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10 The Principles of Maritime Trade

> *A kingdom, that has a large import and export, must abound more with industry, and that employed upon delicacies and luxuries, than a kingdom that rests contented with its native commodities. It is, therefore, more powerful as well as richer and happier.*
>
> (David Hume, *Essay of Commerce*, 1752)

10.1 THE BUILDING-BLOCKS OF SEA TRADE

Seaborne trade has a central place in our lives in the twenty-first century. Walk into any shop, and much of what you see will have come from overseas. Between 1950 and 2005 sea trade grew from 0.55 billion tons to 7.2 billion tons, an average of 4.8% per annum. This expansion was the result of the most fundamental redesign of the world's political and economic arrangements since the industrial revolution. The rapid economic growth and increasing consumer wealth which drove this change were, as we saw in Chapter 1, initiated at the Bretton Woods conference in 1944 which established the economic foundations for a period of economic stability which allowed companies and investors to operate freely across the globe. Three important developments helped:

- The world was progressively opened to free trade. The European empires were dismantled in the 1950s, removing a network of bilateral trade preferences, followed by the break-up of the Soviet Union in 1989 and the opening of the Chinese economy to free trade in the mid-1990s.
- Communications improved as telex, direct-dial telephony, fax, e-mail and the internet appeared in rapid succession. That process is taking another step forward with inter-regional broadband cabling.
- Cheaper transport. The falling cost of sea and air transport gave remote areas of the world access to world markets, making economic development possible. With the associated improvements in inland transport infrastructure, the catchment area for trade widened with each decade.

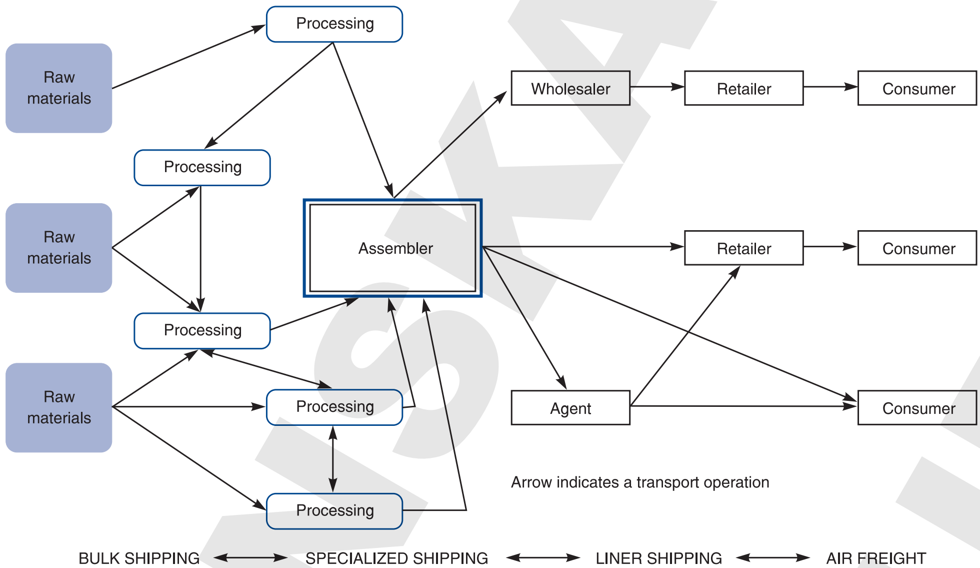

Figure 10.1
The shipping trade and transport system

In the quest to cut costs, corporations were able to shop around the world for components, raw materials and new markets. In doing so they brought new countries into the global system, generating new trade growth and giving rise to the trade system outlined in Figure 10.1. On the left are raw materials, which are shipped by sea to processing plants, often near the markets; in the centre are the assembly plants, and on the right the wholesalers and retailers. As sea transport costs fell, new opportunities for manufacturing were opened up, often involving multiple sea voyages. For example high-technology components are shipped to an assembler in a low-cost economy, processed, then exported as finished goods. This type of classic trade arbitraging is made possible by the transport network.

In this expanding global economy sea trade grew in pace with the world economy. For example, between 1986 and 2005 sea trade grew at an average of just over 3.6% per annum, very slightly faster than the growth of world GDP, which averaged just under 3.6% per annum. But when we dig deeper and look at the individual commodities shown in Table 10.1 we find that the rate of growth varied enormously. The phosphate rock trade declined, whilst coking coal grew at less than 2% per annum. Others grew very rapidly, for example the LNG trade grew at 6.8% per annum. A few new trades such as steam coal appeared and others such as asbestos disappeared. Containerized cargo grew at 9.8% per annum. Regional trade was also constantly on the move. Two of the biggest trading regions, western Europe and Japan, went through a cycle of growth until the early 1970s and stagnation for the next decade. New high growth economies emerged in other areas, notably in Asia and North America. Finally, although on average trade grew rapidly, its path was sometimes irregular, with deep recessions in the 1970s and 1980s.

The theory of maritime trade

Changing trade flows set the framework for the sea transport business, and in this chapter our aim is to understand what drives change. This is not just a theoretical exercise. Liner companies planning new services, shipowners specializing in industrial shipping, shipbuilders planning capacity, and bankers financing fleet expansion all have an interest in understanding what drives trade. Because shipping is demand-derived, we must delve into the world economy for the explanation.

Table 10.1 World seaborne trade by commodity

Million tonnes	1986	2005	% pa
Iron ore	311	631	3.8%
Coking coal	141	191	1.6%
Steam coal	134	491	7.1%
Grain	187	273	2.0%
Bauxite & alumina	42	69	2.7%
Phosphate rock	45	30	–2.1%
Minor ores	555	781	1.8%
Crude oil	1030	1848	3.1%
Oil products	401	672	2.7%
LPG trade	22	37	2.7%
LNG trade	38	132	6.8%
Containerized cargo*	173	1015	9.8%
Other cargo	555	995	3.1%
World sea trade	3634	7163	3.6%
World GDP (1960=100)	279	543	3.6%

*estimate

Source: Clarkson Research Services Ltd

Over the last 200 years economists have developed an extensive body of international trade theory, and this is the starting point for our discussion. However, there are three significant differences between the approach of international economists and our focus as maritime economists. Firstly, maritime economists are primarily concerned with the physical quantity of cargo, whilst trade economists generally focus on the value of trade, which allows them to link their analysis to the economics of the trading economies. Since high-value commodities often have a low volume and vice versa, this inverts the importance of individual commodity trade flows. For example, iron ore exports from Brazil at $45 per ton represent a lot of cargo, but little value compared with manufactures at $20,000 per tonne. Secondly, maritime economists are interested in the way the detailed commodity composition of trade changes with economic circumstances while international economists are more interested in broad categories of trade, for example primary commodities, and manufactures. Thirdly, maritime trade analysis is more focused on geographical regions than political nation states – for example, whether trade is from the US East Coast or West Coast. None of this invalidates the body of trade theory, it simply changes the emphasis which we will place on these different economic tools in the course of this chapter.

Our basic aim is to answer the question ‘What causes trade?’, but before we do this we should consider the fact that, however powerful the economic arguments may be, if a country does not believe that trade is in its interest, it can close its borders. China, the former Soviet Union and Japan have all followed this policy, and at one time or another most Western countries have restricted trade in some way. A policy of not trading, or limiting trade by tariffs or quotas, is known as *protectionism*, or in its extreme form *isolationism*. It seeks to exclude the goods produced by foreigners from local markets in order to protect the livelihood of local producers or for political reasons. Over the last century isolationism in major regions such as the Soviet Union and China shaped the trading world and the opening up of these areas had a major impact on growth and development.

Protectionism is generally driven by the political influence of interest groups whose livelihood is threatened by trade. For example, protectionists may try to prevent the export of local resources which they argue are being exported by unprincipled traders, leaving nothing for the local inhabitants. When the reserves are all gone, the country will be left in poverty.[1] Or the aim may be to protect local jobs and skills which are threatened by cheap imports. If the local shipyard or car plant is about to close because it cannot compete with foreign facilities, offering subsidies or passing laws preventing imports is a natural response. After all, this could be just the beginning. Soon other industries will be under attack and then how will the country earn its living? Currency reserves will drain away and the country will be left in poverty, so trade must be prevented at all costs. Or must it?

The arguments for free trade

Three hundred years ago this 'mercantilist' argument against free trade attracted much attention, and David Hume addressed it in his *Discourse on the Balance of Trade* (1752). Hume did not think much of the mercantilist approach, commenting:

> It is very usual in nations ignorant of the nature of commerce, to prohibit the exportation of commodities, and to preserve among themselves whatever they think valuable and useful ... There still prevails, even in nations well acquainted with commerce, a strong jealousy with regard to the balance of trade, and a fear, that gold and silver may be leaving them.[2]

In nineteenth-century Britain, as in many developing economies, free trade became a major political issue, centring on the question of whether the import of cheap grain should be permitted. Manufacturers in the towns were in favour because they wanted cheap food for their workers, but the domestic landowners, who stood to lose their protected market, were opposed. The issue split the country. Eventually free trade prevailed and in 1847 the Corn Laws, which prohibited imports, were repealed, helping Britain to develop as an industrial economy. Today the principles of free trade are broadly accepted through the World Trade Organization (WTO), but protectionism remains a live issue. In the West there are still concerns that developing economies in Asia will put the older industrial countries out of business, as demonstrated by the difficulties faced by the GATT negotiations over ten years. Apart from any personal considerations for the inhabitants of the developed countries, this would be very bad for shipping. Even where trade is relatively open, many countries protect inefficient industries whose output in a free market would be replaced by trade.

