For example, the European Union produces Directives on Aid to Shipbuilding and has commissioned forecasts for this purpose.[17]

For all the diversity of this group there is one aspect of the decision process which is of particular importance, and that is whether the real decision authority lies with an individual or a group of decision-makers. We consider this important distinction in the following paragraphs.

Who makes the forecast?

Many shipping companies have a sole proprietor, the 'shipowner', who makes the decisions himself. These shipowners have so much riding on their decisions that they often do their own forecasting. Some have MBAs or degrees in economics and may even use the formal techniques discussed in this chapter, but most base their decisions on experience, common sense and 'gut feelings'. They are constantly on the lookout for information

DO NOT DUPLICATE LITERATURE

which gives an insight into what is really going on. There are several reasons why this approach works. Firstly, some key aspects of shipping markets are too subtle to capture in statistical models, for example the effect of congestion and supply shortages which disrupt the demand side of the model and cause unexpected changes in the market. Secondly, statistical data is limited and often arrives too late to be useful to a company trying to keep ahead of the pack. Thirdly, some variables such as market sentiment are too mercurial to capture in a formal forecasting model, so an experienced businessman close to the market has a far better chance of grasping what is really happening than a team of analysts struggling to fit a model to inadequate data.

But although this is a powerful argument, it has drawbacks. Sentiment can influence judgement, and decision-makers sitting too close to the market risk losing perspective. They need objective information and advice. Supporting balanced market decisions during periods of intense market sentiment is one of the most practical, and thankless, functions of shipping economics.

Although independent shipowners are an important group of maritime decision-makers, there are many others working in large shipping corporations, banks or bureaucracies whose approach to forward-looking decisions is very different. Entrepreneurs like Onassis have only themselves to convince, but decision-makers who share responsibility must carry their colleagues with them. Bankers, government officials, shipbuilding executives and board members of oil companies, steel mills and shipping conglomerates all participate in these forward-looking decisions but do not have the time or expertise to research them personally.

These decision-makers delegate the analysis and expect to be presented with predictions based on recognized analytical techniques, in a form which can be circulated to colleagues and independently checked. Even shipping entrepreneurs raising finance may be drawn into this process of structured market analysis. If they are borrowing from a bank, the bank's lending officer and its credit control department will expect to see a structured analysis of the prospects for their business. Or if the funds are to be raised by an IPO or from the bond market, financial institutions must be convinced and that means explaining how the markets work and what the risks are. In such cases forecasts, however inadequate, become part of the decision process.

What decision-makers use forecasts for

The range of maritime business activities which require forecasts or 'forward-looking views' is extraordinarily wide, particularly if we take into account the activities of banks, governments, port authorities, shippers and other organizations with an interest in the shipping market. Some of the more important commercial decisions are listed below and it is apparent that each involves a very different approach to forecasting:

- *Spot-chartering ships.* This is one of the fundamental shipping decisions, and judging what will happen next is crucial. Waiting a couple of days can sometimes result in a better rate and there is the question of which discharge port will leave the ship best positioned. This requires a short-term view of the market and conventional

DO NOT DISTRIBUTE LITERATURE

forecasting techniques are not much help. Little reliable data is available in the time-frame and decision-makers generally rely on their own intuitive models and gut feeling of brokers working the markets, though modelling is not entirely out of the question for big companies or pools with a strong information base.

- *Time-chartering ships*. This covers a longer period and provides an ideal opportunity to take a reasoned view of market prospects. It is a central use of forecasting, focusing on the probable future level of spot earnings over the time-charter period compared with the available time-charter rate and the residual value of the ship at the end of the charter.
- *Sale and purchase*. Deciding when to buy or sell ships is another prime application for shipping forecasts. In this case the focus is on how second-hand prices will develop and identifying market turning points. Market players need to decide where they are in the cycle and whether prices represent good value in relation to long-term trends.
- *Budgets*. Most companies produce some sort of budget for the following year. Shipping companies with ships on the spot market need to estimate earnings and costs in the budget year, and shipbrokers whose commission is a percentage of freight rates have the same interest. Both may be interested in how second-hand prices will develop. Shipyards need to predict sales volumes and prices, whilst marine equipment manufacturers are interested in sales of the ship types which use their equipment.
- *Strategic and corporate planning*. This is moving into more specialist territory. Usually planning systems are used by larger corporates which need to involve the whole organization in thinking through how the business should develop. A few large shipping companies in the bulk, liner and specialist markets do strategic planning, but the technique is more commonly used by major charterers such as oil companies and steel mills; shipyards and marine equipment manufacturers; and ports. They use longer-term market forecasts or scenarios as the starting point for their planning activities.
- *Product development*. Shipyards, shipping companies and equipment manufacturers developing new products need market analysis of ship types that will sell well in future.
- *International negotiations*. Forecasts have a role in many international negotiations and formulating regulations. For example, shipbuilders use market forecasts as the basis for international discussions about capacity and regulators developing phase-out schedules for single-hull tankers needed to understand the impact the proposed regulations would have on the availability of transport capacity.
- *Government policy-making*. Market forecasts are sometimes required as an input to government policy decisions on shipping and shipbuilding.
- *Industrial relations*. Negotiations with shipping and shipbuilding unions often involve a view of market prospects.
- *Bank credit analysis*. Banks lending money to shipowners (or deciding whether to foreclose) must take a view on the risk. This involves appraising the future strength of the market, freight rates and ship prices; a market forecast provides a good starting point for discussing loans that involve a degree of commercial risk.

17.4 MARKET FORECASTING METHODOLOGIES

The forecasting time-scale

Time has a special place in forecasting and has major significance for the forecasting methodology adopted. Although decisions are made in the present,[18] the distance their consequences stretch into the future affects the forecaster's task because important short-term variables often do not matter in the long term and vice versa. The three shipping market time-scales we defined in Section 4.5, p. 163 – momentary, short term and long term – provide a logical way of defining the forecasting time horizon, though it is useful to add a fourth, the medium term.

Momentary forecasts are concerned with days or even hours. This is the time-scale of charterers, shipbrokers and traders who have to decide whether to fix a ship or cargo. Chartering brokers, who work on very short-term decisions, deal with this sort of forecast every day. Should their client accept the offer or wait? Maybe he should ballast to another loading zone. Confronted with chartering options in the spot market, he must choose which part of the world is best for the ship to end up in. Or should he just put the ship on time charter? This is forecasting at the sharp end, at the frontiers of information availability, with no time for thick reports. A risky profession, but very rewarding for those who are good at it!

Short-term forecasts in shipping generally cover a period of months – for example, the remainder of the current year and next year. It is a popular time-frame because it covers the budget year, a forecasting activity most companies get involved in. From the forecaster's point of view there is more to work with and a better chance of being right because the market fundamentals such as the business cycle and the shipyard orderbook are sometimes well defined. The 'future' is close enough to make forecasts based on fundamentals plausible, increasing the chance of harnessing information to make accurate forecasts. Since there is plenty of data available it is an ideal time-frame for modelling.

Medium-term forecasts generally cover a time-scale of 5–10 years. They span an average shipping market cycle, which we know from Chapter 3 could be 4–12 years. Bankers lending to the shipping industry are fascinated by the shape and timing of the next cycle, and shipyards have a similar interest. If the shipowner buys bulk carriers, what is the chance of a protracted recession? Will he have the cashflow to survive a depression? How will operating costs compare with those of competitors? Forecasts over this time-scale often make use of either supply–demand models or some sort of econometric model.

Long-term forecasts have a logical span of 25 years, the life of a merchant ship. By the end of a 25-year forecast there will be little left of the current fleet, so anything is possible! This is 'think tank' territory, and major changes do happen from time to time. Over the last twenty years shipping has seen steam coal grow rapidly; the container charter market develop; reefers lose market share to container-ships; and cruise developed as a new segment. These longer-term developments are relevant for large bulk shipping companies, the shipbuilders, and service providers such as the container business and ports. Governments developing or reviewing maritime policy often want a long-term perspective. Although models are often used for long-term forecasts, they are

Table 17.1 The forecasting applications matrix

	Time-scale			
	Momentary 1 week	**Short 18 Months**	**Medium 5–10 Years**	**Long 20 Years**
Bulk shipping companies	Chartering	Budget	Investment	Strategy
Liner shipping companies		Budget	Investment	Strategy
Cargo owner	Chartering	Budget	Investment	Strategy
Trader	Charteing	Advisory	Business Plan	Strategy
Shipbroker	Chartering	Advisory	Business Plan	Strategy
Shipyard		Budget	Business Plan	Strategy
Equipment manufacturer		Budget	Business Plan	Strategy
Port/terminal		Budget	Business Plan	Strategy
Government		Budget	Policy	Policy
Total	4	8	7	1

little more than a convenient way of presenting conclusions drawn from less formal analysis.

A summary of how these different timescales apply to different decision makers is shown in Table 17.1. Easily the most popular is the short term. Almost everyone uses that at some time or other. Most of the support industries are also interested in the medium term, whilst only governments and large corporations venture into the long-term scenarios.

Three different ways of approaching the forecast

Since decision-makers have such varied needs, covering such different time-scales, we must think carefully about how each forecast is prepared and presented. Even if it turns out to be wrong, the forecast is adding value if it gives decision-makers a better understanding of the decision they are making. In this sense forecasting has an educational element and analysts must think carefully about the methodology that is likely to give the maximum benefit. There are three different ways of approaching this task, each of which has specific advantages and disadvantages. We will call them the market report; the forecasting model; and scenario analysis.

A market report is a written study designed to provide the client with enough information to form his own views about what might happen in future. It will answer such questions as: How does the business work? How fast is it growing and why? What is the competitive structure and who are the market leaders? How are things likely to develop? What are the risks? A report dealing with these issues is necessarily descriptive, but will generally include some statistical analysis and forecast tables, though not necessarily produced with an integrated model.

A more structured approach is to model a segment of the maritime business mathematically. Several companies offer *forecasting models* of the whole shipping market, and shipping companies sometimes develop their own sector models, for example of the

DO NOT DISTRIBUTE - INFORMA LIBRARY

oil trade, the dry bulk trade or the shipbuilding market. Because models are easily updated, sensitivity analysis can be used to show the responsiveness of the results to changes in key assumptions. However, they also have three disadvantages. First, however sophisticated the model, the forecast is no better than the assumptions – typing numbers into a computer does not, in itself, add much value. Second, when forecasting freight rates and prices, supply–demand models can be so sensitive to very small assumption changes that the link between the assumptions and the forecast can become tenuous! Third, models cannot address the issues for which no data is available, however important they may be. Demand information is a particular problem.

Scenario analysis takes a different approach. Instead of starting from a preconceived model, it starts by identifying the critical issues that the decision-maker may have to respond to in future, then works backwards to analyse the forces which lie behind each issue, evolving a scenario. For example, if pollution risk was identified as a key issue for a tanker company, the scenario would examine how regulatory pressures and commercial trends might impact on the business. What is the probability of a serious pollution incident? How would regulators and shipowners respond? The analyst constructs a scenario illustrating how these factors might interact. The advantage of scenario analysis is that it allows ‘lateral thinking’ and can move into areas which are less well defined quantitatively. The disadvantage is that scenarios are complex to produce, and not all decision-makers are prepared to enter into the spirit of this wide-ranging technique.

From a methodological viewpoint there is a fundamental distinction between market forecasting and market research and Figure 17.2 summarizes some of the practical differences. In terms of objectives, market forecasts often have rather general terms of reference, whereas market research is generally linked to a defined business decision. The methodology of the market forecast tends to be dominated by statistical analysis, since statistics are the best way of representing large groups where the law of large numbers can be assumed to apply. Consequently, analysis is numerical and often involves computer modelling. In contrast, market research tends to be more closely concerned with technical and behavioural variables, which are less easily represented in statistical terms – models can be used to establish the framework, but the central issues are questions like ‘How will competitors or charterers react?’ which are best dealt with by research into the current views and behaviour patterns of the relevant decision-makers. Numerical analysis is still important but is generally of a financial nature.