10.2 THE COUNTRIES THAT TRADE BY SEA

The differences in maritime trade by country

There are currently about 100 countries which trade by sea. If every country is included, down to the smallest Pacific island, there are many more, possibly as many as 170. To explain their trade the starting point is to take a close look at the economic differences between the trading countries. Table 10.2 lists the imports and exports of 40 major trading countries, or in some cases groups of countries.[3] Together they account for 89% of world seaborne trade, so it provides a reasonable overview of the countries which trade by sea. Column 1 shows the country's rank; the second its name; columns 3 and 4 its seaborne imports and exports; and column 5 shows the total trade used in the ranking exercise. Columns 6–12 provide details of the geographical and economic size of each country in relation to its sea trade.

At the top of the list is north-western Europe with 1.91 billion tons of imports and exports, followed by the United States with 1.31 billion tons, the Middle East with 1.23 billion tons and China with 0.998 billion. Moving to the bottom of the list, we find some countries with very little trade, for example Cyprus with 6.7 mt and Brunei with 1.9 mt. To explain these trade volumes in a general way is difficult enough, but to do it well enough to forecast their future trade flows is a daunting task. Clearly a short cut is needed. We must look for a theory which will allow us to generalize about the factors which determine a country's trade. Armed with this theory, we can reduce the task to more manageable proportions. The starting point is to see how trade relates to the country's general economic structure, and for this purpose three economic indicators are shown in the table, land area (measured in thousands of hectares), population (measured in millions) and GDP (measured in billions of dollars). The final columns show three important ratios: population density, sea trade volume per capita and the trade per million dollars of GDP. In the following paragraphs we will examine each of these variables – the balance of trade, the size of the region, its level of economic activity, and of course its trade intensity – to draw some general conclusions about what determines the volume of sea trade.

The balance of imports and exports

The first step is to examine the balance of trade. Figure 10.2 plots the imports and exports of the 40 trading countries accounting for 89% of world seaborne trade (see Table 10.2), with each dot representing a country or region. Imports are shown on the vertical axis and exports on the horizontal axis, so a country with balanced trade would fall on the dotted line which bisects the chart on the diagonal. In fact few do, especially amongst the bigger trading countries. The graph shows that trade volumes are very diverse, with one group of countries, including north-western Europe, USA, Japan, China and South Korea, strung out to the left of the dotted line and another group, including the Middle East, Australia and East Coast South America, strung out along the horizontal axis. This focuses on one of the main drivers of trade, the imbalance of supply and demand for resources between regions of the world. To the left of the dotted

Table 10.2 Seaborne trade of 40 countries and regions ranked by trade volume

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(9)	(10)	(11)	(12)
1	2	Sea trade 2004			Country size, 2004				Trade intensity	
	Country	*Exports mt*	*Imports mt*	*Total*	*Area m HA*	*Pop. m*	*GDP US$ bill*	*Pop. Per HA*	*Trade intensity (tons) per capita*	*per $mn GDP*
	Germany	100	164	264	36	83	2,714	2.3	3.2	97
	Belgium	446	452	898	4	10	350	2.8	89.8	2,566
	Netherlands	102	329	431	3	16	577	5.2	26.9	747
	France	97	224	321	55	60	2,003	1.1	5.3	160
1	*Total NW Europe*[a]	745	1,168	1,913	97	169	5,644	1.7	11.3	339
2	*USA*	350	956	1,306	937	294	11,668	0.3	4.4	112
3	*Middle East*	1,084	148	1,231	730	294	600	0.4	4.2	4,188
4	*Japan*	178	829	1,008	38	128	4,623	3.4	7.9	218
5	*China*	352	646	998	960	1297	1,649	1.4	0.8	605
6	*S. Korea*	184	486	669	10	48	680	4.8	13.9	985
7	*Australia*	587	67	653	771	20	631	0.0	32.7	1,035
8	*E. Coast S. America*[b]	463	128	591	1,390	45	97	0.0	13.1	6,063
9	*Singapore*	197	197	393	0	4	107	58.8	98.3	3,680
10	*Spain*	108	258	366	50	41	991	0.8	8.9	369
11	*Indonesia*	246	82	328	190	218	258	1.1	1.5	1,275
12	*Central Asia*[c]	190	50	240	1,708	143	582	0.1	1.7	412
13	*W. Coast S. America*[d]	136	85	221	364	102	290	0.3	2.2	762
14	*Hong Kong*	86	135	221	0	7	163	62.5	32.1	1,355
15	*South Africa*	163	40	203	122	46	213	0.4	4.4	954
16	*Panama*	114	80	194	8	3	14	0.4	64.6	14,039
17	*Norway*	157	25	182	32	5	250	0.2	36.4	727
18	*Malaysia*	70	98	168	33	25	118	0.8	6.7	1,425
19	*Sri Lanka*	66	79	144	7	19	20	2.9	7.6	7,175
20	*Sweden*	65	71	137	45	9	346	0.2	15.2	395
21	*Finland*	43	53	96	34	5	187	0.1	19.2	514
22	*Iran*	33	58	91	165	67	163	0.4	1.4	561
23	*Turkey*	65	11	77	78	72	302	0.9	1.1	254
24	*Ukraine*	62	11	74	60	47	61	0.8	1.6	1,207
25	*Morocco*	28	37	65	45	31	50	0.7	2.1	1,305
26	*Latvia*	54	3	57	7	2	14	0.4	24.8	4,211
27	*Poland*	39	17	56	30	38	242	1.2	1.5	232
28	*Israel*	16	33	49	2	7	118	3.4	7.1	420
29	*Portugal*	10	39	49	9	10	168	1.1	4.9	290
30	*Estonia*	42	4	46	4	1	11	0.2	46.4	4,293
31	*Egypt*	13	29	41	100	69	75	0.7	0.6	549
32	*N. Zealand*	22	18	41	27	4	100	0.1	10.2	410
33	*Pakistan*	8	31	39	80	152	96	1.9	0.3	408
34	*Lithuania*	22	5	27	7	3	22	0.5	9.2	1,232
35	*Tunisia*	7	14	21	16	10	28	0.6	2.1	749
36	*Croatia*	7	13	20	6	4	31	0.8	4.5	646
37	*Bangladesh*	1	16	17	14	140	57	9.7	0.1	299
38	*Slovenia*	3	9	12	2	2	32	1.0	6.0	375
39	*Cyprus*	2	5	7	1	1	15	1.1	6.7	438
40	*Brunei*	0	2	2	1	0	5	0.4	5.4	386
	Total 1–40	6,018	6,037	12,054	8,180	3,583	30,722		3.4	392
	Other countries	741	750	1,491						
	World	6,758	6,787	13,545						

Source: World Bank (GDP), *UNCTAD Monthly Bulletin of Statistics,* UNCTAD (2005)

Notes:

[a]Total NW Europe includes only Germany, Belgium, the Netherlands and France

[b]East Coast S. America includes Guyana, Venezuela, Suriname, Argentina, Bolivia, Brazil, Uruguay

[c]Includes Russia, Kazakhstan, and various other central Asian countries

[d]West Coast S. America includes Chile, Columbia, Ecuador, Peru

line are the highly populated and wealthy regions of the world which are relatively resource-poor, whilst to the right are the resource-rich areas where demand is lower due to lower population (in the case of Australia) or income (in the case of East Coast South America).

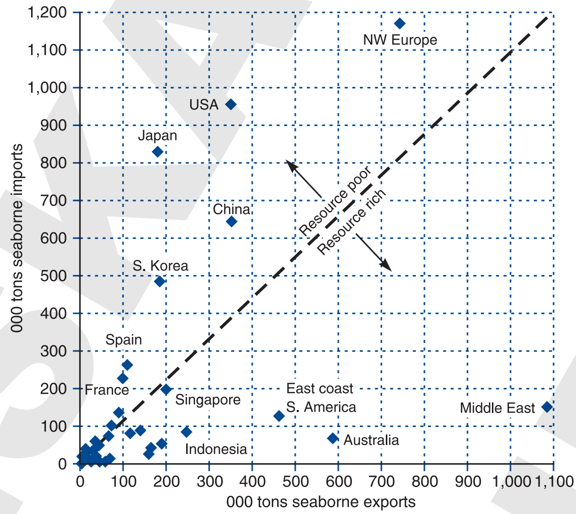

Figure 10.2
Seaborne imports and exports, 2004
Source: UN *Monthly Bulletin of Statistics*

Wealth and seaborne trade

The obvious explanation of a country's seaborne trade is the size of its economy. Common sense tells us that bigger economies are likely to generate more trade. If we examine the relationship between seaborne imports and GDP, we find there is indeed a close relationship, as is demonstrated by Figure 10.3. This plots the seaborne imports of the 40 countries in 2004 against their GDP. As the level of GDP increases, so do imports. For example, the USA has a GDP of $11.66 trillion and imports of 956.2 mt, whereas the GDP of Cyprus was only $15 billion and its sea imports are 5.1 mt.

Taking the analysis a stage further and fitting a linear regression model of seaborne imports on GNP (see graph inset) we find that 71% of the variation in seaborne imports is explained by variations in GNP (this is R^2). The model implies that in 2004 seaborne imports start when GNP reaches $60 billion and increase by 110,500 tons for each $1 billion increase in GNP. The relationship is very approximate, but it is clearly significant and follows the sort of pattern we would expect. There are three reasons why rich countries with a high GNP might be expected to have a higher level of imports than a poor country with low GNP. First, a larger economy has greater needs in terms of the raw materials and manufactured goods which are shipped by sea. Some of these will not be available locally. Second, mature

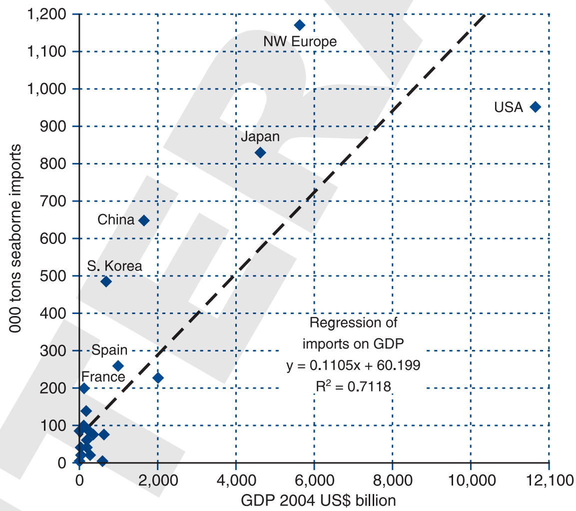

Figure 10.3
Seaborne imports and GDP, 2004
Source: UN *Monthly Bulletin*, World Bnak

economies which started out with plentiful local resources will eventually use them up, leading to the need for imports. For example, the USA started out with abundant oil reserves but now imports more than half its requirements. Third, a country with high GNP can afford to purchase imports and has more to export in return.

Land area and sea trade

When considering the trade of a country, the next factor to consider is its physical size. We might expect the size of a country in terms of its land area to influence trade because it determines the amount of physical resources available locally. After all, reserves of energy, minerals and the production of agriculture and forestry are all likely to be greater in a large land mass than a smaller one. When we examine the correlation between sea trade and land area, (Table 10.2), we find that there are many countries that very obviously do not fit the model. For example, Singapore, a country with only 62,000 hectares, has roughly the same trade volume as Spain, which has an area of 50 million hectares.

But when we distinguish importers from exporters things start to make more sense. Figure 10.4 shows the relationship between seaborne imports and land area. Strung along the vertical axis of the graph are some quite small countries with big imports – north-western Europe, Japan, South Korea and Spain. Conversely, strung out along the horizontal axis are the countries with a big area and low imports, including the Middle East, Australia and Indonesia. In other words, imports are inversely related to country size, though the precise amount of trade arising from natural resources is also a matter of supply–demand economics. Where demand is high and no local reserves are available, as in the case of iron ore used by the Japanese steel industry or oil used by France and Germany, trade is directly related to demand. But often there is an economic choice between domestic and imported resources. For example, Europe has extensive coal deposits, but finds it more economic to import cheaper foreign coal. So we see the very high imports shown for north-western Europe, Japan and South Korea in Figure 10.4. Resource depletion is also an issue, and we have very large countries such as China and USA with abundant resources, but where imports are high because the resources are insufficient to meet domestic demand. In the case of China this is due to the high population and for USA the high GNP. In these large economies the domestic resources are diverted to the domestic market, whereas

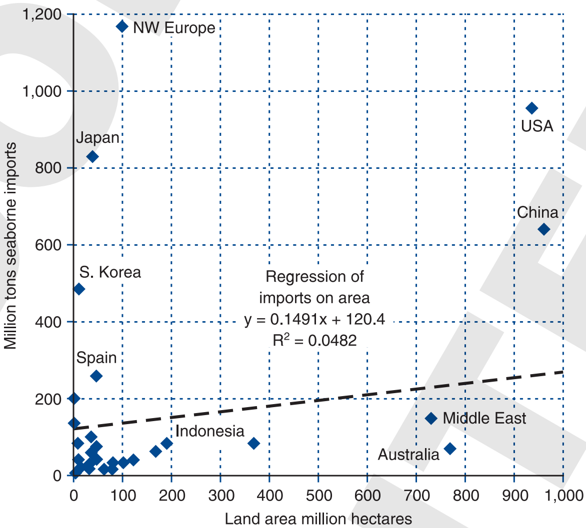

Figure 10.4
Seaborne imports and land area, 2004

for large landmasses with smaller population or GDP such as the Middle East, Australia and Indonesia, which appear at the bottom of the graph, local resources are the sufficient so there is little demand for imports. As we shall see when we study trade theory, factor endowments play a vital part in explaining trade, but this does not allow us to generalize about the relationship between resources and trade. The results of the regression analysis are a reminder of this fact.

So although common sense suggests that the area of a country should be important, it is not a simple relationship. Statistically there is almost no statistical correlation between a country's area and its volume of trade. But on reflection this is not really a surprising result. It reinforces the point that trade is about economic growth, not physical size. A country may be very large, but if it is mainly empty, there will not be very much import trade.

Population and sea trade

Finally there is population. The idea that population and trade go hand in hand stretches back to the nineteenth-century trader's dream of 'oil for the lamps of China'. If there are enough people, it was argued, there is great trading potential. Much the same hopes were extended to South American countries such as Brazil. In both cases the expectations were disappointed and trade was slow to develop, despite the size of the population. For example, China has a population of 1.3 billion, ten times Japan's 128 million, but in 2004 it imported 25% less cargo (see Figure 10.5). A statistical analysis of the relationship between population and trade shows virtually no correlation. The correlation coefficient is 0.2. If nothing else, this demonstrates that sea trade is primarily an economic phenomenon.

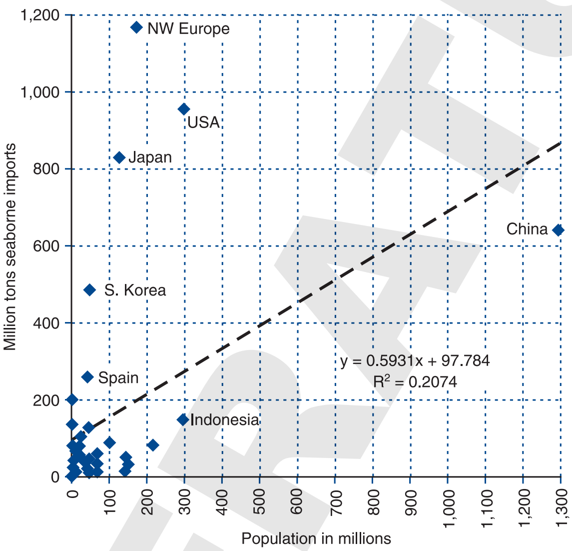

Figure 10.5
Seaborne trade and population, 2004
Source: *UN Monthly Bulletin*, World Bank

10.3 WHY COUNTRIES TRADE

Trade theory and the drivers of trade

The conclusion from the brief overview of sea trade is that economic activity creates the demand for imports and the supply of exports, not numbers of people, or land area, though both have some influence. The countries that trade more than others generally have bigger economies (GDP), but trade volumes are also a matter of supply and demand. The USA, a major oil producer, imports oil because demand has outstripped supply. Similarly, China suddenly imported 60 mt of steel products in 2003 because local demand surged ahead of local steel production. That is fine for raw materials, and the bulk shipping industry, but what about manufactures? Why is the Japanese export trade in manufactures so high? Why does Europe import so many Japanese motor cars when it has a car industry of its own? These issues become more important when we study the container trade.

The three fundamental reasons for trade

The starting point is that trade takes place because someone makes a profit from it. There are a few minor exceptions to this rule, such as food aid, but it applies to most trade and our quest to explain trade in theoretical terms starts here. That leads on to the question of what makes trade profitable, and the answer is generally a difference in costs. If it is possible to sell a foreign product for less than the price of locally produced goods, after deducting freight and duties, and make a profit, someone is going to do it. It does not need a model to figure that out, but it is useful to state the model anyway:

$$TR_{ij} = f(p_i, p_j, T_{i,}\ \mathrm{F}_{ij}) \tag{10.1}$$

This model stipulates that the trade (TR) between regions i and j depends on the price in country i (p_i), the price in country j (p_j), any tariffs between the two areas (T_{ij}) and the cost of freight (F_{ij}). So all we have to do is explain why products produced overseas cost less than their local counterparts. Of course, there are an infinite number of specific circumstances, but as far as explaining global sea trade of the type we reviewed in Tables 10.1 and 10.2 is concerned, three stand out: differences in manufacturing costs, differences in local natural resources, and temporary shortages or surpluses which disrupt the normal pricing process. We will consider each of these in the following sections, but a brief preview puts them into perspective:

1. Differences in manufacturing costs. If one country can manufacture a product cheaper than another, for whatever reason, and the price difference is more than the transport costs and tariffs, trade is profitable. So we need to explain why certain goods cost more to manufacture in one area than another, an issue which has preoccupied trade economists more than any other.
2. Differences in natural resources. Natural resources are not spread evenly around the world, so another set of trade flows developed moving them from where they are located to where they are needed. Unlike manufacturing plants which can be relocated, commodity trades are dictated by the distribution of resources. But the cost of recovering natural resources is important, too. If a country has no oil and there is a demand for motor cars, it has to import. But where there are local supplies, trade is determined by relative delivered costs of domestic and imported oil.

3. Temporary imbalances. A third category of trade is a subset of item 2 which is important for shipping. Temporary local imbalances create a price differential between local and overseas products. This type of trade often happens during business cycles when, for example, shortages of chemicals, petroleum products or steel products result in imports of commodities, even if they can normally be manufactured competitively at home. However, cyclical patterns of trade also occur over much longer periods as economies develop, which we will refer to as the 'trade development cycle'.

These three types of trade are closely related, but each involves a slightly different theoretical model to explain how much trade, where and when. However, it is helpful to see them in the context of the transport system we reviewed at the beginning of the chapter (Figure 10.1). This highlighted the differences between the primary commodity trades which can generally be explained by a relatively simple model focusing on differences in primary commodities availability and the manufactures trades which involve a more complex trade model. The primary commodities are shipped from areas of low-price abundance to manufacturers who process them into semi-manufactures such as steel products, oil products, and chemicals. These are the backbone of the bulk trades discussed in Chapter 11. In contrast, the manufactured goods may be shuffled around the world between components manufacturers, assemblers and retailers, and we are interested in what determines who does what. From a shipping viewpoint the manufactures trade offers endless opportunities for sea transport, and before they reach the consumer, some components may have made several voyages and most are shipped in general cargo, which is discussed in Chapter 13. The specialized cargoes discussed in Chapter 12 fall somewhere between the two.