In preparing a market research study it is generally necessary to narrow down the area of analysis to make the task manageable in terms of the volume of information to be handled. This leads to one of the most important functions of the market forecast, which is to set the scene for the more detailed market research study. However thorough the market research may be, it cannot afford to ignore trends in the market as a whole. If we take an analogy from road transport, the market forecast is equivalent to the road map that establishes where the main roads go, whilst the market research is equivalent to the route plan a driver prepares before setting out on a long journey. He will certainly refer to the roadmap, but his route plan will be unique. It will deal with a specific journey and, to be successful, must take account of such details as expected traffic density, speed limits, short cuts and road repair work which might cause delays, none of which are

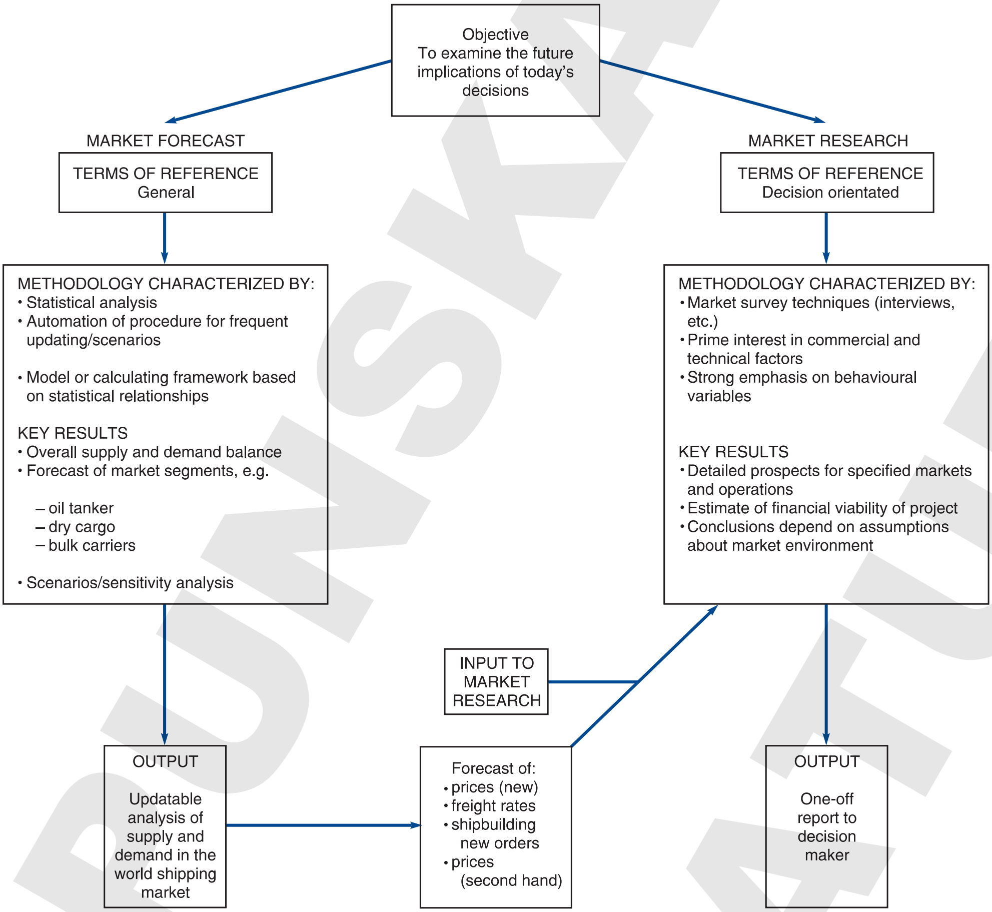

Figure 17.2
Differences between maritime market forecasting and market research
Source: complied by Martin Stopford from various sources

shown on the map. Of course, motorists going on long journeys do not have to consult maps or prepare route plans Many just set off and follow the road signs, hoping not to get lost. Much the same is true of decision-makers in the shipping market.

In the following sections we discuss each of the approaches in more detail.

17.5 MARKET RESEARCH METHODOLOGY

A market research report is as much about education as prediction. The aim is to summarize all the relevant facts about the market, examine trends, and draw conclusions about what might happen in the future.

Preparing this type of study requires a combination of commercial and economic knowledge. The statistical techniques we discuss in later sections are useful, but the emphasis is on identifying the factors that will significantly influence the success or failure of the commercial decision, gathering information and assessing how these may develop. A systematic procedure for carrying out a market research study is shown in Box 17.1, which lists the six main tasks involved.

BOX 17.1 STAGES IN PREPARING A SHIPPING MARKET REPORT

1 Establish terms of reference
- 1.1 Discuss the study with the decision-maker.
- 1.2 Identify type of information required.
- 1.3 Specify means by which results are to be presented.
- 1.4 Estimate time and resources required for study.
- 1.5 Ensure resources are available.

2 Analyse past trends
- 2.1 Define market structure/segmentation.
- 2.2 Identify competition.
- 2.3 Compile database and tabulate.
- 2.4 Calculate trends and analyse their causes.
- 2.5 Extract cyclical effects.

3 Survey competitors' plans and opinions of experts
- 3.1 Identify main competitors.
- 3.2 Survey opinions of experts on future developments.
- 3.3 Survey plans of companies operating in market.
- 3.4 Prepare summary of the industry's view of the business.

4 Identify influences on future market development
- 4.1 Determine future market environment.
- 4.2 List key factors that will influence future outcome.
- 4.3 Prioritize variables in terms of potential future impact.

5 Combine information into forecast
- 5.1 Think through forecast theme (what will happen?).
- 5.2 Develop detailed forecast tables.
- 5.3 Write up forecast as clearly as possible.

6 Present results
- 6.1 Executive summary.
- 6.2 Detailed report.
- 6.3 Verbal presentation.

Step 1 is to establish the terms of reference of the study. What decision is to be made, and how will the study contribute? A great deal depends upon the stage of thinking that has been reached. For example, a liner company considering setting up a new service would need to decide what type of operation to set up and how much to invest in it. In this case some of the questions it must answer are the following:

- How big is the accessible market and what share might the company win?
- How will freight rates and volume develop on that route?
- What aspects of the service will be most important in achieving future sales?
- What ship type will be most cost-effective in providing this service?
- How will competitors react to a new entrant to the trade?

Setting out the terms of reference in this way makes it clear that the decision-maker is seeking more than a simple forecast of trade. He needs advice on how the competitive position is likely to develop and how the commercial environment in which he will be operating will change.

Step 2 is to assemble whatever information is available and analyse past trends. Defining the market segment can often be quite difficult. For example, an investor thinking of buying a small products tanker to trade on the spot market may not be sure what type of vessel is best. Should it be able to trade in chemicals? Is it for clean or dirty products? How much attention should be given to tank size, number of segregations and pump capacity?

Once the market segment has been defined, the third step is to identify the competition. The shipowner may find himself squeezed out of the market by cut-throat competition or over-ordering by competitors. In the case of a shipbuilding company, this may involve identifying other shipyards with a known capability in the market segment and assembling information about their commercial performance. In a bulk shipping project, it may involve identifying the fleet of ships able to trade in this market and analysing the future orderbook and the strategy of other operators.

The compilation of the database for all this work is often difficult because information is incomplete or unavailable, but it should aim to provide an overview of what is happening in the market, which the analyst can then investigate and explain. A final step is to consider any cyclical effects which may be at work – for example, recent strong growth may be due to the economic business cycle rather than a long-term trend.

Step 3 takes the study into the activities of competitors. Statistics are not usually helpful for analysing this type of information, and a more productive approach is to survey the opinions of people involved in business about the plans of companies operating in the relevant market segment. This involves:

- identifying the relevant experts to question;
- deciding on a list of the questions that need to be answered;
- selecting the most appropriate method of surveying opinions.

There are many established techniques for surveying opinion, ranging from the personal interview to the general questionnaire.[19] For example, an opinion survey of the ferry market revealed that the commercial trend was strongly towards treating the cruise ship as a 'floating hotel' in order to maximize on-board expenditure by passengers. This provided the basis for a new line of investigation about how this trend would develop over the next decade.

The first three stages in Box 17.1 lay the foundation for the study by defining its aims, analysing statistical trends, obtaining the views of experts, and identifying the plans of competitors operating in the market. It remains to prepare the report, and this is subdivided into three steps. *Step 4* involves the future market environment and questions such as: How sensitive is this market to commercial conditions in other sectors of the shipping market? For example, during the 1990s the market for small products tankers proved to be comparatively robust against the surplus of VLCCs that developed early in the decade. *Step 5* singles out the factors that are likely to be most important in determining the future outcome for the project and draws conclusions about how these will develop.

DOPUNSKA LITERATURA

Finally, *Step 6* is the crucial task of presenting the results. Usually a report is prepared with an executive summary for busy decision-makers who do not want to read the whole thing. That does not mean they do not want the detail. The ability to have an independent expert check the methodology is important and a report setting out the detailed research gives credibility to the conclusions. The summary may include a risk analysis. For example, suppose some of the key influences on the market develop unfavourably, what would happen and how would the company be able to react? Suppose, the company buys products tankers but one or more of the growth markets for products imports fails to develop. Would it matter? Is there any action that can be taken now to guard against such an event? This is not easy to carry out but it is a valuable addition to the 'spot prediction' technique.[20] In addition to the written report, a verbal presentation with slides is often provided.

17.6 FREIGHT RATE FORECASTING

Probably the most common requirement is for a forecast of freight rates. Freight rate forecasts are extensively used by banks, shipping companies, civil servants and consultants commissioned to produce commercial studies. There are several market forecasting models commercially available which allow users to enter their own assumptions. Although these models vary enormously in detail, most use a methodology based on forecasting the supply and demand for merchant ships and using the supply–demand balance to draw conclusions about developments in freight rates. This provides a consistent framework for preparing a market forecast of the shipping market and can be developed in appropriate detail to produce projections that are significant for particular purposes. Although forecasts of this type are produced in precise detail they are often wildly inaccurate. Their detail is the result of the way they are produced and not an indication of their accuracy.

The classic maritime supply–demand model

For some purposes a computer model is more useful than a report. All economic forecasts are based on some sort of model, which provides a simplified image of the world we are seeking to forecast, but in this case we are aiming to develop a working model that will successfully reproduce the relationship between the key variables in the segment of the shipping market under investigation, often including prices and freight rates.

The shipping supply–demand model was discussed at length in Chapter 4. We reviewed the key variables and the relationships between them and this model is summarized in Figure 17.3. The main variables 'V' are shown by rectangular boxes and the relationships 'R' which form the links in the model by arrows. The principal demand variables are the world economy, the commodity trades and ship demand, whilst the main supply variables are scrapping, orders, and the merchant fleet. In addition to 'normal' values of these variables there may be wild cards, which are sudden and unexpected changes in

DOWNSIZE LITERATURE

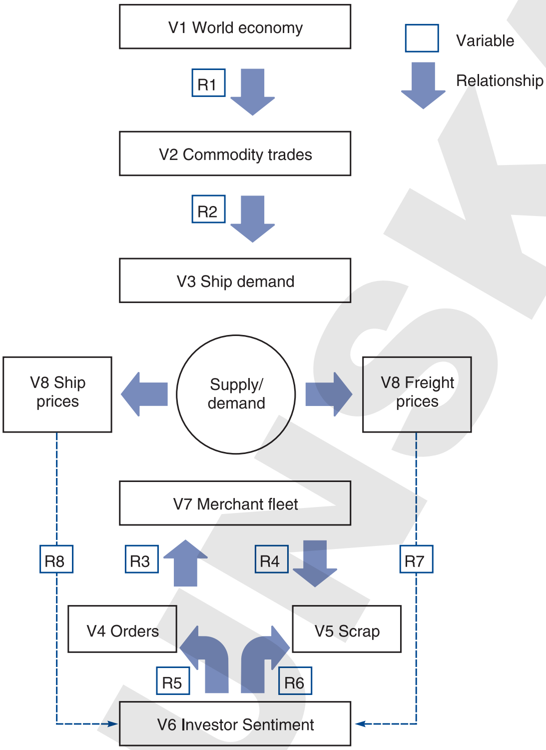

Figure 17.3
Macroeconomic shipping model

any of these key variables (see Section 17.2). The important point about wild cards is that although their timing is unpredictable, their occurrence is not. For example, it is impossible to predict exactly when political disruption will occur in the Middle East, but it has happened seven times over the last 50 years (1952, 1956, 1967, 1973, 1979, 1980 and 2001), so it is likely to happen again at some point. A parallel example is designing a ship to deal with 'super-waves'. The designer does not know when a ship will be hit by one, but if it is likely to happen eventually, the design must be able to cope with it. So timing is not the only issue.

Relationships link the variables together. The key relationships in the macroeconomic model in Figure 17.3, shown by the arrows, are the links between the world economy and commodity trade; commodity trade and ship demand; shipowner investment, orders and scrapping. Finally there is the crucial relationship between the supply–demand balance, freight rates, prices and investor sentiment. This feeds back into the supply side of the model through the relationship between freight rates, prices and investment sentiment shown by the dotted lines. This is one of the most difficult parts of the model. Obviously there are many ways the model can be developed in greater detail. For example, the world economy can be divided into regions or countries, commodity trades can be split into many commodities, each dealing with the industrial sector concerned in detail, and ship demand can be split by cargo type, for example containers, bulk and specialized cargoes. On the supply side, the fleet can be split by ship type and size, and such issues as fleet productivity can be developed in detail. Taken to extremes, the result could be a model with many thousands of equations, though as we will see in what follows, detail does not necessarily make models more accurate.

Five stages in developing a forecasting model

In principle, supply–demand modelling can be applied to any segment of the shipping industry, but success depends on quantifying the variables at a significant level of desegregation, and in practice this is easier for some segments than others. Shipping segments such as crude oil tankers and bulk carriers which operate in well-documented markets are the easiest to model, whilst specialist vessels such as container-ships, vehicle carriers and chemical tankers are more difficult to model as a whole due to the lack of published information and the more complex relationships involved. Having said this, it is often possible to model parts of these complex sectors. The five stages in preparing a model are summarized below:

1. *Design model*. Draw a flow chart of how the model works. This helps to think about the structure and ensures that all possible influences on the dependent variables are considered. What variables are important? Does the model make economic sense?
2. *Define relationships and collect data*. At this stage the structural form of the model is established as a set of related equations. This stage is shown in parallel with data collection in Figure 17.3 because the form of the model will be influenced by data availability – there is no point in specifying equations which cannot be fitted because no statistical information is available. Once the structural equations have been established it is usual to recast the model into reduced form, by algebraic manipulation, to derive a model in which each endogenous variable has a separate equation in terms of exogenous variables. This can help to avoid statistical problems.[21]
3. *Estimate equations and test parameters*. This stage is usually carried out using a computer package which estimates the parameters and automatically provides a range of test statistics. In addition to the correlation coefficient and the 't'-test, various statistics are used to test for particular econometric problems – for example, the Durbin-Watson statistic to identify autocorrelation. The results of these tests will determine whether the equations are useful.
4. *Validate model*. In addition to statistical tests, it is good practice to test the model by carrying out a simulation analysis, ideally using data which was not used to estimate the equations. Following this stage, the model structure is finalized.
5. *Prepare forecast*. To make a forecast of the dependent variables it is necessary to forecast values for the exogenous variables. For example, this might include predictions of industrial production, commodity trade, and ship investment. The study of the appropriate values for the exogenous variables is therefore a vital stage.