10.4 DIFFERENCES IN PRODUCTION COSTS

Interest in the 'who does what' aspect of trade was initially sparked during the industrial revolution in Britain because various parties stood to gain or lose a great deal of money from opening global free trade (there is nothing like hard cash to create economic controversy!). In the seventeenth and eighteenth centuries the dominant economic argument was that a country should encourage exports and discourage imports so that it could accumulate gold reserves and grow rich. Adam Smith coined the term 'mercantile system' to describe this trade theory.[4] The mercantilist theory suited the interests of the British landowners who were keen to prevent imports of cheap American corn, and they had the upper hand politically, so the country's policy was to restrict trade. But as the industrial revolution gathered force the merchants and producers became more powerful, and they wanted cheap grain to feed their workforce and a free world market to sell their goods. Naturally they became keen supporters of any trade theorists who argued that free trade was a beneficial strategy. Rarely have economic theorists been so close to frontline policy-making.

The theory of absolute advantage

The best known of the early theories of the benefits of trade was developed by Adam Smith in *Wealth of Nations* and it is often referred to as the 'theory of absolute advantage'. At this time England was a rapidly growing industrial economy with a thriving export trade, and Smith treated the topic as a matter of common sense. He argued that countries are better off if they specialize, trading their surplus production for the other goods they need, because specialization makes them more productive. Although it might be possible to grow grapes in Scotland and make wine, the cost would be prohibitive and the quality poor. Importing wine and specializing in something the Scots are better able to produce means everyone benefits because the world's limited economic resources (factors of production) are used more efficiently. To illustrate the point he drew the analogy with tradesmen, who are better off if they specialize:

> It is the maxim of every prudent master of a family, never to attempt to make at home what it will cost him more to make than to buy. The tailor does not attempt to make his own shoes, but buys them from the shoemaker. The shoemaker does not attempt to make his own clothes, but employs a tailor. What is prudence in the conduct of every private family, can scarce be folly in that of a great kingdom. If a foreign country can supply us with a commodity cheaper than we ourselves can make it, better buy of them with some part of the produce of our own industry, employed in a way in which we have some advantage.[5]

Goods are cheaper because trade permits greater division of labour, allowing more to be produced with the same resources. So long as transport costs do not exceed the cost saving in production, trade is bound to be beneficial.

The point is easily demonstrated by the numerical example in Table 10.3. Two countries, Big and Bouncy, produce two goods, food and cloth. Both have 60 labourers. Bouncy, which is better at growing food, needs only 3 labourers per ton, whilst Big needs 4. But Big is better at cloth, using only 2 labourers per bale, whilst Bouncy needs 6. Assume that there are constant costs (i.e. they use the same labour per unit of output, regardless of volume). Big's production possibilities are 15 tons of food or 30 bales of cloth (or any combination). Write this as (15, 30). Bouncy's production possibilities are 20 tons of food or 10 bales of cloth (20, 10). They both need 12 tons of food to live on. Big uses 48 units of labour to produce its food and uses the remaining 12 units to produce 6 bales of cloth, so its output is (12, 6). But Bouncy only needs 36 units of labour to produce its food and uses the remaining 24 units to make 6 units of cloth (12, 6). So both states end up with exactly the same amount of food and cloth (12, 6).

Now we introduce trade and allow the two countries to specialize in their best products. Bouncy switches all its labour into food, producing 20 tons, consuming 12 and exporting 8 to Big. Thanks to the imports Big only produces 4 tons of food, using its remaining 44 units of labour to make 22 bales of cloth. It consumes 11 bales and exports 11 to Bouncy in return for the food. Thanks to trade Big and Bouncy now have 12 tons of food and 11 bales of cloth (12,11), almost twice as much cloth as previously. It's magic!

The theory of comparative advantage

This theory leaves a crucial question unanswered. If Bouncy is better at producing food and Big at producing cloth there is no problem, but suppose one country is better at producing both goods? The mercantilists could still argue that under free trade the less efficient country would be driven out of both food and textile production, and would sink into poverty, so inefficient countries must avoid trade at all costs. In 1817, in his *Principles of Political Economy and Taxation*, David Ricardo came up with an elegant demonstration of why that was not the case. Trade is beneficial, he argued, even if one country is more efficient than its trading partners at producing all goods. If we rerun the example, but make the Bouncy better at producing both food and cloth, the countries are still richer with trade than without.

Bouncy now requires less labour than Big to produce both food and cloth. If there is no trade it can produce the 12 tons of food it needs and 24 bales of cloth (12, 24). Big would produce 12 tons of food, but only 6 bales of cloth (12, 6). However, if the countries specialize in the product in which they are *comparatively* more efficient, their production increases. Big is now relatively more efficient at food production, because it uses only twice as much labour as cloth, whereas Bouncy uses three times as much labour to produce food. So Big specializes in food, producing 15 tons, consuming 12 and exporting 3. With imports of 3 tons of food, Bouncy now cuts food production to 9 tons, requiring 27 units of labour. With the remaining 33 units of labour it produces 33 bales of cloth, nine more than previously. It exports 6 bales to Big in return for the 3 tons of food and is left with 3 more bales of cloth than it had

Table 10.3 Absolute and comparative advantage

1. Absolute advantage example		
	Big	Bouncy
Available labourers	60	60
Labour required per unit of output		
Food (tons)	4	3
Cloth (bales)	2	6
Production possibilities		
Food production (tons)	15	20
Cloth production (bales)	30	10
Production without trade (full output)		
Food production (tons)	12	12
Cloth production (bales)	6	6
Total (units)	18	18
Production with trade		
Food production (tons)	4	20
Cloth production (bales)	22	0
Total (units)	26	20
Memo: exports	11	8
2. Comparative advantage example		
	Big	Bouncy
Labour required per unit of output		
Food	4	3
Cloth	2	1
Production without trade (full output)		
Food production (tons)	12	12
Cloth production (bales)	6	24
Total (units)	18	36
Production with trade		
Food production (tons)	15	9
Cloth production (bales)	0	33
Total (units)	15	42
Memo: extra output	3 bales of cloth	

without trade, so trade has increased output by 3 bales of cloth. The question is how much of this does Big get?

The heart of the theory is that free trade allows each country to specialize in its most competitive products. More wealth is created by trade because limited 'factors of production' are used more efficiently and all participants are better off than they would be without trade.[6] This has important implications for trade. The appearance of new competitors in the international market does not put existing traders out of business. Provided there are relative differences in efficiency it leads to more trade and greater wealth, though it does raise difficult questions about the redistribution of economic resources and how the gains from trade are distributed between the participating countries.

In reality free trade is often not all good news for individual interest groups. As the balance of comparative advantage adjusts, there are winners and losers. For example, the English landowners who resisted the repeal of the Corn Laws in the nineteenth century were right in thinking that they would suffer from free trade. After the Corn Laws were repealed in 1847, cheap foreign corn flooded into the country, depressing prices and impoverishing the countryside. Workers were forced to migrate to the towns, helping Britain to become even more successful as an exporter of manufactures. In the end Britain as a whole was better off for free trade, but the process of change left some individuals, particularly landowners, seriously worse off. There are parallels with the competition between European heavy industry and Far East in the 1970s and 1980s. European manufacturers were driven out of business by Far East competition. It is not much compensation to a redundant shipyard worker that he has lost his job because the country now has a comparative advantage in financial services, a business that has no call for welders. This is important because these side effects can lead to protectionism.

Modern theories of manufacturing advantage

Comparative advantage is one of the most influential economic theories ever developed, providing the intellectual foundation for the free trade philosophy which has dominated political thinking over the last half century through the WTO. Much work has been done to extend the model to deal with multiple commodities and countries and to examine the effects of tariffs and imperfect competition. From a maritime perspective the important issue is the light it casts on why trade has grown so rapidly in the last fifty years. During this period of free trade improved transport and communications have stimulated growth by allowing global sourcing and marketing of products. The new technology also improved the services that support trade. Legally secure documentation, especially in such areas as establishing the ownership of goods, cheap direct-dialled phone calls, improved international banking, and more recently e-commerce have made global trading easier, especially for smaller companies.

Armed with these new services, industry can migrate to the remote corners of the globe where costs are low and many more towns and cities in these areas are continuously being drawn into the global trading system. Today trade growth in manufactures is driven by exploiting differences in labour costs between regions, but it does not rely exclusively on inter-country differences. Michael Porter's model of world trade attributes comparative advantage not only to local resources such as cheap labour, but also to expertise. He argues that clusters of companies specializing in a particular item, say ski boot clamps, develop a 'comparative advantage' in that product. With the right communications and transport, these clusters can exploit their advantage globally, leading to a broader trade matrix and improved global efficiency and trade growth even if wage cost differences are eliminated.[7] This process is dynamic. Once a particular company, country or cluster has become an established product area, it is difficult for others to build up sufficient volume of sales to break into that market. In the nineteenth century Britain developed mechanized textile manufacturing, and for some years gained a comparative advantage from this. Eventually other countries caught up. Today technical advance is continuous. The manufacture of medical equipment, the production of a particular type of rubber belt drive, and the manufacture of complex products such as cruise ships and aircraft are all examples where one country has developed a competitive advantage based on technical innovation and is protected by barriers such as the high cost of entry. In the case of particular inventions the manufacturing rights may even be covered by a patent.

A variant on this is driven not by production technology, but by *product differentiation* in the market. Motor cars are a good example, but petroleum products, electronic equipment and a whole range of consumer goods also qualify. In these cases the cause of trade is differences in tastes between countries. For example, motor car manufacturers face economies of scale, so low-volume production is expensive. If most Americans like to drive very big motor cars, while most Europeans prefer to drive small motor cars, then the minority in Europe who wish to purchase large motor cars can benefit from importing American cars and vice versa, especially if transport costs are low. This has had a tremendous impact on trade. In most countries consumers can now choose from twenty or thirty different brands of motor car, each sold at a highly competitive price. The production economics of car manufacture is such that if the market were fully supplied by UK manufacturers, there could only be a small number of different designs, and costs would almost certainly be higher. Similarly, if oil refineries are technically restricted to producing a mix of petroleum products which does not exactly match local demand, they will seek to export the products not needed locally.