Example of a forecasting model

The practical procedure for producing a forecast using the shipping market model SMM described in Appendix A involves working through nine separate stages.

STAGE 1: ECONOMIC ASSUMPTIONS

The first step is to decide what period the forecast is to cover and to discuss what assumptions should be made about the way in which the world economy will develop during this period. Specific requirements of the forecasting model are an assumption about the rate of growth of gross domestic product (GDP) and industrial production in the main economic regions. Deciding which regions to include and in how much detail is a key task. Oil prices may also play an important part, as will views on such issues as political instability, passage through the Suez Canal, etc.

STAGE 2: THE SEABORNE TRADE FORECAST

The next step is to forecast seaborne trade during the period under review. The simplest method is to use a regression model of the following type:

$$ST_t = f\,(GDP_t) \qquad (17.1)$$

where *ST* is seaborne trade and *GDP* is gross domestic product, both in year *t*.

Suppose, for example, we assume that there is a linear relationship between seaborne trade and gross domestic product. The linear equation which represents this model is:

$$ST_t = a + bGDP_t \qquad (17.2)$$

This model suggests that the two variables, seaborne trade and gross domestic product move together in a linear way. For example, if industrial production increases by \$1 billion, seaborne trade increases by 100,000 tons; whilst if industrial production increases by \$2 billion, seaborne trade increases by 200,000 tons. The precise nature of the relationship is measured by the two parameters *a* and *b*. Using past data and the linear regression technique we can estimate the value of these parameters. As an example, Figure 17.4(a) shows this model fitted to data for the period 1982–1995 using a linear regression:

$$ST_t = -26.289 + 30.9.\ GDP_{\mathrm{t}} \qquad (17.3)$$

What does this model tell us? The estimate for *b* shows us that during the period 1982–1995, for each 1 point increase in the GDP index, seaborne trade increased by 30.9 million tonnes. The 'fit' of the equation is excellent, with a correlation coefficient of 0.99, which means that changes in industrial production 'explain' 99% of the changes in sea trade. If we accept the model, a forecast of seaborne trade can then be made by substituting an assumed value of GDP and calculating the associated level of seaborne trade.

How reliable is this model? One way to test it is by carrying out a simulation analysis. We feed the actual GDP index for the years 1995–2005 into the equation and compare the predicted level of sea trade with the actual trade volume. The comparison of projected with actual trade growth in Figure 17.4(a) shows that the model worked very well. Anyone who used it in 1995 to forecast trade volume would have been correct to within 0.1%. There were a few small divergences along the way, as the dotted line showing the predicted trade shows – the prediction was low in 1997 and high in 2002. But overall the model works very well, and provided the correct assumptions were made about GDP the result would have been very accurate.

DOPUNSKA LITERATURA

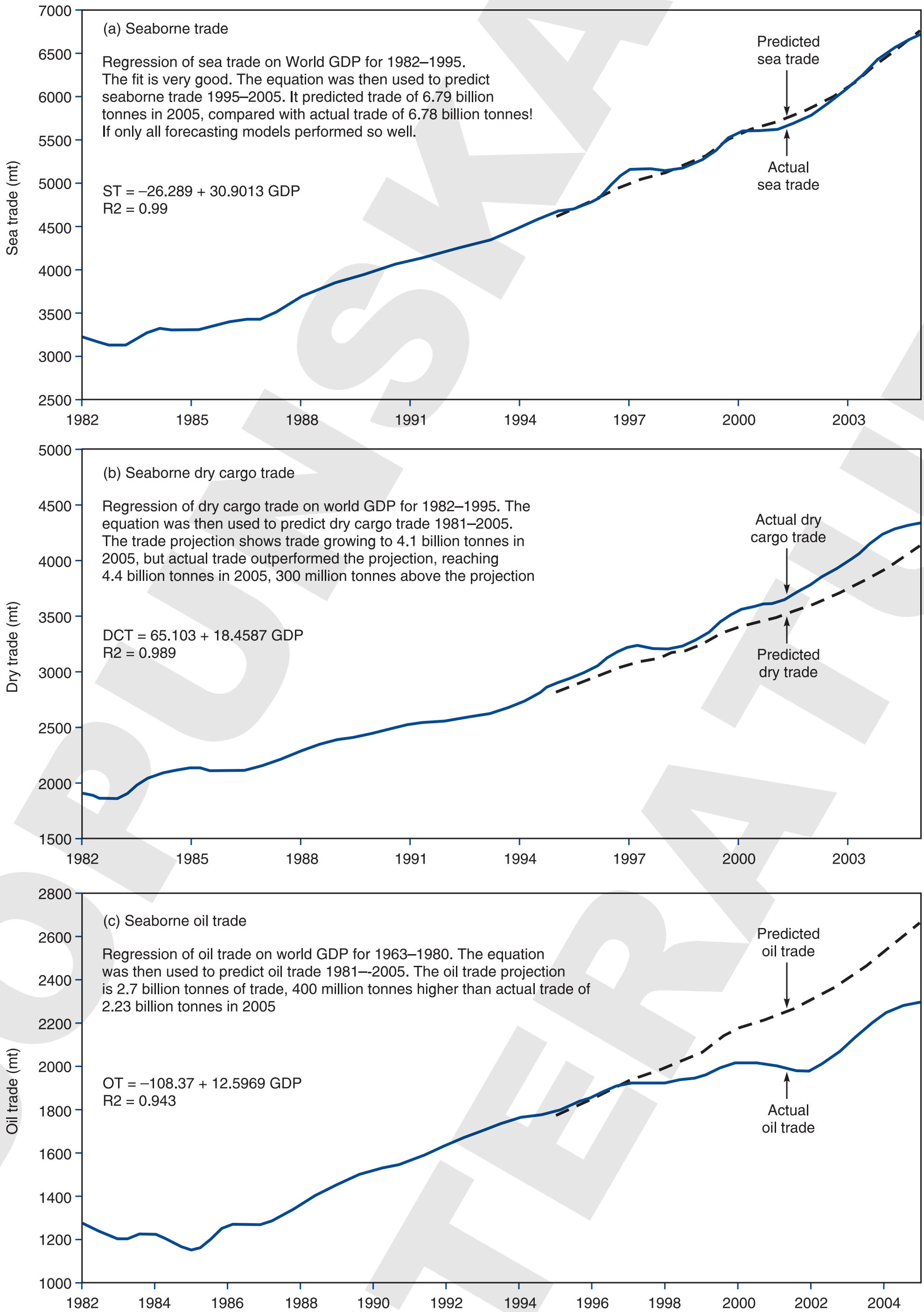

Figure 17.4
Seaborne trade models comparing projections with actual trade growth
Source: World Bank and Fearnleys Annual Review, various editions

The problem with simple models of this type is that we have no way of checking in advance whether the relationship will be valid in future. A more thorough approach, which helps to check out the model, would be to subdivide the trade into separate commodities (crude oil, oil products, iron ore, coal, grain, etc.), and to develop a more detailed model of the type discussed in Section 10.5, for each commodity trade. For example, we might start by splitting seaborne trade into dry cargo and oil and estimating the regression model separately for each commodity, again using data for the period 1982–1995.

The result of this analysis for dry cargo is shown in Figure 17.4(b). For the years 1982–95 we estimate the relationship between the tonnage of dry cargo trade each year and world GDP. Once again the fit is excellent, with a regression coefficient of 0.989. However, when we use the equation to project seaborne trade through to 2005 using actual GDP the projection proves to be less accurate. The model predicts seaborne dry cargo trade of 4.1 billion tonnes in 2005, compared with actual trade of 4.4 billion tonnes. Admittedly a 7% error over 10 years is a better result than most economists would dare to hope for, but in real life it is unlikely that the GDP assumptions would be precisely correct and any errors here would be reflected in the projection.

When we extend the exercise to the oil trade the result is even less satisfactory, as can be seen in Figure 17.4(c). Although the model fits quite well during the base period 1982–95, with an R^2 of 0.94, the projection for 2005 is 400 million tonnes too high, an error of 20%. Between 1995 and 2000 the trade hardly grew, then it picked up between 2001 and 2005. There is really no choice but to dig deeper, perhaps by developing a regional oil trade model. During the first half of the projection period Japan and Europe hardly increased imports and a properly specified model of the type discussed in Section 10.5 would incorporate regional analysis to pick up these trends, thus providing a more informed basis for making forecasts

Some of the more sophisticated market forecasting models subdivide trade into many commodities and forecast each commodity trade using a set of equations. In theory more information should lead to a more reliable result. The danger is that it is very time-consuming and can easily generate so much detail that the underlying rationale of the forecast is lost. The key issue is to identify a significant level of detail to work at. Finally, we can note that we got a bit lucky with the total sea trade projection in Figure 17.4(a). The amazingly accurate projection in Figure 17.4(a) was the result of a dry cargo forecast which was 300 million tonnes too low and an oil trade forecast which was 400 million tonnes too high.

STAGE 3: AVERAGE HAUL FORECAST

There are two alternative ways of forecasting average haul. The simple way is to project historic trends in the average haul for each commodity, attempting to identify the factors that might cause the average haul to increase or decrease. In the case of the crude oil trade, for example, an increase in the market share of Middle East oil producers would increase the average haul and vice versa.

DOUNSYA LITERATURE

Another approach is to analyse the trade matrix for each commodity, and from this to calculate the average haul. This is technically possible and probably worthwhile for some of the larger commodities such as oil, iron ore, coal and grain. For others it is extremely difficult because the information about the trade matrix is difficult to obtain, and the time taken to produce a matrix forecast is disproportionate to the small amount of trade involved. A compromise is to study the average haul of the major commodities in some detail, whilst extrapolating past trends for the remainder of the trade.

STAGE 4: THE SHIP DEMAND FORECAST

As we saw in Chapter 4, ship demand should be measured in ton miles of cargo to be transported. The total requirement for transport is calculated by multiplying seaborne trade by the average haul. Some forecasters take an additional step and calculate the ship requirement in deadweight tons. This presents conceptual problems because the productivity of the fleet is a supply variable – it is the shipowner who decides how fast his ship should travel – but it is easier for users to understand because it can be compared directly with the fleet. Typically the merchant fleet transports about 7.3 tons per deadweight each year and that is a useful rule of thumb for converting tons of cargo into deadweight demand (see stage 6).

STAGE 5: THE MERCHANT FLEET FORECAST

The supply side of the forecast starts by taking the available merchant fleet in the base year, adding the predicted volume of deliveries and subtracting the forecast volume of scrapping, conversions, losses and other removals. Forecasting scrapping and deliveries is complicated because these are behavioural variables. The minute freight rates go up, shipowners stop scrapping and start ordering new ships. For this reason the forecast needs to be made on a dynamic basis, preferably year by year using a computer model that adjusts scrapping and new ordering in line with the overall supply–demand balance.

STAGE 6: SHIP PRODUCTIVITY FORECAST

As we saw in Chapter 4, the productivity of a ship is measured by the number of ton miles of cargo carried per deadweight of merchant shipping capacity per annum. There are two forecasting methods. The simplest is to take a statistical series of the past productivity of the merchant fleet either in tons per deadweight or ton miles per deadweight (see Figure 4.8) and project this forward, taking account of any changes of trend that may be thought appropriate. Since productivity depends on market conditions, the forecast ought to be developed on a dynamic basis that recognizes that when market conditions improve the fleet will speed up and vice versa. A more thorough methodology for building up a forecast of productivity in this way would use an equation like (6.7) in Chapter 6.

STAGE 7: THE SHIPPING SUPPLY FORECAST

The shipping supply is calculated in ton miles by multiplying the available deadweight tonnage of ships by their productivity. By definition, supply must equal demand. If supply is greater than demand, the residual is assumed to be laid up or absorbed by slow steaming; if supply is less than demand, the fleet productivity must be increased.

STAGE 8: THE BALANCE OF SUPPLY AND DEMAND

As we have already stressed, a supply–demand model of this type contains behavioural variables, particularly the scrapping and investment variables. This is the most difficult part of the model. We know that supply must equal demand, and if the forecast level of supply does not match the forecast level of demand, then we must go back through the whole process again and make the adjustments that we believe the market would make in response to financial stimuli such as asset prices, freight rates and market sentiment.

STAGE 9: FREIGHT RATES

Now we come to the heart of the forecast, the level of freight rates which will accompany each level of supply and demand. We discussed the relationship between supply, demand and freight rates in Chapter 4, relating demand to the shipping supply function and showing how prices are established in different time-frames. This is the method which should be used. From a technical viewpoint the most difficult element to model accurately is the J shape of the supply curve. Regression equations relating freight rates to laid-up tonnage do not generally work very well due to the difficulty of finding a functional form which picks up the 'spiky' shape of freight graph. Simulation models offer a more satisfactory solution.

A typical market forecast generally includes predictions of the rate of growth of ship demand, the requirement for newbuilding tonnage and the overall balance of supply and demand. There may also be scenarios of freight rates and prices.

Finally, a word of caution. Analysts who successfully design and use a model of this type will learn an important lesson about the freight market which only becomes obvious when the relationships are quantified. As the market modelled approaches balance, the freight rates become so sensitive to small changes in assumptions that the only way to produce a sensible forecast is to adjust the assumptions until the model predicts a level of freight rates which is determined by the forecaster. That is the nature of the market. When there are two ships and two cargoes freight rates are determined by market sentiment at auction, and economics cannot tell us how the auction will develop. At their best shipping market models are educational in the sense that they help decision-makers to understand in simple graphic terms what could happen, but when it comes to predicting what will actually happen to freight rates they are very blunt instruments.

Sensitivity analysis

Forecasting models can be used to develop sensitivity analyses which explore how much the forecast changes as a result of a small change in one of the assumptions. A 'base case' forecast is first established using a reasonable set of assumptions, then small changes are made to the input assumptions and the resulting changes in the target variable are recorded. For example, the model might be used to explore the impact of lower industrial growth or higher scrapping on projected freight rates and a table compiled showing the change in each exogenous variable and the corresponding change in the target variable.

In theory this technique allows the user of the forecast to understand the sensitivity of the forecast to small changes in assumptions, but in the maritime economy there are many interrelationships which cannot be quantified with sufficient clarity to make this sort of sensitivity analysis totally 'automatic'. A change in the assumption for world industrial growth might reduce trade and trigger a fall in freight rates. However, in the real world lower freight rates may result in higher scrapping, so the market mechanism compensates for the lower growth in subsequent periods. Models are rarely capable of reflecting these behavioural interrelationships automatically and just changing one assumption whilst leaving everything else the same does not necessarily accurately reproduce the way the market mechanism works.

17.7 DEVELOPING A SCENARIO ANALYSIS

A third approach to forecasting is scenario analysis. The problem it deals with is communication between the analyst and the decision-maker. By the end of his market study the forecaster may be an expert, but how does he convey this knowledge to the decision-maker? And how does he take advantage of the decision-maker's own knowledge? Scenario analysis tackles this problem head on by involving the decision makers in the forecasting process. Scenarios are developed in a seminar forum with executives working alongside analysts. This avoids the rigidity of formal models which can oversimplify complex issues and be biased towards quantifiable variables. It also provides a better opportunity to focus on weighing up which issues are likely to be important.

The scenario approach was developed by Herman Kahn in his work for the Rand Corporation in the 1950s. He borrowed the term 'scenario' from the film industry, where the 'scenario' of a film outlines its plot and the mood of each successive scene. Khan's scenarios aimed to deal with the future in the same sort of way. Over the years this approach has been adapted and developed, often by big corporations (though nobody has yet tried producing feature length movies!). One approach is to start with a base-case scenario which takes the current 'plot' and develops it forward into a 'surprise-free' scenario which continues much as the past. From this base, alternative scenarios are developed by systematically discussing the developments which could produce different scenarios. Generally the scenarios are developed in clusters of two or three, normally covering long periods.

DOPUNSKA LITERATURA

A systematic methodology for scenario analysis might consist of phases as follows:

1. A group of analysts manage the analysis and ask the assembled group of experts and managers to name the issues which they feel will be most important in determining how events will develop over the time-scale of the forecast. This can be done by splitting the group into working parties and asking each to report back with a list of issues.
2. Compile a list of 'key' issues based on the responses of the various groups and discuss the significance of each. The aim of this part of the analysis is to establish the facts that will be important in future, for example demographics, geography, political alignments, industrial developments, and resources.
3. Feed the edited list back to the working party and ask them to rank the issues in order of importance, using weights on the scale 1 to 10. Analyse the results and identify the variables on which there is greatest consensus, and those on which there is least agreement.
4. From this base develop a social, technical, economic and political 'no change' scenario, and alternatives in which the most important variables are changed, and prepare a report summarizing the results.

Scenario analysis is a way of encouraging management and staff in large organizations to become more aware of the issues which will be facing the company in future. Because it is based on 'systematic conjecture' it is much easier to range widely, but it requires skill and judgement to narrow down the range of possible trends to the few which are significant.

In conclusion, scenario analysis can be a useful way of defining the long-term business risks and opportunities. However, it is demanding in terms of time, calls for intellectual energy, and the results are difficult to encapsulate and distribute. The risk of a single quantified model forecast is that it ignores key issues. The risk of a scenario analysis is that it becomes so blurred that it is of little value.

17.8 ANALYTICAL TECHNIQUES

We will now briefly review the analytical techniques which are available. Four of the most popular forecasting techniques are summarized in Table 17.2. A brief review of their different capabilities will help to give newcomers to forecasting an idea of what to expect.

- *Opinion surveys* ask people 'in the know' what they expect to happen. Lots of shipping people do this informally, but there are structured methodologies such as the Delphi technique or opinion surveys. This technique is particularly useful for picking up emerging trends that are obvious to specialists but are not apparent from past data. The approach can be formal, using a panel, or informal.

DOUNGVA LITERATURA

Table 17.2 Overview of five analytical techniques used in shipping

	Analytical technique	Main characteristic
1	Opinion survey	
	Delphi technique	Discussion session in which group of experts make a consensus forecast
	Opinion surveys	Send questionnaire to selection of experts and analyse results
2	Trend analysis	
	Naive	Simple rule e.g. ‘no change’, or ‘if earnings are more than twice OPEX they will fall’
	Trend extrapolation	Fit a trend using one of several methodologies and extrapolate forward
	Smoothing	Smooth out fluctuations to obtain average change, and project this
	Decomposition	Split out trend, seasonality, cyclicality and random fluctuations, and project each separately
	Filters	Forecasts are expressed as a linear combination of past actual values and/or errors
	Autoregressive (ARMA)	Forecasts expressed as a linear combination of past actual values
	Box–Jenkins model	Variant of the ARMA model, with rules to deal with the problem of stability
3	Mathematical model	
	Single regression	Estimated equation with one explanatory variable to predict target variable
	Multiple regression	Estimated equation with more than one independent variable to predict target variable
	Econometric models	System of regression equations to predict target variable
	Supply–demand models	Estimate supply and demand from their component parts and predict change in balance
	Sensitivity analysis	Examine the sensitivity of the forecast to different assumptions
4	Probability analysis	
	Monte Carlo	Probability analysis used to calculate the likelihood of a particular outcome occurring.

- *Trend analysis* identifies trends and cycles in past data series (time series). The naive forecast extrapolates recent trends into the future, a quick approach because there are no tricky exogenous variables to forecast, but it gives no indication of when or why the trend may change. More sophisticated trend analysis analyses the underlying trends, cycles and the unexplained residuals. With one grand gesture the trends and cycles tell us what will happen, but the forecaster still has to decide whether past trends will change.
- *Mathematical models* go a step further and explain trends by quantifying the relationships with other explanatory variables. For example, how much does the oil trade grow if world industrial production increases? By estimating equations which quantify relationships like this we can build a model to predict the oil trade.
- *Probability analysis* uses a completely different approach. Instead of predicting what will happen, probability analysis estimates the chance of a particular outcome occurring. For example, probability analysis might tell the decision-maker that

there is a 20% chance that freight rates will be $20,000 per day next year. This approach only works if you can find a way of calculating probability in numeric terms.

Analysts can approach each of these techniques at several different levels. In all cases there is a quick approach which requires little special skill and yields nearly instant results, and a sophisticated version which is a specialist subject in itself. In this section we will concentrate on the quick forecasting methods and limit the discussion of the sophisticated methods to a review of the general issues involved.

Opinion surveys

Opinion surveys involve canvassing the opinion of other experts. This is a good way of investigating issues that are constantly changing, and this approach is a firm favourite with shipping decision-makers who are constantly on the lookout for insights from experts. For analysts it can be a useful way of finding market intelligence, and opinion surveys approach the task in a structured way designed to provide a balanced appraisal of what experts in the industry think is important. Of course there is no guarantee that the issues identified will be correct, but in an industry driven by sentiment, knowing what others think has its uses (but see the dangers of consensus forecasting in Section 17.9).

Time series analysis

Statistical techniques for analysing time series range from the straightforward to the highly sophisticated. In its simplest form trend extrapolation requires little technical knowledge, while the more sophisticated forms of exponential smoothing are complex, involving advanced mathematical skills.

TREND EXTRAPOLATION

The simplest time series technique is trend extrapolation. A forecast is made by calculating the average growth rate between two points in a time series and extrapolating into the future. That is all there is to it, and it is very handy. When there is no data to build a more complex model, or there are hundreds of target variables to predict, it may be the only option. For example, a forecaster predicting the throughput of container terminals in the Mediterranean may have little choice but to extrapolate trends in the trade on each route, because all he has is a time series of past container lifts and no idea what is in them. Trend extrapolation may be simplistic, but it is better than nothing.

However, it is important to be aware of the pitfalls. A time series may look simple, but often there are several different components at work below the surface. Figure 17.5 illustrates the point. The line A_1A_2 shows the linear trend (T) in the data series; the curve shows the cycle (C) superimposed on the trend; and a small section of a seasonal cycle (S) is also shown. So at any point in time t, the value of variable Y will be a mixture of

DOPUSKLITERATURA

the trend, the two cycles, plus an error term E to reflect the random disturbances that affect all time series, thus:

$$Y_t = T_t + C_t + S_t + E_t \tag{17.4}$$

In shipping the cycles C_t are the shipping cycles we discussed at length in Chapter 4; the seasonal cycles S_t are found in many trades in agricultural commodities, and especially in oil demand in the Northern Hemisphere; and the trend T_t reflects long-run factors such as the trade development cycle we discussed in Chapter 10.

Because time series mix trends and cycles, extrapolation must be carried out with care. A forecast based on one phase of a cycle, for example between points B_1 and B_2 in Figure 17.5, is highly misleading because it suggests faster growth than the true trend A_1A_2. In fact the cyclical component C_t changes from negative at B_1 to positive at B_2. Just after point B_2 the cycle peaks and turns down, so it would not be correct to extrapolate this trend. This is not just a fanciful example; it is one of the 'bear traps' with which maritime forecasting is littered. The economic world dangles the 'bait' of rapid exponential growth in front of forecasters, who are delighted to predict a positive outlook. After all, that is what their clients usually want to hear. But no sooner have they made their positive forecast than the ground opens under them and they are in the trap. Our discussion of 'stages of growth' in Chapter 9 showed that growth rates often change as economies and industries mature, so the fact that a trade has grown at 6% per annum for 10 years does not really prove anything. Trends change.

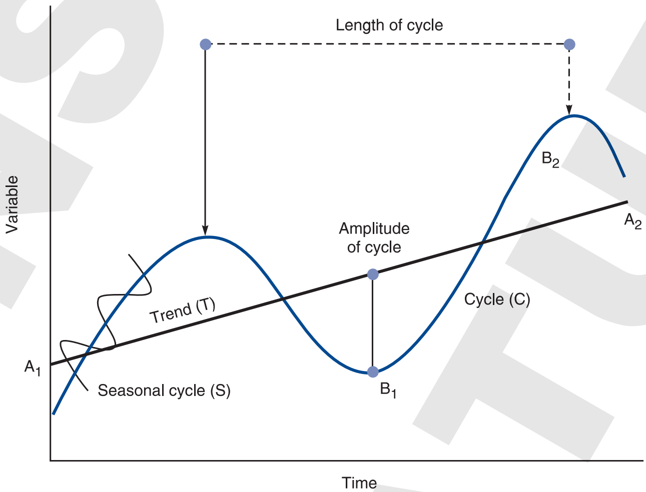

Figure 17.5
Cyclical components in a time series model

In conclusion, trend extrapolation is handy for quick forecasts, but the 'bear trap' awaits forecasters who rely on it for long-term structural forecasts. Remember the second principle of forecasting – there must be a rational explanation for the forecast. Data series must be examined to establish what is driving the growth, including cyclical influences, and, as far as possible, these must be taken into account. Fortunately there are well-established techniques for doing this.

EXAMPLE OF TIME SERIES ANALYSIS

Now we will analyse a time series in a different way, known as 'decomposition analysis'. Figure 17.6 shows a 16-year series for the freight rate for grain from the US Gulf to Japan.

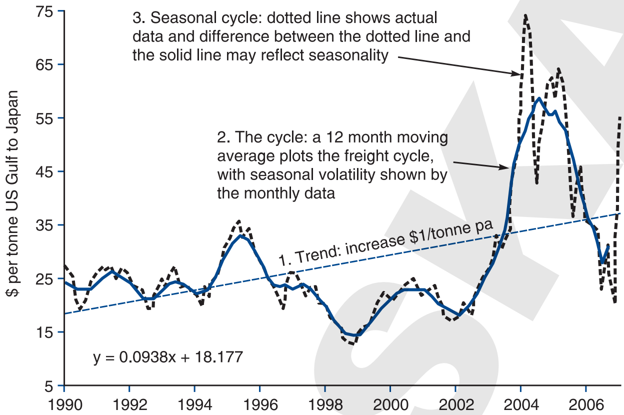

Figure 17.6
Grain freight rates – trend and seasonal volatility
Source: CRSL, monthly grain rates US Gulf to Japan

Brokers watch this series carefully for signs that rates are moving in or out of a cycle. We have three components to think about: the trend; some big cycles which seem to peak in 1995, 2000 and 2004; and what looks like short-term volatility which may turn out to be seasonal.