10.5 TRADE DUE TO DIFFERENCES IN NATURAL RESOURCES

The classical economists were mainly interested in trade theory from a *normative* viewpoint and the theory of comparative advantage was a response to the political debate over free trade. Ricardo and other classical economists did not pay much attention to explaining what determines the comparative advantage a country may have. However, by the early twentieth century when the free trade battle had been won, economists became more interested in explaining trade patterns. The key issue turned out to be the assumption of constant costs, which is one of the basic building-blocks of Ricardo's model.

Resource-based trade and the Heckscher-Ohlin theory

The theory of comparative advantage makes the important assumption that resources can be freely switched between the manufacture of different products without any loss of productivity. Even in the abstract world of economic theory this is clearly not realistic. In the 1920s two Swedish economists, Eli Heckscher and Bertil Ohlin, concluded that because countries have different endowments of factors of production, attempts to substitute one factor for another usually result in falling productivity or may not be possible at all. For example, America with its great prairies can expand grain production, but if the UK tries to switch more labour into agriculture, as we assumed in the example earlier in the chapter, yields would fall as the land was farmed more intensively. Conversely, although the UK with its abundant skilled labour can easily expand cloth production, the USA runs into diminishing returns due to the lack of suitable labour. Heckscher and Ohlin argued that these differences in the available factors of production (land, labour, etc.) can lead to differences in production costs between countries. All we need for trade to be beneficial is that economic resources are unevenly distributed between countries. Winters [8] summarizes these minimum conditions as follows:

1. The production functions for the two products give constant returns to scale if both factors are applied proportionally, but diminishing returns to any individual factor (i.e. if a country runs out of land, but keeps applying more labour, fertilizers, machinery, etc., marginal returns fall).
2. Goods differ in their requirements of different factor inputs (e.g. food production needs more land than textile manufacture).
3. The countries have different relative factor endowments.

As an illustration, imagine the ‘no trade’ situation on two islands. Each island relies on its own domestic resources. Island A struggles to feed a large population by intensive agriculture on the limited land available. It mines coal from a few deep mines and manufactures a whole range of products, mainly on a small scale. In agriculture and labour the islanders face sharply increasing costs as they try to maintain growth by pouring more labour into fixed physical resources.

Island B has the same population but open-cast coalmines and better land. If trade is opened up the islands specialize. Because island A has few natural resources, its comparative advantage is in manufacturing. It imports coal and food from island B and switches the labour into manufacturing industry which for it (but not island B) is relatively more productive. In other words, it exports those goods whose production is relatively intensive in the factors with which it is well endowed. Island B opens more coalmines and switches labour into them, exporting coal. It all depends on their relative factor endowment. The precise definition of ‘natural resources’ raises all sorts of questions. In Chapter 1 we showed that the trading world is constantly on the move, so we should not rely too heavily on static models. However, the Heckscher-Ohlin theory suggests that in a free world market, countries must make the best of whatever resources they have, and this theory goes a long way towards explaining the diversity of trade in Figure 10.2. The countries on the left of the dotted line are like island A and the countries on the right of it are like island B.

The commodity trade supply–demand model

This is a good point at which to discuss the commodity trade model. Raw materials account for a large part of seaborne cargo, and one of the main tasks of the bulk shipping industry is to anticipate future trade, so that efficient transport can be planned. For this reason alone shipping analysts often have to analyse trends in the commodity trades. The supply–demand model is the most commonly used technique for carrying out this analysis. For example, Japan has no local supplies of iron ore, so it must import what it needs from mines in Australia or Brazil. Iron ore is traded in an international market and supply and demand for the commodity are controlled by price movements. Thus the model consists of a demand function for the commodity, showing the relationship between demand and price, and a supply function, showing how supply responds to price changes.

The demand function describes the relationship between per capita income, commodity prices, and the consumption of the product and is generally referred to as the consumer demand function. It is expressed as

$$q_{it} = (\, p_{1it}, p_{2it}, y_{it}) \qquad (10.2)$$

where q is per capita consumption of the commodity, p_1 is its price in domestic currency, p_2 is the price of other commodities and y is per capita income for the ith country in year t.[9] This function suggests that the demand for a commodity responds to changes in relative prices and income. To explain how demand responds to a change in price we need to introduce two economic concepts, the income elasticity and the price elasticity.

The income elasticity shows how consumers of the commodity adjust their consumption in response to a change in income. It is defined as the proportionate change in the purchase of the commodity such as energy for a change in income, with prices constant:

$$e_i = \frac{(\log q)}{\mathrm{d}(\log y)} \qquad (10.3)$$

In other words, the income elasticity is the percentage change in demand divided by the percentage change in income. The nature of this relationship varies from one commodity to another, with important consequences for trade. We can use the income elasticity to classify commodities into three different groups. *Inferior goods* have a negative income elasticity (i.e. less than 0), so when income rises, demand falls. For example, at higher incomes people typically consume less of basic foods such as bread and potatoes, switching their demand to other foodstuffs such as meat. *Necessities* are goods whose demand increases as income rises, but more slowly than income (i.e. the income elasticity is in the range 0–1). Finally, *luxuries* are goods for which demand grows faster as income rises (i.e. the income elasticity is greater than 1). These differences are important because they warn us to expect demand relationships to change when income changes. For example, the income elasticity of motor cars could be very high at low income levels because buying a motor car is a priority. When most people have a car the demand continues to rise with income as a few buy second cars, but the rate of increase slows and car demand eventually stagnates, or switches to higher value-added vehicles. The same is true of housing. For anyone modelling the demand for steel, much of which is used in construction and motor vehicle production, it is vital to model these relationships in a way which allows for these changing relationships.

The price elasticity shows how demand responds to a change in prices. It is derived from the demand function and represents the percentage change of consumption for a 1% change in prices. In mathematical terms the price elasticity can be expressed as follows:

$$e_p = \frac{\mathrm{d}(\log p)}{\mathrm{d}(\log q)} = \frac{p.\mathrm{d}q}{q.\mathrm{d}p} \tag{10.4}$$

where e_p is the price elasticity, p is the price of the commodity and q the quantity consumed. It is possible to sub-divide the price elasticity into two components, the substitution effect and the income effect.

$$\frac{\mathrm{d}q}{\mathrm{d}p} = \left.\frac{\mathrm{d}p}{\mathrm{d}q}\right|_{\bar{u}} - \frac{\mathrm{d}p}{\mathrm{d}m}q \tag{10.5}$$

where m is income. Equation (10.5) is known as the Slutsky equation. The first term on the right-hand side represents the *substitution effect* and the second the *income effect*. The substitution effect measures the extent to which a change in the price of a commodity results in the substitution (negative or positive) of other commodities in the total budget. The income effect measures the change in the level of consumption due to the change in real disposable income as a result of the price change.

This relationship is helpful to analysts in explaining and modelling sudden commodity price changes because it shows the different factors involved. For example, it was useful in explaining the crude oil trade during the two oil crises in 1973 and 1979 (see Figure 11.8, which shows the relationship between oil prices and seaborne crude oil shipments). When the price of oil increased sharply in 1973, the income effect was dominant because oil was a necessity and there was not very much substitution. Consumers spent more of their income on oil and had less to spend on other goods, triggering a recession in the world economy. But by the time the oil price went up again in 1979, the substitution effect was the dominant response because by that time it was technically possible to substitute coal and gas for oil. As a result consumers, particularly power stations, switched from high-priced oil to cheaper coal and gas and the crude oil trade fell sharply (see Figure 4.5 which shows how the oil trade declined), providing another different example of the two components of the Slutsky equation at work.

Derived demand for a commodity

The next step in the commodity trade model is to reproduce the relationship between the demand for raw materials in an industry, and demand for the products of that industry which are sold to the final consumer. Industrial users often have a choice in sourcing their raw materials, raising the possibility that manufacturers will substitute one raw material for another. Heavy industries such as steel production and motor manufacturing are major users of raw materials, as is the transport industry (e.g. ships' bunkers). These industries will be concerned with minimizing their costs, and their demand for raw materials is derived from the underlying demand for the commodities the industry produces. The starting point is the cost function. For a given output level the cost function is

$$C = P_1 X_1 + P_2 X_2 + b \tag{10.6}$$

where C is the cost of production, P is the price of each commodity, X represents the quantities of factor inputs required at that price level and b is capital cost, which is assumed to be fixed. Faced with a change in the price of raw material (P_1) and a fixed capital stock, the key issue for the industrialist will be whether it is cheaper to use less of one input (X_1) and more of some other input (X_2). The answer to this question is provided by the rate of technical substitution (RTS) which represents the extent to which commodity inputs can be substituted for each other with the available industry technology. It can be defined as

$$RTS = \frac{\mathrm{d}X_2}{\mathrm{d}X_1} \tag{10.7}$$

We have already mentioned the example of power stations which can use oil, coal or gas. In 1973 when the oil price increased sharply, most power stations used oil and were not equipped to burn other fuels, so the substitution effect (RTS) was small. By 1979, when the price of oil rose to over $30 per barrel, most power stations had invested to allow other fuels such as coal or gas to be burned. As a result the substitution effect was very large and oil consumption fell sharply. But that substitution is a one-off change which could not be repeated when the oil price started to rise again twenty years later. Thus RTS shows how the manufacturers respond to a change in the relative price of their raw materials. The relationship expressed in equation (10.7) is subject to the influence of technical development and change, which may significantly influence the amount of primary energy required to achieve a given effect – for example as a result of an improvement in the fuel conversion rate in marine diesel engines.

Picking up the example of forecasting Japanese iron ore imports, there is the impact of stock building during periods of economic change to consider. For example, as the Japanese economy matured in the 1980s, the growth rate of steel demand slowed. This caught out forecasters who, in the early 1970s, had assumed that steel demand in Europe and Japan would continue to grow at the same rate in the 1970s as it had in the 1960s. To meet this demand steel-makers planned to expand output from 110 mt to 180 mt.