The starting point is the *trend* shown by the flat dashed line on the chart. It increases from $17 per tonne in 1990 to $36 per tonne in 2007. This trend was fitted by linear regression, which we will discuss below. However, it could easily have been drawn in by hand. It increases at a rate of $1 per tonne each year, so if we extrapolate it we find that in 10 years' time, cycles aside, the grain rates will have increased to around $46 per tonne. That is a very significant forecast for anyone running Panamax bulk carriers used in this trade, since it suggests they will be very profitable over the next decade. Naturally that invites the question 'why'. If we had fitted the trend to a slightly shorter data set of data ending in 2002 the positive slope would have disappeared and the rate would be stuck at around $24 per tonne. So have we found a significant trend caused by, for example, the emergence of China as a major importer and exporter? Or it could just be a cyclical effect caused by bulk carriers having an exceptional cycle between 2003 and 2007. Time series analysis gives trends, but not explanations, and a serious forecaster would not let the matter rest there. Research is needed.

Next we can look for signs of *cycles* which are shown by the 12-month moving average. As already noted, Figure 17.6 shows a cycle which peaks in 1995, falls to a trough in 1999, peaks again in 2000, declines in 2002, then finishes with a spectacular peak in 2004. Unfortunately, there is not very much consistency in these cycles, a conclusion that will not surprise readers of Chapter 3 where we argued that shipping cycles are periodic rather than symmetrical.

Finally, there is the *seasonal cycle*. The usual technique for revealing the seasonal cycle is moving averages. The method is simple. Using a monthly time series, we take a 12-month moving average of the US Gulf–Japan freight rate, centring the average in June (a 'centred' moving average calculates the average freight rate for an equal number of months either side of the target date, so if you start in June, the average would be taken from January to December). The resulting 12-month moving average, shown by the solid line in Figure 17.6, has smoothed out the seasonal fluctuations in the data, and we can see how the actual rate shown by the dotted line fluctuates around the 12-month trend. Computation of a moving average helps to squeeze a little extra information out of the data by a separating the seasonal and the trend components.

The next step is to calculate the seasonal cycle by averaging the deviation from the trend for each calendar month, to produce the pattern shown in Figure 17.7. By the magic of statistical analysis the random fluctuations of the dotted line in Figure 17.6 are transformed into the well-defined seasonal cycle in Figure 17.7. It shows that the US Gulf–Japan rate is above trend for the first five months of the year and then dips below trend during months 6–9, before recovering in months 10, 11 and 12. That is exactly what we would expect. The US grain harvest is ready for Gulf loading in October and shipments build up during the following months, reaching a peak in January. They then slump in the last months of the agricultural year when there is less grain to ship. So the statistical analysis supports a common-sense view of what is likely to happen, and we may choose to accept this for forecasting. The cycle in Figure 17.7 can be used to 'correct' trend forecasts and make allowance for seasonal factors. The dip over the summer is quite significant.

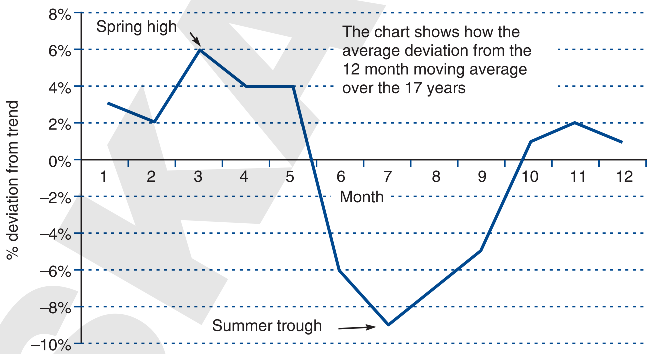

Figure 17.7
Grain trade seasonal cycle, 1990–2007
Source: CRSL, monthly grain rates US Gulf to Japan

EXPONENTIAL SMOOTHING

This technique is similar to moving averages, but instead of treating each (for example). monthly observation in the same way, a set of weights is used so that the more recent values receive more emphasis than the older ones. This notion of giving more weight to recent information is one that has strong intuitive appeal for managers, and adds credibility to the approach. It is useful for short-term forecasting jobs when there are many target variables.

AUTOREGRESSIVE MOVING AVERAGE

This takes the whole process of time series analysis a step further. Although the underlying approach is the same as for exponential smoothing, a different procedure is used to determine how many of the past observations should be included in the forecast and in determining the weights to be applied to those observations. The most commonly used technique is the procedure developed by Box and Jenkins.[22] They devised a set of rules for identifying the most appropriate model and specifying the weights to be used. This technique assumes that there are patterns buried in the data. It is particularly good for forecasting large numbers of variables when these are elements of cyclical activity. For example, the sales of many retail products are seasonal and large stores handling

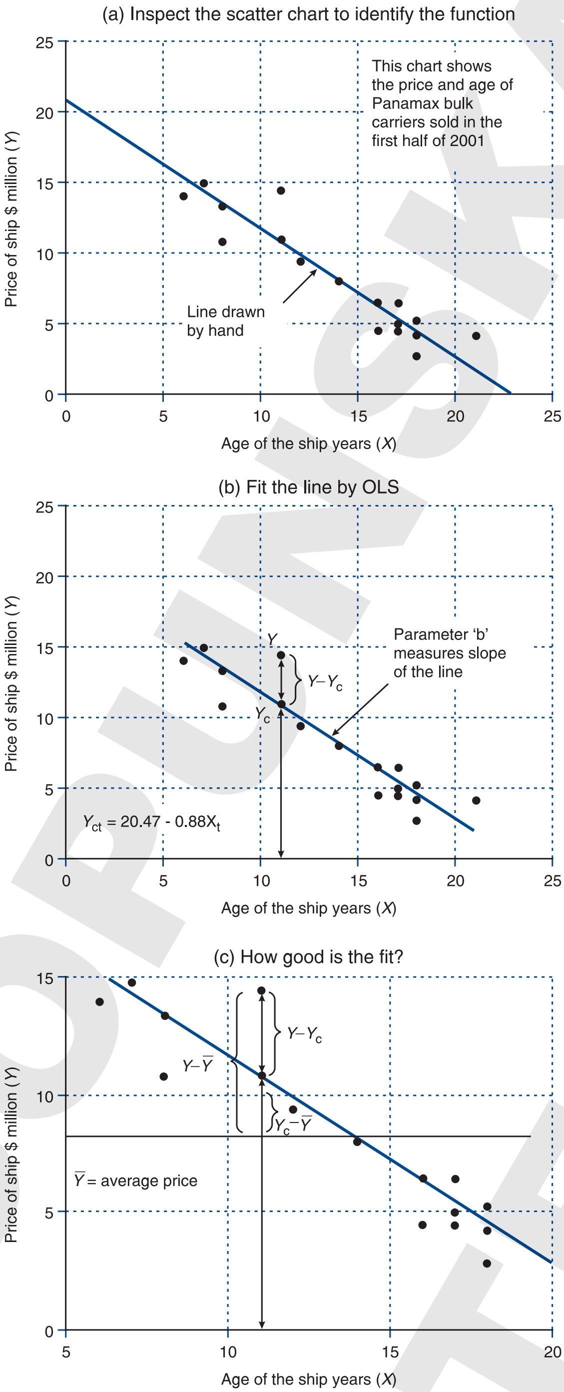

Figure 17.8
Three steps in fitting a regression equation

thousands of product lines often use this technique to predict sales levels for inventory management.

Regression analysis

Regression analysis is a useful statistical technique for modelling the relationship between variables in the shipping market. Spreadsheets make estimating regression equations straightforward and, with so much data available in digital form, regression analysis has suddenly gained a new lease of life. Developing big models has become much easier, but regression can also be used for simple jobs. So it is worth looking carefully at the application of this technique. There are excellent textbooks which discuss the methodology in detail, so here we will only deal with the broad principles.

Regression analysis estimates the average relationship between two or more variables. An example explains how this is done. Suppose you are asked to value a Panamax bulk carrier and have available the data on 21 recent ship sales shown by the dots in Figure 17.8(a) – the price is on the vertical axis and age is on the horizontal axis. The ships range in age from 6 to 21 years, and the prices paid range from $2.8 million to $15 million. How do you do it? By fitting a regression equation to the data to estimate the *average* relationship between the dependent variable *Y* (the sale price) and the independent variable *X* (the age of the ship when it was sold). Thus we aim to reduce the relationship between *Y* and *X* to an equation of the form

$$Y_t = a + bX_t + e_t \tag{17.5}$$

In this equation, which represents a straight line, '*a*' and '*b*' are parameters (i.e. constants) and *e* is the error term. The parameter '*a*' shows the value of *Y* when *X* is zero (i.e. where the line cuts the vertical axis), the parameter *b* measures the slope of the line (i.e. the change in *Y* for each unit change in *X*), and *e* is the difference between the actual value and the value indicated by the estimated line. This is 'simple regression'. If we have several independent variables it is a 'multiple regression'. The aim is to find the line which fits the data best.

FITTING A REGRESSION EQUATION

The three main steps are set out below and illustrated graphically in Figure 17.8.

Step 1: *What type of function?* The first step is to plot the data on a scatter diagram and examine it to see whether there appears to be a relationship. In this case the data is plotted in a scatter graph shown in Figure 17.8(a), with the price of the ship (*Y*) on the vertical axis, and the age (*X*) on the horizontal axis. We seem to have a negative linear relationship, since as the variable *X* increases, the variable *Y* declines. The points are scattered about, but there is clearly a relationship. If we draw a line by hand we can see if the relationship makes sense. The line crosses the *Y* axis at about \$21 million, which is the value of the parameter *a*, or in economic terms the value of the ship when *X* (its age) equals zero, that is, the ship is new. It then falls steadily to cross the *X* axis at about 22.5 years, which is the age of the ship when it has no value. That certainly makes sense. A new Panamax bulk carrier cost about \$22 million in the second half of 2001, and on average Panamax bulk carriers get scrapped at about 25 years old. By fitting a regression equation we can estimate the line that fits the data best.[23]

Step 2: *What Equation?* To fit the equation we use the 'ordinary least squares' (OLS) technique. This method calculates the line that produces the smallest difference between the actual values *Y* and the calculated value which we refer to as Y_c (see Figure 17.8(b)). The values of these parameters which minimize the squared differences $(Y\text{-}Y_c)^2$ can be found by solving the 'normal equations' for '*a*' and '*b*'. This can be done using the Regression 'Add-in' provided by most spreadsheet packages. The results are as follows:

$$Y = 20.47 - 0.88X \tag{17.6}$$

In this case the estimated value of *a* is \$20.47 million and the value of *b* is –0.88, (see Table 17.3) which means that the value of the ship falls by \$0.88 million a year. That is very close to the line we fitted by eye.

Step 3: *How good is the fit*? Having found the line which fits the data most closely, the third stage is to examine just how close the fit really is. The OLS technique splits

DOBRA KNJIGA LITERATURA

Table 17.3 Example of regression statistics for 2 variable equation
SUMMARY OUTPUT (regression of Panamax price on ship age)

(a) Regression statistics

Number of observations		21	
Multiple R	0.95	Adjusted R^2	0.90
R^2	0.90	Standard error	1.43

(b) Analysis of variances (ANOVA)

Row label	*df*	*SS*	*MS*	*F*	*Significance F*
Regression	1	355.6	355.6	173.3	5E-11
Residual	19	39.0	2.1		
Total	20	394.5			

(c) Parameter estimates and test statistics

Row label	*Coeff-icients*	*Standard error*	*t stat*	*P value*	*Lower 95%*	*Upper 95%*
Intercept	20.47	0.90	22.63	3.3336E-15	18.57	22.36
X variable 1	–0.88	0.07	–13.17	5.3277E-11	–1.02	–0.74

Source: Based on output of regression function produced by popular spreadsheet 'add in'

the variation in Y from its mean into two parts: the part explained by the regression equation, and the 'error' term e which is not explained. This is shown diagrammatically in Figure 17.8(c). From this basic information we can derive three central test statistics, the standard error, the t-test, and the correlation coefficient (R_2) (see Box 17.2 for definitions). These statistics are a quick way of summarizing how good the fit is. The test statistics in Table 17.3 were obtained for the regression of Panamax price on age illustrated in Figure 17.7. The standard error is 1.43, which tells us that on average \$1.43 million variance in the price of a Panamax is not explained by the equation. The t statistic is the value of b divided by its standard error. It should be at least 2 in absolute value. In this case it is –13.2, which is highly significant. Finally, the R_2 is 0.9, which tells us that 90% of the variation in y is explained by the equation. So overall the equation works pretty well.

CALCULATING THE REGRESSION EQUATION

Although it is quite straightforward to calculate the parameters and test statistics using a spreadsheet, it is easier to use a statistical package which automatically calculates the estimated parameters and a table of test results.[24] The example of a standard table shown in Table 17.3 has three parts. Part (a) shows the number of data observations, which in this case is 21, and the regression statistics – the correlation coefficient and the standard error of regression. Part (b) is an analysis of variance (ANOVA) table describing the relationship between Y, Y_c and its mean, as discussed in Figure 17.8. Finally, part (c) shows the coefficients a (the intercept) and b, along with their test statistics.

DOPUNSKA LITERATURA

BOX 17.2 SUMMARY OF TEST STATISTICS

Test 1: Standard error. The standard error of the regression measures how well the curve fits the data by calculating the average dispersion of the *Y* values around the regression line. It is given by:

$$SER = s_Y = \sqrt{\frac{\Sigma(Y - Y_C)^2}{N - K}}$$

where *N* is the number of observations and *K* is the number of parameters estimated.

Test 2: Standard error of the regression coefficient. Although the standard error is an interesting descriptive statistic, it does not in itself test the equation for significance. To do this we need to establish the confidence limits which can be placed on the estimated value of the regression parameters *a* and *b*. If we can make the assumption that *b* is normally distributed, it is possible to estimate its standard error:

$$s_b = \frac{s_y}{\sqrt{\Sigma x^2}}$$

Test 3: The *t*-test. If the independent variable does not contribute significantly to an explanation of the dependent variable we would expect the estimated value of *b* to equal zero (i.e. *X* will vary randomly in relation to *Y*). To test whether *b* could have come from a population in which the true value was zero we use the *t*-test. Divide the coefficient by its standard error (s_b)

$$t = \frac{b}{s_b}$$

and look up the resulting ratio in the *t*-table for *N–K* degrees of freedom. As a rule of thumb the value of *t* needs to be at least 2 to pass the test at the 5% significance level. If it is less than 2 the estimated parameter is probably not worth using.

Test 4: The *F* statistic. An alternative test statistic to the *t* test is the *F* statistic which is defined as follows:

$$F = \frac{\text{Variance explained}}{\text{Variance unexplained}}$$

Typically *F* will be a number in the range 1–5, with higher numbers indicating better fit. The statistic is tested by looking up the value of *F* In a table of critical values for the appropriate degrees of freedom of the numerator and the denominator.

Continued

DORUNSKA LITERATURA

BOX 17.2—cont'd

Test 5: The coefficient of correlation (R^2). A more general measure of the relationship between two variables is the coefficient of correlation. This statistic shows the average variation in Y from its mean as a proportion of the total variation in Y:

$$R^2 = \frac{\Sigma(Y_c - \bar{Y})}{\Sigma(Y - \bar{Y})}$$

A little reflection will make it clear that the value of R will fall between 0 and 1 (or −1). This makes the statistic particularly easy to interpret, and probably accounts for its popularity. It can, however, be misleading in time series analysis, since the variances are calculated in relation to the mean and two time series which are changing rapidly will invariably give a higher value of R than two time series which are not growing. For this reason the correlation coefficient should be treated with some caution. In multiple regression the correlation coefficient shows the overall fit of the equation, and is a quick test to see how successful additional variables are in explaining variation in Y.

Test 6: The Durbin–Watson statistic. This a test for autocorrelation of the residuals. This statistic should show a value of about 2 and is defined as follows:

$$D = \frac{\Sigma(e_t - e_{t-1})^2}{\Sigma(e_t^2)}$$

D takes values between 0 and 4. Values of D below 2 indicate that the residual values (e) are close together and that there is positive autocorrelation which causes bias in the parameter estimates. Values of D above 2 indicate negative autocorrelation.

We have already discussed Regression statistics. The correlation coefficient R^2 in Table 17.3(a) explains the variation of the dependent variable Y_c from its mean, as a percentage of the total variation. In this case an R^2 of 0.9 tells us that 90% of the variation in Y was explained by variations in X, which is a good result.

The first column of the ANOVA table in Table 17.3(b) shows the row labels; the second shows the degrees of freedom (df) accruing to the sum of squares appearing in the corresponding row; the third states the sum of squares (SS) of the regression and the residual. The bigger SS is for the regression and the smaller the summed square of the residuals the better; the 4th column shows the mean square (MS). The final column shows the value of F, which is the mean square of the regression divided by the mean square of the residual (355.6/2.1), which is a test of goodness of fit and should be looked up in a table of the F distribution for the number of degrees of freedom for the numerator and denominator.

DOPUSKA LITERATURA

Table 17.3(c) shows the coefficients in the second column and the standard error, the t statistic, p value and the 95% confidence limits. The latter show that we can be 95% certain that the intercept lies in the range 18.57 to 22.36 and the b coefficient lies in the range −1.02 to −0.74. These are useful results.

MULTIPLE REGRESSION ANALYSIS

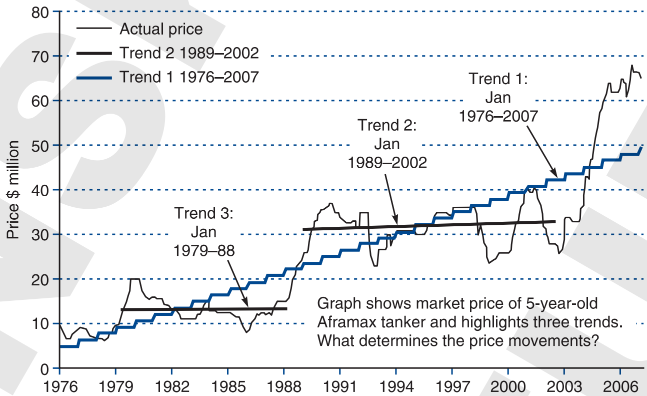

Figure 17.9
Example of time series trend analysis
Source: CRSL 5 year old Aframax price

Regression analysis can be extended by adding more explanatory variables. Continuing with second-hand prices, we can construct a time series model to forecast the price of a five-year-old Aframax tanker using the data shown in Figure 17.9. This time series starts in 1976, showing many fluctuations in the price over the years which the model needs to explain. In Chapter 4 it was argued that two key variables drive second-hand prices, newbuilding prices and earnings. To model this we run a multiple regression analysis using the five-year-old price of an Aframax tanker as the dependent variable (Y) and the newbuilding price (X_1) and one-year time-charter rates (X_2) as the independent (exogenous) variables:

$$Y_t = a + b_1X_{1t} + b_2X_{2t} \qquad (17.7)$$

where Y is the second-hand price, X_1 is measured in millions of dollars and X_2 in thousands of dollars per day. Running this regression produces a high R^2 of 0.92 and significant t test results for all the parameters. The equation we estimate is

$$Y_t = -10.6 + 0.589X_{1t} + 1.1478X_{2t} \qquad (17.8)$$

This equation tells us that on average the second-hand price of the ship increases by $0.589 million for each $1 million increase in the newbuilding price, and $1.148 million for each $1,000 increase in the one-year time charter rates. When we compare the estimated past values shown by the dotted line in Figure 17.10, it is clear that the fit is reasonably close. Throughout the 22-year period the equation explains the main cycles in second-hand prices very well. Its weakness is that it sometimes overestimates the second-hand price at the peak of cycles, and underestimates it at the trough. These are quite significant differences.

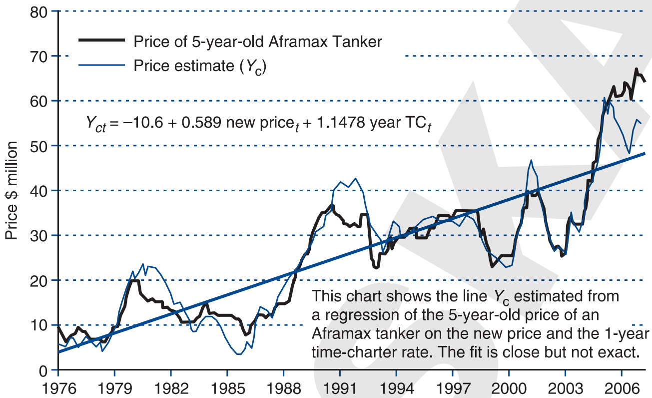

Figure 17.10
Example of time series trend analysis
Source: CRSL and estimate

However, there are two important matters to consider before we risk using this model for forecasting. The first is the specification of the model. We have assumed that new prices influence second-hand prices, and got an equation with a good fit. However, in Chapter 15 we argued that shipbuilding prices are influenced by second-hand prices. So which is it? Unfortunately statistical analysis will not answer this question. It is an economic question which we have to resolve by examining how the economics of the shipbuilding price model really works. In fact in, Section 15.4 we suggested that shipyard prices are determined by the interaction of shipbuilding demand and supply functions and one of the demand variables is the second-hand price – when second-hand ships become too expensive shipowners start to buy new ships. So there is much more that could be done to develop this simplistic model before relying on it too much.

This leads on to another common problem, autocorrelation. Since both time-charter rates and newbuilding prices are influenced by the shipping market cycle, they are likely to be correlated (i.e. they move in the same direction at the same time). When this happens it is possible that the parameters are not estimated accurately in the equation. The Durbin-Watson statistic is used to test for autocorrelation. In this case it shows a very low value of 0.12 (ideally it should be about 2), which indicates significant autocorrelation. The value is small because the value of e_t is often very close to the value of e_{t-1}. This is a matter which should be addressed.

Unfortunately, in this text space prevents us from exploring this type of modelling further, and indeed many practical forecasters would find the degree of analysis carried out here sufficient for their purposes. The model fits the data well enough, and although it may not work perfectly in some circumstances, as long as we are aware of the underlying risks, we might decide to use the equation anyway to predict second-hand prices in future. After all, there is no point in pouring an enormous amount of effort into a statistical analysis when the estimates for the newbuilding prices and time-charter rates which we feed into the model are likely to be wide of the mark!

Hopefully, this brief review has given readers who are not familiar with statistical analysis a sense of the way it can be used for modelling purposes and the precautions which must sensibly be taken. Sometimes regression equations are used as part of a comprehensive model, but often they can be used in a piecemeal way in different parts of a market report. Or maybe just as a ‘rule of thumb’ for making a quick forecast ‘on assumptions' – for example, to project iron ore imports into Japan, or US oil demand. If nothing else, this type of simple analysis illustrates relationships that have existed in the past, and that is bound to be helpful to the decision-maker who is trying to weigh up what might happen in future.

Regression analysis is simple to apply, but a more thoughtful investigation reveals the fundamental problem that the analyst does not know with any certainty the true relationship between variables, and has available only a limited amount of statistical data from which to estimate these relationships. It is all too easy for these estimated relationships to be biased, producing results which are inaccurate and possibly misleading. Econometrics is the branch of economics which deals with these problems and offers a collection of skills and techniques which allow the practising economist to avoid the pitfalls outlined in the previous example. There are also some excellent texts available on econometric modelling,[25] and many excellent articles on this subject in shipping journals.[26]

Probability analysis

We began this chapter by observing that forecasts are bound to be wrong sometimes, and this raises the question of probability. Some future events are reasonably predictable. For example, deliveries of ships next year are quite easy to predict because the orders have already been placed. But other shipping variables such as freight rates and prices are much less predictable, changing dramatically from month to month. Faced with this uncertainty, decision-makers might reasonably ask for an analysis of how predictable or unpredictable events are. That, essentially, is the role of probability analysis.

The basic technique involves taking a sample of data, either a time series or a cross-section, and calculating the number of times a particular event occurs. For example, if the basic data is a time series of tanker freight rates, you calculate how often during the sample period freight rates were above or below a particular level. If VLCC freight rates exceeded $60,000 per day 10 times in a data series with 100 entries, then on the basis of this sample, you can say there is a 10% chance that freight rates will exceed $60,000 a day.

As an example, suppose we take a time series of monthly earnings for tankers and bulk carriers, and analyse them into the histograms shown in Figure 17.11. On the horizontal axis this shows monthly earnings divided into $2,000 per day bands. The vertical axis shows the number of months when earnings fell into each band. For example, there were seven months when tanker earnings fell into the $10,000–$12,000 per day band. This frequency distribution gives us a snapshot of the earnings profile of these two market segments, and at a glance it conveys some significant information. Firstly, tankers obviously earned more than bulk carriers. In fact, the average tanker earnings were $21,800 per day, whilst the average bulk carrier earnings were $10,900 per day. Secondly, the earnings profile for tankers is much more widely distributed, ranging from $10,000 per day at the lower end to $68,000 per day at the upper end. In contrast,

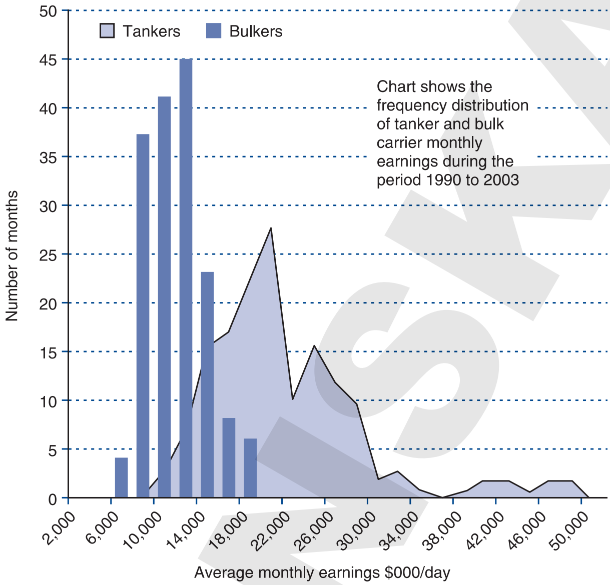

Figure 17.11
Earnings frequency distribution, 1990–2003
Source: CRSL and estimate

the bulk carrier distribution ranges from $4000 per day at the bottom to $18,000 per day at the top. Third, the bulk carrier at distribution is much more compact, with over 40 months in the $10,000–$12,000 per day band, whilst the most heavily populated tanker band has only 28 observations in it.