But as the economy matured steel demand stopped growing and Japanese steel production never exceeded 120 mt. The same issue arose with the Chinese steel industry when it started to grow very rapidly in 2003–8. Analysts had to estimate how long the very rapid growth of steel production would continue. The problem was that the underlying demand was growing rapidly because the economy was building infrastructure, housing and durable goods stocks such as motor cars, and once the stocks were built up demand growth would slow. In both cases a carefully structured forecasting model would show how much of the demand growth was driven by stock building of steel-intensive products such as buildings and motor vehicles and how that trend might change as the economy matured. What it cannot usually do is predict how rationally people will approach the process of building the economy – whether it will be a sequence of boom and bust cycles or a carefully planned evolution. That is a matter of judgement.

Another potential trap for unwary forecasters is factor substitution. In addition to iron ore, there are other materials such as steel scrap which will do the same job. If the supply of steel scrap increases, this can be used instead of ore, making the iron ore demand forecast more complex. Or consider the thermal coal trade. There may be no local coal, but many power stations can use oil or gas in place of coal. Another complexity is the competition between domestic and foreign supplies. During the 2003–8 Chinese steel boom, international iron ore prices rose sharply and in 2005 there was a large increase in Chinese domestic iron ore production, which had previously been static, but which suddenly became very profitable. Sometimes technology changes alter the domestic or foreign production functions, with major consequences for trade. For example, the rise of 'mini-mills' using cheap scrap in Asia provides direct competition for blast furnace steel, changing the pattern of the iron ore trade. Similarly, new technology which reduced the cost of offshore production enabled Europe to increase its domestic oil production in the 1990s. Whilst these relationships are not easy to quantify, they illustrate the importance of gaining a thorough understanding of the demand relationships underlying the demand function for a commodity.

10.6 COMMODITY TRADE CYCLES

Another aspect we need to get to grips with in analysing trade is the trade cycle. When we discussed shipping cycles in Chapters 3 and 4, we saw that part of the cyclical effect filters through from the demand side of the shipping model. Trade is subject to cycles at three levels: seasonal cycles which occur regularly at particular times of the year; short-term cycles which accompany the international business cycle; and long-term waves arising from structural developments in the international economies.

Seasonal and short-term cyclical trade

Seasonal cycles are well known in shipping and may arise from seasonal effects on the supply or demand side of the commodity market. An example of a supply-driven seasonal cycle is the summer lull in the bulk carrier market caused by the slow down of grain exports from the USA in July and August. This is when the US grain harvest takes place and by this time shipments from the previous season have usually run down but the new season shipments have not yet started. An example of seasonality in commodity demand is the cycle in world oil demand which results in lower trade in the second quarter of the year and higher trade as stocks are built up for the Northern Hemisphere winter in the fourth quarter. This is shown in Figure 10.6, which plots quarterly oil demand. These seasonal fluctuations are generally more noticeable when the oil market is just in balance and less apparent when it is very tight or in surplus.

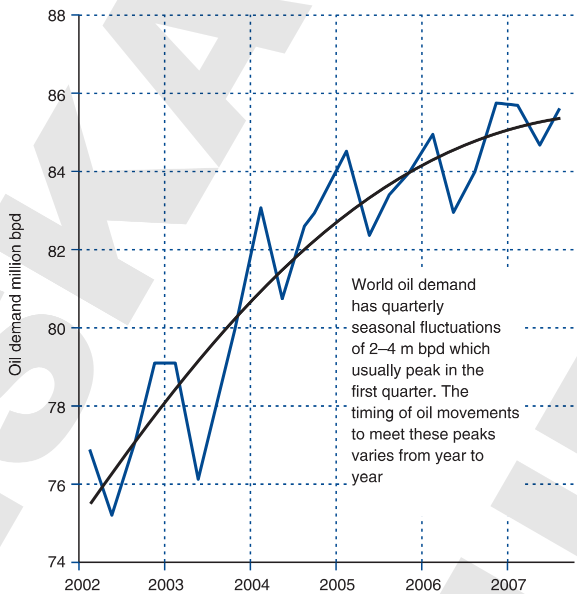

Figure 10.6
Quarterly cycles in world oil demand
Source: IEA Monthly Oil Market Report

Short-term volatility in commodity trades can also result from temporary local shortages of a product or commodity which could normally be obtained locally at a competitive price, but which temporarily is not available in sufficient quantities. Temporary shortages may arise from business cycles in demand, mechanical failure, disasters (e.g. the Kobe earthquake in 1994), poor planning or a sudden burst of commodity inflation which encourages manufacturers to build stocks of raw materials. In these circumstances the pattern of trade suddenly changes. For example, chemical manufacturers produce many different compounds and much of the seaborne chemicals trade is to supply temporary shortages for a particular compound or feedstock.

Long-term influences on trade

There are also long-term cycles in trade. Our analysis of the 'causes' of sea trade at the start of this chapter identified economic activity (GDP) as by far the most important and that on average trade increases with GDP at an average rate of 104,300 tons for each extra $1 billion of GDP. One of the important lessons to be learned is that the relationship between trade and GDP is not static. As countries grow, their economies change and so does their trade. One of the most fundamental principles of trade forecasting is to recognize these changes and build it into the forecast. To do this we must understand the relationship between trade and GNP.

The key is to recognize the patterns in the way different parts of the economy develop over time. If we look more closely at the structure of world economic activity we can

BOX 10.1 ISIC SECTORS

ISIC	*Sector*	*% Total GNP*	*Maritime intensity*
1	Agriculture	8	High
2–3	Mining and utilities	4	High
4	Manufacturing	28	High
5	Construction	6	High
6	Wholesale and retail	16	None
7	Transport and comm	7	None
8–9	Other (services)	31	Very low
	TOTAL	100	

immediately see why trade is likely to change as a country grows. Gross national product, a measure of the total economic output of a country, can be divided into the nine sectors shown in Box 10.1, which follow the International Standard Industrial Classification (ISIC). Each sector has a different propensity for maritime transport. Agriculture, mining and manufacturing are directly involved with trade because they produce and consume physical products which can be imported or exported. In contrast, businesses in the wholesale, retail, transport and service sectors produce services rather than physical goods. For example, the service sector consists of activities such as banking and insurance, public administration, social services, education, medicine, recreation facilities, and household services (repair, laundry) which have little if any impact on maritime transport. Of course, it is not quite that simple because a thriving service sector generates income which may be spent on physical goods, but often as income rises demand switches to services such as health care, education and eating out.

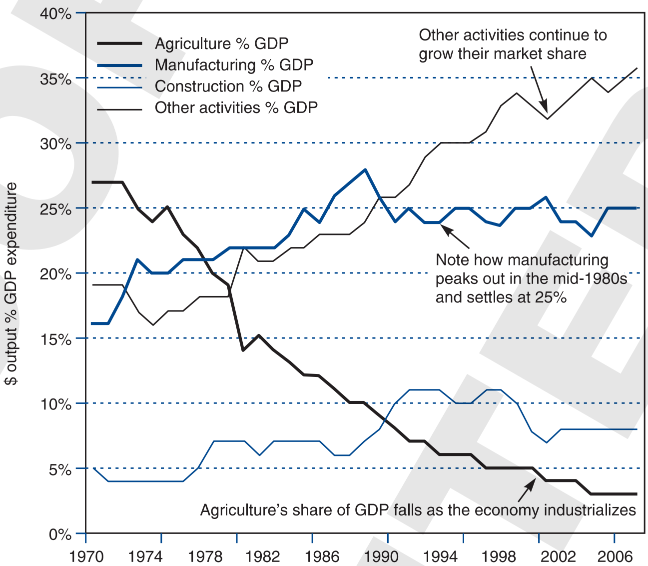

Figure 10.7
Structural GDP changes, South Korea, 1970–2006
Source: United Nations statistical database

When we examine the growth of modern economies we find that economic activity shifts away from the trade-intensive activities towards the service sector. It follows that we must expect the pattern of trade growth to change as the country grows and develops. To illustrate the nature of this change, Figure 10.7 shows how the GDP of South Korea changed between 1970 and 2006 when the country was going through its development cycle. In 1970 the South Korean economy was in the early stages of industrialization and the economy was dominated by agriculture, which accounted for 28% of GDP, while manufacturing was only 16% of GDP. But in the following decades agriculture declined to 3%, whilst manufacturing, construction and other service activities increased their share of GDP, changing South Korea from a rural society to a modern industrial economy. As a result, seaborne imports grew very rapidly at 11% per annum. But in the mid-1980s manufacturing's share stabilized at 25% and construction did much the same. But the other activities, which include many services such as education and healthcare, continued to grow, reaching 37% in 2006. Much the same development pattern was followed by Japan during its development cycle in the 1960s. Agriculture, mining, utilities, construction and manufacturing all peaked out, but services increased their share of GDP. In the USA, a very mature economy, services now have a dominant position, accounting for 56% of GDP in 2006, whilst agriculture, still a major US business, fell to 0.9% and manufacturing was only 13%. The development pattern is clear from these examples – agricultures give way to manufacturing and construction, which in turn give way to services.

However, this is not the whole story. As manufacturing industry loses market share, there is also a change in the type of goods manufactured. An analysis carried out by Maizels to establish a typical pattern of expansion of manufacturing industry, shown in Table 10.4, illustrates the point. At low income levels food manufacturing and textile industries are the most important when, in accordance with Engel's law, these products make up a large part of demand. Their share then declines rapidly, to be taken over by metals, metal products and chemical. At a certain income level the share of metals stabilizes, while the share of metal products continues to grow as more value is added to the basic materials. This implies that output becomes less resource-intensive at high income levels, being directed towards value-added products. For example, motor car production progresses from economy models to executive limousines. Again we see evidence that we must expect the structure of economic activity to change with growth, bringing consequences for trade.

Table 10.4 Pattern of manufacturing production per head, 1955 prices and percentages

	$100	$250	$500	$750	$1,000
Food and beverages	40	33	26	21	18
Metals	4	5	7	7	8
Metal products	4	10	18	24	29
Chemicals	0	2	4	7	9
Textiles	26	18	13	10	8
Other manufactures	27	32	32	31	29
Total	100	100	100	100	100

Source: Maizels (1971).

The stages of economic development

Academics have spent much time discussing these changes to see if there is a consistent pattern of development. The 'stages of growth' theory developed by Rostow provides a useful starting point.[10] He argued that as economies grow they go through a series of different phases which he put into five categories according to the stage of economic development they had reached. The five stages are shown in Box 10.2.

There has been a good deal of discussion of Rostow's work. Like so many economic theories, Rostow's theory is based in a simple common-sense idea. As economies grow they start by producing necessities such as infrastructure which are resource-intensive, then progressively turn to the finer things of life (value-added products) as they become wealthier.

BOX 10.2 ROSTOW'S FIVE STAGES OF ECONOMIC DEVELOPMENT

Stage 1 *The traditional society*. This is a predominantly agricultural economy. Unchanging technology places a ceiling on the level of attainable output per head. This ceiling results from the fact that 'the potentialities which flow from modern science and technology are either not available or not regularly and systematically applied'. These societies devote a very high proportion of their resources to agriculture. They hardly trade by sea, except for food aid and the export of a few cash crops.

Stage 2 *The pre-conditions of take-off established*. The second stage requires a surplus above subsistence, the development of education and a degree of capital accumulation to provide the foundation for economic growth. For example, in seventeenth-century England these conditions were established by a change in attitudes to investment, the emergence of banks and other institutions for mobilizing capital, etc. Sea trade is small but very active and growing fast.

Stage 3 *The take-off*. In Rostow's analysis this stage is followed by a long interval of sustained but fluctuating progress as technology is extended over the whole front of economic activities. Increased investment permits output regularly to outstrip the increase in national population. New industries appear, older ones level off and decline. Changes take place in the external trade of the country, goods formerly imported are produced at home, new import requirements develop and new commodities are made for export.

Stage 4 *Maturity*. After a period, which Rostow placed at 60 years after the beginning of take-off, maturity sets in. By this stage the economy has extended its range into more refined and complex processes, with a shift in focus from coal, steel and heavy engineering industries to machine tools, chemicals and electrical equipment. He thought Germany, Britain, France and the United States passed through this phase by the end of the nineteenth century or shortly afterwards. Depletion of raw materials may boost the import trade, while manufacture will dominate exports.

Stage 5 *Mass consumption*. The fifth stage sees a movement of the leading sectors of industry towards durable consumer goods and services. A large proportion of the population can afford to consume much more than basic food, shelter and clothing, and this brings about changes in the structure of the working population, including a progressive movement into office and service work.

Maizels, who made a very long-term study of this hypothesis, explained it in the following terms:

> as a country becomes progressively more industrialised the proportion of the occupied population engaged in manufacturing does not rise indefinitely – there is an effective limit which may have been reached in a number of countries. This limit comes into operation for two reasons. Firstly as the economy grows and income rises the demand for workers in service operations such as doctors, typists, government officials increases as fast [as] or faster than the demand for manufactured goods. Secondly as productivity increases in manufacturing tend to outstrip the productivity increase in the distribution of goods from factory to the consumer, these workers tend to be absorbed in distribution to match the increased flow of industrial products.[11]

This reasoning suggests that the progress of economic growth will be associated with an increasing share for services and a corresponding decline in the growth rate of manufacturing industry and seaborne trade. Each development cycle is different, so it is not possible to set precise limits on the duration of a stage, or even to be sure when a new stage is about to begin, and the concept of a progression is helpful.

The trade development cycle

If we apply the `stages of growth' concept to seaborne trade it is clear that, over a period of years, we must expect the trade of a country to change. How it changes depends on what stage the economy has reached in the economic growth cycle. The early stages of growth involve the import of all but the simplest items such as food and textiles, paid for by the export of whatever 'cash crops' are available – sugar, tropical fruit, oil, copper, jute and hardwood logs are typical examples. The availability of foreign exchange is the main constraint on trade and generally keeps trade at a low level. Countries such as Guinea, Togo and Cameroon in West Africa currently fall into this category.

As the economy develops through stages 2 and 3, the demand for raw materials such as iron ore, coal, non-ferrous metal ores and forest products increases as the industrial infrastructure is built up. If raw materials are not available locally they must be imported, as must the more sophisticated machinery, and paid for by exports of semi-manufactures and any primary exports which are available. The reconciliation of domestic and foreign markets thus forms a basic requirement of growth at this stage. Industries such as shipbuilding and automobiles are frequently developed as lead export earners, a pattern set by Japan in the 1950s and subsequently followed by South Korea, Poland and China.

When the economy matures, the character of seaborne trade changes again. In the course of time, whether 20 years or 50, the building-blocks of a capitalist economy are in place. Industrial infrastructure, housing, roads, railways and stocks of consumer durables such as motor vehicles and washing machines have reached a mature level.

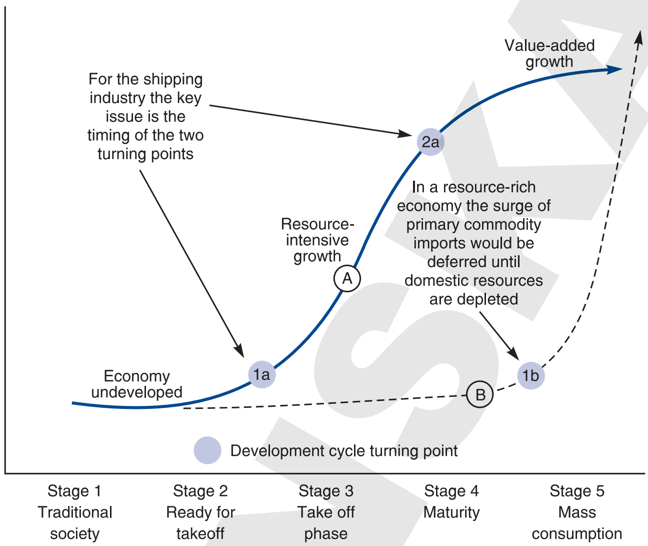

Figure 10.8
Seaborne trade development cycle
Source: Martin Stopford

Industries such as steel, construction and vehicle manufacture, which underpinned the growth during stage 2, stop growing and economic activity gravitates towards less material-intensive activities. Manufacturing gravitates towards the higher value-added end of the product range. How this affects trade depends on domestic resources. If the economy has always relied on imported raw materials, the growth rate of bulk imports slows, though the trade in manufacture shipped by liner and air freight will continue to grow. Typically this produces a trade development cycle of the type shown by curve A in Figure 10.8. However, the sea trade of countries which start out with extensive natural resources is likely to follow a different path. As industrialization consumes resources and domestic supplies become depleted, or better-quality materials become available abroad, bulk imports may start to increase. This happened in the USA when oil demand drew ahead of domestic production and imports started to grow rapidly after 1970. In such cases the trade development cycle may follow a path more like curve B in Figure 10.8.

Ultimately the seaborne trade development cycle is just a convenient way of summarizing certain common patterns which appear to occur in the world economy – it is not a law, nor does it apply in every case. Since economic development draws heavily on natural resources which are unevenly distributed between countries, we must expect each country to have a unique trade development cycle, determined by its factor endowments or other unique political and cultural characteristics. Thus the trade development cycle of a resource-rich economy which can draw on local raw materials in the early stages of growth, possibly with an exportable surplus, will be completely different from that of a country without raw materials. The shape of these 'trade development curves' can be seen in Figure 4.3 which shows the imports of western Europe, Japan, South East Asia and China between 1950 and 2005. The pattern is surprisingly similar considering the diversity of the countries and regions. Europe took a long pause in its development path between the mid-1970s and the mid-1980s and Japan's import path changed more dramatically than Europe's has done yet, probably because Europe is a much bigger economic unit with more domestic resources. Clearly there is much to consider in explaining the precise shape of these curves, but what we can be sure of is that economies are constantly changing and these changes have a major impact on the international transport industry.

10.7 THE ROLE OF SEA TRANSPORT IN TRADE

Long-term price elasticity of sea transport demand

Finally, we should be aware of the part played by sea transport in facilitating trade. In the short term demand for sea transport is generally price inelastic, since once the cargo reaches the quayside shippers generally have few options other than shipping it. But in the longer term, trade volumes are price elastic and the price of freight plays a vital part in determining the growth and pattern of trade. The world trade model we discussed in Sections 10.4 and 10.5 suggests that the location of manufacturing processes will respond to the relative costs of factors of production between regions, and for many commodities the cost and availability of sea transport plays a part in that process. So the sea transport model should take account of this long-term relationship between transport costs and the volume of trade.

Because freight is part of the delivered cost of goods, a change in relative transport costs can affect the volume of cargo shipped. For example, in today's highly competitive world a television set assembled in Malaysia and exported to London could be competing in London shops with a similar set assembled in Wales. In one case the television set makes a 10,000 mile sea voyage, whilst the other only travels 200 miles from Wales to London. So we have two sets of relative costs to consider: the relative cost of manufacturing in Malaysia and Wales, and the relative cost of transport. If the c.i.f. price of the Malaysian product is lower than that of the Welsh product, the retailer will buy the Malaysian product in place of the Welsh one and sea trade will grow.

Viewed in this way, the liner trade is likely to be price elastic because lowering prices encourages the substitution of cheap foreign substitutes for local products. As manufacturers adjust their sourcing strategy to changes in relative c.i.f. costs and the transport element in this calculation falls, overseas suppliers will increase their market share, boosting trade. This resulted in the trade system we discussed at the beginning of the chapter (see Figure 10.1) with shipping providing the vital economic link between raw materials exporters, primary processing plants, assembly plants, wholesalers and retailers. As sea transport costs fell in real terms over the last fifty years, it opened up new opportunities for low-cost manufacturing, often involving multiple sea voyages. For example, in the present case, many high-tech components are shipped to China where they are processed and exported as finished goods. An extreme example is rough castings from Detroit, which are shipped to China for machining and then back to Detroit for finishing. This is just a simple arbitraging based on the reliability and cost of the transport network. So the liner operator who drives freight costs down by ordering bigger ships helps to generate new cargoes.[12]

Unit costs and transport logistics

By far the most important way of reducing the price of sea transport is economies of scale, but when viewed in the context of the whole seaborne logistics operation, the relationship between ship size and unit cost is not simple. We touched on economies of scale in earlier chapters (Sections 2.6, 2.8, 6.2), but now it is time to analyse its impact on the operating economics of the bulk, specialized and liner trades we discuss in the next three chapters, using a modified version of the unit cost model discussed in Chapter 6.