In fact this data is just a sample, but by using statistical analysis we can calculate the probability of earnings falling within a particular range. For example, if the frequency distribution is normally distributed, the mean and standard deviation can be used to calculate the probability of a particular event occurring. If the break-even earnings of a bulk carrier company are $7,500 per day, we can calculate the probability of earnings falling below that level. The mean bulk carrier earnings are $10,109 per day and the standard deviation is $2,708 per day, so $7,500 per day falls one standard deviation below the mean, which has a 66% chance of occurring. This is fine in theory, but the events of 2003–8 (see Figure 5.7, p. 195) showed that historic probabilities are not always a guide to the future.

This is a simplistic example, but statisticians have developed an extensive body of statistical analysis so that the analysis of probability can be applied to business problems. For example, a shipping banker trying to weigh up the credit risk on a particular loan may know that if the shipowner defaults on his repayments, his main source of collateral is the mortgage on the ship. As the mortgagee, he is entitled to seize the ship and sell it. So he is interested in three questions. First, what is the probability that during the five-year period following the shipowner will default? Second, in the event of a default, what is the probability that the resale value of the ship will equal or exceed the outstanding loan? Third, are there any actions he can take now which will improve the chances of a successful outcome? In such cases probability analysis and more sophisticated uses of it, such as Monte Carlo analysis, can be helpful.

17.9 FORECASTING PROBLEMS

There are many obstacles to producing worthwhile forecasts and it is useful to round off our discussion of forecasting methods with a review of some of the errors that can easily trap the unwary, including behavioural issues, problems with model specification and the difficulties of monitoring results:[27]

Problems with behavioural variables

We will start with a few home truths about our own capabilities. It seems that most of us are programmed to feel overconfident in our ability to make accurate estimates and find it hard to accept that we know so little about the future, preferring to give forecasts that are unrealistically specific.[28] Behavioural economists illustrate this point by asking a group to estimate the value of something they know nothing about (say the length of cable on a VLCC's anchor). Rather than playing safe with a wide range, most participants give a narrow one and miss the right answer. Because we are unwilling to reveal our ignorance by specifying the very wide range, we choose to be precisely wrong rather than vaguely right.[29] The same sort of thing happens with forecasts, and we need to be careful not to be misled. The solution to this problem is to test strategies under a much wider range of forecast scenarios for example by adding 20–25% more downside (or upside) to the extreme cases.

The next problem is *status quo bias*. It is always tempting to forecast that the future will be like the past, even when common sense says that it will not be. When freight rates are high at the top of a cycle we assume that they will always be high, and when low that they will always be low. To make things worse, we often evaluate new developments in the context of the present system and conclude that the new way will not work. This happened to some shipping companies when containerization started to appear in the 1960s. They concluded it would not work because they evaluated it within the framework of the cargo liner system.

The *herding instinct* reinforces status quo bias and is well known in markets, including shipping. When markets are high, there is peer pressure to produce more positive forecasts. Conversely, during recessions forecasts tend to be downgraded. The desire to conform to the behaviour and opinions of others is a fundamental human trait, and when sentiment is pessimistic it is natural to want to fit in. Warren Buffet made the point neatly when he wrote: 'failing conventionally is the route to go; as a group, lemmings may have a rotten image, but no individual lemming ever has received bad press'.[30] This is particularly relevant to shipping cycles. It suggests that forecasters should look to the periphery for innovative ideas and look particularly carefully at counter-cyclical cases.

Finally, we have the issue of *false consensus*. The similarity of forecasts published by several different agencies may give the impression that a particular outcome is likely, but in reality it is often caused by the uncertainty of the agencies as a result of which each keeps an eye on what the other is saying. P.W. Beck, Planning Director for Shell UK Ltd, found that there were few 'uncorrelated estimates' in the work done by so-called independent forecasters.[31] He argued that, uncertain about what to predict, agencies check what other forecasters are saying and follow the consensus. In such cases the fact that all the forecasts are the same is not evidence of a strong case for that particular outcome; it just means nobody is sure what to think.

DO NOT DISTRIBUTE — LA LITERATURE

Problems with model specifications and assumptions

Another obvious danger area lies in developing the framework (or model) and deciding what assumptions to use. The following problems often occur:[32]

- *Incorrect or superficial model specification*. The forecast may analyse and measure only surface factors and ignore important underlying forces. For example, when considering the future of the seaborne coal trade, it is important to take account of new technology which may, for example, change the type or volume of coal used in steel-making.
- *Too much detail*. There is a research rule of thumb that the researcher will identify 80% of the facts in 20% of the time required to obtain 100% of the facts. Put another way, it is easy to spend a long time investigating interesting but unimportant matters and lose sight of the overall objective.
- *Unchallenged preconceptions*. It is all too easy to assume that certain assumptions or relationships are correct and to accept them without question. Careful examination may show that under some circumstances they may be wrong (look how often forecasters have been caught out by oil price changes). Recall Aristotle Onassis's the assumption in 1956, mentioned earlier in this chapter, that Egypt could not reopen the Suez Canal for several years when in fact they reopened it in a few months.
- *Attempting to predict the unpredictable*. Some variables, such as the actions of small groups of people, are intrinsically unpredictable, and to attempt to predict them can create a false sense of security for decision-makers who assume that the forecast has a 'scientific' basis.

The forecaster needs constantly to ask the question: Am I falling into one of these traps?

The problem of monitoring results

When we look at past forecasts, we see just how difficult forecasting really is. Even deciding whether a forecast was right is not as easy as it seems. The problem was neatly summarized in an article reviewing the forecasting record of the UK National Institute of Economics and Social Research over a period of 23 years.[33] The article comments:

> It might be imagined that it must be possible, after a certain time has elapsed, to conclude in an unambiguous way whether a forecast has turned out to be correct or not. Unfortunately, the comparison of forecasts with actual results is not nearly as straightforward as it sounds. The first difficulty is that official statistics often leave a considerable margin of doubt as to how big the increase or decrease in output has been. The three measures of GDP (from expenditure, income and output) often give conflicting readings. Moreover the estimates are frequently revised, so that a forecast which originally appeared wrong may later appear right and vice versa. Another difficulty is that forecasts, which were pre-budget, were

DOPUNSKA LITERATURA

conditional on unchanged policies. Since policies often did change it would be inappropriate to compare the forecasts directly with what actually happened.

Assessing the accuracy of shipping forecasts presents just as many problems. In some cases we find that the forecasts are of ship demand, but there are no published statistics of ship demand with which we can compare the forecasts to judge their accuracy. In others, the statistical database has been so manipulated that it requires a considerable effort to reduce currently available statistics to a form comparable with the forecast.

The difficulty of making accurate comparisons of the predictions with actual events led M. Baranto to comment: 'The analysis of forecasting errors is not a simple process – ironically it is as difficult as making forecasts'.[34] Care is needed to produce forecasts that are capable of being monitored quickly and easily by users.

Objectivity: the problem of escaping from the present

Another challenge facing any forecaster is to escape from the present. An illuminating example of this is provided by a forecast of the British economy in 1984 which was published in the early 1960s. Although this is a long time ago, the study is of particular interest because it was so wide-ranging and explicit in both its assumptions and its predictions. Reviewing the book 20 years later, Prowse draws the following conclusions:[35]

- Some of the basic assumptions that appeared unquestionable at the time have proved to be very wide of the mark. For example, the study contains the passage: 'It has been assumed throughout that no Government in power will permit unemployment to rise above 500,000 (2 per cent of the labour force) for any length of time'. In a similar vein, it assumed that there would be an 'average rise in retail prices of 1–2 per cent per annum'. Neither of these assumptions looked unreasonable in terms of the statistical trends evident in 1964. In fact, by 1984 Britain had unemployment of 10–15% in many areas of the country, while a reduction of the annual inflation rate to 5% per annum was regarded as a major achievement.
- In the area of technological change, the forecasts proved to be equally wide of the mark. Written at a time when the Concorde supersonic liner project was at the development stage, the study anticipated the use of vertical take-off passenger airliners crossing the Atlantic in 1½ hours. As it turned out the airlines, like shipping, preferred economies of scale to cutting-edge technology. In 1984 no new Concordes had been built, and transit times had hardly changed, but 'jumbo jets' had made cheap air travel available on an unprecedented scale. In the motor industry it was the same story. The study anticipated the replacement of the petrol engine by the fuel cell. By 1984 the cars were still basically the same as in the 1960s, but their design had evolved, making them more fuel efficient, better built and relatively cheaper. In all these cases revolution was predicted, but the commercial world chose evolution. Yet some revolutions were overlooked. The potential of computers was recognized in the statement that 'By 1984 the electronic computer will have come into its own', but the study did not anticipate the

DO NOT USE – SAMPLE LITERATURE

revolutionary impact which the microchip revolution has had on almost every area of business.

- Another area where problems arose was in the long-term projections of economic growth. The study predicted that UK productivity would increase by 2½% per annum, and taken together with a 17% rise in the labour force, it was expected that real GDP would double by 1984. As it turned out, the stagnation of demand during the 1970s and the failure of productivity increases to materialize meant that the increase in output was only about one-third during the period.

At the time these forecasts were prepared, inflation was running at 1% and within living memory prices had actually fallen; Concorde was the big technical phenomenon; and the first generation of nuclear power stations had been highly successful. In short, the forecasts seemed reasonable and it is easy to see the problems of following any alternative line of thought. A forecast in the mid-1960s that anticipated inflation rates of 20%, or the virtual stagnation of the nuclear power programme, would have been extremely difficult to justify. The one certainty is that things will change and we must not be surprised by surprises.

17.10 SUMMARY

Francis Bacon, the sixteenth century man of letters, said that ‘if a man will begin with certainties, he shall end in doubts; but if he will be content to begin with doubts, he shall end in certainties’. How right he was. We began with doubts about whether it is sensible to make shipping forecasts, and ended with the certainty that many of the issues confronting forecasters are impossible to predict reliably. But that does not mean forecasting is pointless. Since forecasters are only called on to predict things which are unpredictable, they must expect to be wrong (the forecasting paradox). Their task is not to predict precisely, it is to help decision-makers to reduce uncertainty by obtaining and analysing the *right information* about the present and show how that information can help to understand the future.

All forecast analyses should satisfy three simple criteria: they should be *relevant* to the decision for which they are required; they should be *rational* in the sense that the conclusion should be based upon a consistent line of argument; and they should be based upon *research* at a significant level of detail.

We discussed the preparations for the forecast. The first step is to carefully define the decision being made. Decision-makers have very different requirements and forecasts are used for many different purposes, ranging from speculative investments to budgets and product development by shipbuilders. The forecasting time-scale is also important and we identified four different time horizons: momentary, which is concerned with days or even hours; short term, which is concerned with a period of 3–18 months; medium term, which covers a typical shipping cycle of, say 5–10 years; and long term, which spans the life of a merchant ship. Each time-scale requires a different forecasting technique.

There are three different types of analysis: the market report, a written study designed to provide the client with enough information to form his own views about what might happen in the future; the forecasting model, which uses economic analysis and a computer program to model some aspect of the business in numerical terms; and scenario analysis, which is designed to involve the decision-maker in the process of developing different scenarios about the future. We discussed each of these methodologies in some detail.

We also discussed analytical techniques. Opinion surveys are a good way to identify issues. Time series analysis is an easy way to make a quick forecast, and may be the only viable technique if there are many variables to predict, but can be misleading if several cycles are combined in a single series. Regression analysis is used to model relationships, and requires technical skills to fit regression equations and use the test statistics needed to determine if the equation is valid. Probability analysis takes a different approach. It is used to calculate the chance that a particular outcome will occur. Finally, scenario analysis builds 'future histories'.

These techniques are all useful in developing market models and market reports. Market models typically use a supply–demand framework to model the major market sectors such as crude oil tankers, and bulk carriers. They generally predict freight rates and ship prices. An eight-step programme for developing a market forecasting model was discussed, using the supply–demand analysis developed in Chapter 4 and described in mathematical form in Appendix A.

Market reports generally concentrate on a specific topic and use a less formal structure. They provide information and analysis in a logical framework, leading to conclusions. We discussed a six-stage procedure for planning and developing a study of this type.

In the last section of the chapter we discussed forecasting problems. Many problems are behavioural and arise because we are not as rational as we like to think. For example, we are over-confident about our ability to predict the unpredictable. Other problems arise because the model is incorrectly specified and misses out a key variable; uses consensus assumptions; has too much detail; or accepts assumptions that should be challenged. Monitoring forecasts against actual developments can be difficult. Care must be taken to ensure that predictions are made in a form that is directly comparable with regularly published information.

So forecasting really does matter. The market has just one objective, to reduce the resources used in transportation and get a better deal for the consumer. Gamblers take a chance and speculate, but shipping investors do their homework, calculate the odds, reduce uncertainty and take less risk. So, on average, their decisions should be better. Shipping forecasts have a part to play during those periods when market sentiment is running at the extremes of optimism or pessimism. Clear-sighted analysis and the willingness to take a well-thought-out risk are what mark out the professional investor. He may not get his picture on the front of *Forbes* magazine, but he can still leave a sizeable fortune to his children!

DO NOT USE LITERATURE

A An Introduction to Shipping Market Modelling

The early chapters of this book, and particularly Chapter 4, were devoted to a discussion of the economic principles that underlie the shipping market. With the increasing power of microcomputers it has become possible to develop shipping market models that can assist in judging future trends in the shipping market. This appendix provides a brief description of the basic supply–demand framework, using numerical examples. This is not intended to be a complete model, but rather a skeleton that can then be developed in a number of different ways.

Since for most cargoes there is no viable alternative to ships on deep-sea routes, the supply and demand for sea transport can be defined in the following way:

$$DD_{t=} f(CT_t, AH_t) \qquad \text{(A.1)}$$

$$SS_t = f(MF_t, P_t) \qquad \text{(A.2)}$$

where, for year t, DD is demand for seaborne transport, CT the tonnages of cargo transported, AH the average haul of cargo, SS the supply of seaborne transport, P is ship productivity and MF the size of the merchant fleet.

Demand, measured in ton miles of transport required, is determined by the tonnage of cargo to be moved and the average distance in miles over which each ton of cargo is transported. The supply of shipping capacity, measured in cargo ton miles, is determined by the merchant fleet capacity measured in deadweight tonnage and fleet performance, which is the average ton miles of cargo delivered per deadweight per annum. Market balance occurs when demand (DD) equals supply (SS). The cycles which dominate shipping markets are driven by the endless adjustment of these two variables in pursuit of equilibrium. This dynamic process is one of most difficult parts of the shipping market to reproduce in a model.

These definitions are highly simplified, but they make the important point that, in economic terms, although the physical supply of ships is fixed at a given point in time, the available transportation capacity is flexible. As we saw in Chapter 4, transport supply depends on fleet performance, which is in turn determined partly by market variables and partly by physical characteristics of the ships in the fleet.

DOPUNSKA LITERATURA

Building on the definition of supply and demand in equations (A.1) and (A.2), we can specify the basic structural equations of the macro model as follows. The demand equations are:

$$CT_{tk} = f(E_t, \ldots) \tag{A.3}$$

$$CT_t = \sum_k (CT_{tk}) \tag{A.4}$$

$$DD_{tk} = CT_{tk} - AH_{tk} \tag{A.5}$$

$$DD_{tm} = \sum_k (A_{tkm} DD_{tk}) \tag{A.6}$$

$$A_{tkm} = \frac{DD_{tkm}}{DD_{tk}} \tag{A.7}$$

The supply equations are:

$$MF_{tm} = MF_{(t\text{-},1)m} + D_{tm} - S_{tm} \tag{A.8}$$

$$AMF_{tm} = MF_{tm} - L_{tm} \tag{A.9}$$

$$SS_{tm} = AMF_{tm} - P_{tm} \tag{A.10}$$

Finally, an equilibrium condition is required:

$$SS_{tm}(FR_{tm}) = DD_{tm}(FR_{tm}) \tag{A.11}$$

In the above equations, again for year t, E is an indicator of economic activity, A is the market share of ship type m *(tankers, ...), D* represents deliveries of merchant ships (m.dwt), S the amount of scrapping of merchant ships, P is ship productivity as in equation (A.2), *AMF* represents the active merchant fleet (m.dwt), L the laid-up tonnage, *FR* the freight rate, and k is an index representing the commodities (oil, …).

Dealing first with the demand side of the model, in equations (A.3) and (A.4) we define seaborne trade as the aggregate of k individual commodity trades. The simplest forecasting model would treat seaborne trade in aggregate, as we did in the example in Chapter 14. This simulation analysis emphasized the importance of treating major commodity trades separately. Clearly the oil trade should be modelled separately in a way which takes account of developments in the energy market such as changing energy prices.

DOPUNSKA LITERATURA

A more detailed discussion of the approach to specifying the form of the functions in equation (A.3) is presented in Chapter 7. If this approach is followed the trade model can become complex and very time-consuming to update. Alternatively, the volume of seaborne trade by commodity may be treated as an exogenous variable, and obtained from some other source, for example by using forecasts of trade published by consultancy organizations.

Moving on to equation (A.5), the volume of ship demand generated by each commodity, *k*, and measured in ton miles is the product of the tonnage of cargo of each commodity and its average haul. At this stage, demand is expressed in terms of the total ton miles of demand generated by each commodity, *k*, and it is still necessary to transform this into demand by ship type, *m*. This is done in equation (A.6), which shows that the demand for ship type *m* is defined as the market share of that ship type in each commodity trade, summed over all commodities. This is a simple relationship to write in algebraic terms, but is much more difficult to define in practice. In reality trade will be carried in whatever ships are available, which depends on what shipowners order, so analysing investment trends may be the answer.

We pick this up on the supply side of the model in equation (A.8), which defines the fleet of ship type *m* as equalling the fleet in the previous year, plus deliveries minus scrapping during the year. This fleet includes all vessels of type *m* potentially available, but at any given time part of the fleet will not be trading. Equation (A.9) derives the active merchant fleet by deducting laid-up tonnage from the total merchant fleet. This equation could be extended to include other categories of inactive tonnage, for example oil tankers in storage. Finally, equation (A.10) shows that the supply of shipping capacity for ship type *m* is determined by the product of the active fleet and the productivity of that fleet, measured in ton miles of cargo delivered per annum.

The balancing condition in the model is shown in equation (A.11), which specifies that the available ton mile supply of transport capacity of type *m* equals the ton mile demand at the equilibrium freight rate. If too much supply is available, the freight rate will fall until equilibrium is achieved, by additional vessels being laid up or reduced steaming speeds. Conversely, if there is too much demand, the freight rate will rise until the demand is satisfied, though in the extreme case this may not be possible owing to the time-lag in delivering new ships.

The simple model set out in equations (A.3)–(A.11) is deterministic, in the sense that the key equations take the form of simple algebraic identities. The model is also closed, in the sense that any change in demand must be matched by an identical change in supply, and vice versa.

As a practical illustration of the basic shipping market model, we can take the three market segments for oil tankers, combined carriers and dry cargo vessels. The model calculations are illustrated for tankers in Table A.1 and can be briefly summarized as follows:

1. Starting from the oil trade in column 1 and average haul in column 2, the oil trade is calculated in billions of ton miles in column 3. A forecast would require predicting both of these variables exogenously.

Table A.1 Supply–demand model, tanker fleet

			Tanker demand				Tanker supply (m. dwt)			
Year	Trade volume mt	Av. haul miles	Transport required btm	combined carriers btm	Total demand btm	Fleet productivity tm dwt per annum	Active tanker fleet	less: laid up	less: storage & grain	Total tanker fleet
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1963	582	4,210	2,450	-	2,450	35,871	68.3	0.7	1.0	70
1964	652	4,248	2,770	-	2,770	37,534	73.8	0.5	1.7	76
1965	727	4,292	3,120	24	3,096	38,128	81.2	0.4	3.4	85
1966	802	4,152	3,330	53	3,277	36,330	90.2	0.4	3.4	94
1967	865	4,775	4,130	162	3,968	39,171	101.3	0.3	1.4	103
1968	975	5,077	4,950	358	4,592	40,565	113.2	0.2	0.6	114
1969	1,080	5,194	5,610	400	5,210	40,671	128.1	0.2	0.7	129
1970	1,193	5,440	6,490	465	6,025	40,709	148.0	0.2	0.8	149
1971	1,317	5,664	7,460	714	6,746	40,541	166.4	1.2	0.4	168
1972	1,446	5,982	8,650	920	7,730	42,034	183.9	1.4	0.7	186
1973	1,640	6,232	10,220	1,255	8,965	41,834	214.3	0.3	1.4	216
1974	1,625	6,535	10,620	1,084	9,536	37,707	252.9	0.7	0.7	254
1975	1,496	6,504	9,730	826	8,904	33,856	263.0	26.8	1.1	291
1976	1,670	6,695	11,180	841	10,339	36,951	279.8	38.5	2.2	321
1977	1,724	6,647	11,460	912	10,548	35,160	300.0	30.3	1.6	332
1978	1,702	6,251	10,640	676	9,964	34,205	291.3	32.8	4.5	329
1979	1,776	5,912	10,500	635	9,865	33,947	290.6	14.8	21.4	327
1980	1,596	5,783	9,230	404	8,826	28,582	308.8	7.9	8.0	325
1981	1,437	5,699	8,190	368	7,822	26,408	296.2	13.0	11.0	320
1982	1,278	4,914	6,280	389	5,891	23,744	248.1	40.8	12.0	301
1983	1,212	4,587	5,560	328	5,232	23,922	218.7	52.4	15.0	286
1984	1,227	4,603	5,648	285	5,363	26,051	205.9	46.0	17.0	269
1985	1,159	4,450	5,157	304	4,853	24,779	195.9	34.9	15.0	246
1986	1,263	4,675	5,905	479	5,426	26,208	207.0	20.8	14.0	242
1987	1,283	4,689	6,016	480	5,536	25,669	215.7	11.0	14	241
1988	1,367	4,770	6,510	355	6,155	26,717	230.4	4.0	11	245
1989	1,460	4,984	7,276	316	6,960	28,523	244.0	2.3	7.2	254
1990	1,526	5,125	7,821	445	7,376	29,995	245.9	2.3	11.7	260
1991	1,573	5,268	8,287	403	7,884	30,360	259.7	2.2	5.4	267
1992	1,648	5,217	8,597	398	8,199	31,221	262.6	5.8	4.5	273
1993	1,714	5,266	9,026	411	8,615	32,057	268.8	4.5	5.2	278
1994	1,771	5,189	9,190	314	8,876	33,145	267.8	3.5	3.6	275
1995	1,796	5,105	9,169	212	8,957	33,674	266.0	2.5	6.5	275
1996	1,870	5,099	9,535	319	9,216	33,782	272.8	2	3.9	279
1997	1,929	5,122	9,880	378	9,502	34,756	273.4	3	4.4	281
1998	1,937	5,090	9,859	403	9,456	33,629	281.2	1.6	3.1	286
1999	1,965	5,107	10,035	387	9,648	33,961	284.1	1.5	3.2	289
2000	2,027	5,064	10,265	382	9,883	33,776	292.6	1.4	1.8	296
2001	2,017	5,047	10,179	408	9,771	34,023	287.2	2	1.7	291
2002	2,002	4,944	9,898	374	9,524	32,769	290.6	3	1.5	295
2003	2,113	5,007	10,580	293	10,287	33,976	302.8	0.4	0.6	304
2004	2,254	4,925	11,100	106	10,994	34,415	319.5	0.1	0.5	320
2005	2,308	4,965	11,460	109	11,351	33,120	342.7	0.1	0.5	343

(1) Fearnleys Annual Review - oil and products
(2) (3)/(1)
(3) Fearnleys Annual Review - oil and products
(4) Fearnleys Review 2006, assumes 4,551 average haul
(5) (3)–(4)
(6) (5)/(7)×1,000
(7) (11)–(8)–(9)
(8) Fearnleys Review
(9) Fearnleys Review incl. tankers in Grain
(10) CRSL Shipping Review and Outlook

2. Oil tanker demand in column 5 is calculated by deducting combined carrier cargo (column 4) from oil trade (column 3). This calls for a judgement about how the combined carrier fleet will change in size and how it will be distributed between the oil and dry cargo trades. This is usually a matter of relative freight rates, which means that so long as there is a combined carrier fleet the tanker market cannot be treated in isolation from the rest of the market (though as the combined carrier fleet shrinks the link is becoming more tenuous).
3. The supply of tanker capacity starts from the total fleet in column 10, deducts tankers in grain (a rarity nowadays) and tankers in oil storage (column 9) and tankers laid up (column 8), deriving the active tanker fleet in column 7.
4. Fleet productivity is shown in column 6 in ton miles per deadweight per annum and tanker supply in column 6 in billion ton miles.

The statistics in this table provide historical trends showing the relationships between the variables and the way they have changed in the past. To make a forecast requires input assumptions for the tanker fleet, trade and the combined carrier fleet in oil. From these variables surplus tonnage can be calculated as the balancing item, on the assumption that supply must equal demand. Substituting these into the model, the volume of surplus tonnage can be calculated. This supply–demand model can be progressively enlarged so that it generates its own forecasts of the key assumptions, for example by introducing equations to predict the future level of oil trade, average haul, fleet growth, etc. (see Chapter 14). Since the variables on the supply side include behavioural variables, automating them is very difficult.

Once the level of surplus tonnage has been established, an estimate can be made of the level of freight rates. In extreme cases where there is a very large surplus this is easy. We know that freight rates will fall to operating costs. The difficulty lies in modelling market behaviour when the demand curve is hovering in the ‘kink’ of the supply curve. Sometimes this is done with regression equations, but a simulation model is likely to work better. Whatever method is used, the first lesson modellers learn is that when the market is close to balance, tiny changes in supply or demand send rates shooting up or down, which makes forecasting very difficult. Unfortunately, that is how the shipping market works. If it was easy to predict, there would be no need for a market!