The cost per tonne of cargo transported depends upon the annual cost of the ship itself plus the bunkers consumed in the year, divided by the tonnes of cargo transported:

$$\text{Cost per tonne} = \frac{\text{Ship cost p.a.} + \text{Bunker cost p.a.}}{\text{Tonnes transported p.a.}} \tag{10.8}$$

As we saw in Chapter 6, the cargo transported depends on the number of trips made in a year, multiplied by its cargo capacity, which in this case is measured in deadweight:

$$\text{Tonnes transported p.a.} = \frac{\text{Days on hire}}{\text{Days per trip}} \times \text{Ship size (dwt)} \tag{10.9}$$

Finally, the days per trip depends on the distance, the speed and the port days:

$$\text{Days per trip} = \frac{\text{Distance per trip}}{\text{Speed} \times 24} \times \text{Port days per trip} \tag{10.10}$$

The analysis in Table 10.5 illustrates the relationship between ship size, unit transport costs, and transport volumes which is an equally important part of the logistics problem facing the sea transport business. The analysis uses vessels ranging from 30,000 to 170,000 dwt and the general assumptions are shown in column 1 of Table 10.5(a). All ship sizes spend 6 days per trip in port, 350 days on hire per annum, and operate at 14 knots using bunkers costing $200 per tonne. Backhaul voyages are in ballast. The ship costs are shown in columns 2–5 of Table 10.5(a). Time-charter rates are taken from Table 6.1 and represent the break-even cost in 2005. Bunker costs shown in columns 5 and 6 are based on typical consumption rates for each size of ship. Finally, in column 7 we calculate the annual cost per deadweight for each ship size, which falls from $185 per deadweight per annum for a 30,000 dwt vessel to $66 per deadweight per annum for a 170,000 dwt bulk carrier. So transporting cargo in the Capesize bulk carrier saves about 65% compared with a 30,000 dwt bulk carrier because the unit costs of both the ship and bunkers are lower for the big ship.

Table 10.5(b) examines the impact of distance on transport costs and transport volumes. Voyages range from 4,000 miles per round trip to 11,000 miles. Part A shows that the number of trips per annum reduces from 30 for a 4,000 mile trip to 11 for an 11,000 mile trip. This covers the range of voyages normally undertaken by deep-sea bulk carriers.

Table 10.5 Economies of scale model for different bulk carrier sizes and distances

(a) Basic assumptions	**1**	**2**	**3**	**4**	**5**	**6**	**7**
		Ship costs					
	General assumptions	*Ship size dwt*	*Timecharter hire (1) $/day (1)*	*Timecharter hire (1) $ mill pa*	*Bunker costs (2) Tons/day*	*Bunker costs (2) $ mill pa*	*Total $/dwt/pa*
Port days per trip	6						
Days on hire pa	350	170,000	24,374	8.53	39	2.73	66
Speed (knots)	14	72,000	16,360	5.73	30.5	2.135	109
Bunker price $/ton (1)	200	46,000	13,657	4.78	24.3	1.701	141
Backhaul %	0	30,000	11,494	4.02	22	1.54	185

(b) Transport performance calculation

Round trip distance

Ship size (dwt)	4,000	5,000	6,000	7,000	8,000	9,000	10,000	11,000
A Trips per year (number)								
All sizes	30	24	20	17	15	13	12	11
B Days at Sea per year (no Backhaul)								
All sizes	170	206	230	247	260	270	278	285
C Tons of cargo transported per year (million tonnes)								
170,000	5.09	4.07	3.39	2.91	2.54	2.26	2.03	1.85
72,000	2.15	1.72	1.44	1.23	1.08	0.96	0.86	0.78
46,000	1.38	1.10	0.92	0.79	0.69	0.61	0.55	0.50
30,000	0.90	0.72	0.60	0.51	0.45	0.40	0.36	0.33
D Total cost per tonne of cargo transported ($ per tonne)								
170,000	2.21	2.77	3.32	3.87	4.43	4.98	5.53	6.09
72,000	3.65	4.56	5.47	6.38	7.30	8.21	9.12	10.03
46,000	4.71	5.89	7.06	8.24	9.42	10.59	11.77	12.95
30,000	6.20	7.75	9.29	10.84	12.39	13.94	15.49	17.04
E Cost per tonne ratios								
170,000	35.7%	35.7%	35.7%	35.7%	35.7%	35.7%	35.7%	35.7%
72,000	58.9%	58.9%	58.9%	58.9%	58.9%	58.9%	58.9%	58.9%
46,000	76.0%	76.0%	76.0%	76.0%	76.0%	76.0%	76.0%	76.0%
30,000	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Notes

1. Time-charter rates from the final column of Table 6.1 based on 2005 capital costs and OPEX
2. From 1990 to 2006 380cSt bunker oil in Rotterdam varied from $90/tonne to $340/tonne

Part (b) focuses on the time spent at sea, and this obviously depends on the time in port. On a 4,000 mile voyage the ship only spends 170 days at sea, compared with 285 days on an 11,000 mile voyage, so cargo handling is very significant on the shorter routes. This is one reason why ships used on long-distance trades generally do not have their own gear, whereas vessels likely to be used in short trades are generally geared. It also explains why vessels for short-haul routes are often designed with smaller engines and slower speeds and are less sensitive to fuel costs, and more sensitive to port turnaround times.

In Part C we look at the tonnes of cargo carried in a year, and the result is dramatic. The Capesize bulk carrier operating on a 4,000 mile trip transports 5 million tonnes of cargo, whilst the 30,000 deadweight vessel operating on a 11,000 mile trip transports only 300,000 tonnes. This reveals an important logistics characteristic of the economies of scale model. Big ships are cheaper in any trade, but the volumes of cargo they transport may be too large to provide a regular delivery service. In this example to permit a monthly delivery of cargo, the trade would need to be 60 million tonnes a year. This is an important constraint on ship size in both the liner and bulk markets. By the time you get down to the small and medium-size trades there just is not the cargo volume to support a bigger vessel. However, it does mean that small ship trades are always 'upsizing'.

Finally, the total cost per tonne of cargoes transported is shown in Part D. The cheapest transport is provided by the Capesize bulk carrier on the 4,000 mile round trip. It costs just $2.21 per tonne. At the other extreme, on the 11,000 mile round trip, the 30,000 dwt bulk carrier costs $17.04 per tonne. So economies of scale obviously do matter. A general point confirmed by the analysis is that economies of scale diminish as the size of ship increases. For example on the 11,000 mile voyage, by moving up from a 30,000 dwt bulk carrier to a 46,000 dwt bulk carrier the saving is $4.09/dwt, but increasing the ship's size by another 16,000 dwt to 72,000 deadweight only saves $2.90/dwt. Finally, the jump in size from Panamax to Capesize, an increase of 100,000 dwt, only saves another $3.94/dwt, roughly the same as increasing from Handy to Handymax. So the pressure to increase parcel size is at its most intense in the smaller sizes. There are many more of these vessels, which explains why size increases in the various bulk fleets occur in all size categories of vessels, not just the biggest.

From this analysis we can derive four conclusions on the role of economies of scale in sea transport:

1. Big ships are always cheaper than small ships creating a financial incentive to use a bigger ship in a particular trade, other things being equal.
2. In absolute terms, the economies of scale on short-haul routes are much smaller than on long-haul routes, so there is less financial incentive to invest in the necessary infrastructure to handle bigger ships.
3. Short-haul trades spend less of their time at sea, therefore design should be focused on cargo handling.
4. Delivery volumes increase rapidly as the voyage length reduces, so the ship size also depends on there being sufficient cargo to fully occupy bigger ships.

One way or another, these conclusions help to explain why the fleets of bulk ships which we will examine in the next two chapters include vessels of many different sizes. In every market we find size segments ranging from very small ships to very large ships, with new investment in every category. We also find that in most trades there is a steady upward drift as bigger ships slowly become substituted for smaller ships.

10.8 SUMMARY

In this chapter we have looked at sea trade from the viewpoint of the countries which trade. There are 100 countries and regions that trade by sea, but some are much bigger than others. In 2004 north-west Europe headed the list with 1.9 billion tonnes of imports and exports, while Brunei, the smallest, reported trade for only 2 million tonnes. When we looked for an explanation for the volume of trade it was clear that the level of economic activity, measured by GNP, was by far the most important. Two other explanatory variables, the size (area) of the country, and its natural resources, make a small contribution, explaining about a quarter of the variation in trade volume. This does not mean they are unimportant, but rather that their impact on trade cannot be reduced to a simple general rule. Population size, it seems, has no explanatory value whatsoever. In conclusion, we must expect sea trade to go hand in hand with economic growth, but modified by the availability of natural resources.

We then turned to trade theory for an explanation of why countries trade. The theory of absolute advantage shows that countries enjoy a higher living standard if they trade because it allows them to focus their scarce resources in the products they are most efficient at producing. Trade increases efficiency and everyone is better off. Taking this explanation a step further, the theory of comparative advantage shows that countries are better off with trade even if their competitors are more efficient at producing everything. All that is needed for trade to be beneficial is that they are relatively better at producing some goods than their competitors. Countries that fear that they will be reduced to poverty by foreign competition are wrong, though in a changing world, adjusting to new competitors can be painful and expensive for some parts of the economy.

What, then, determines the comparative advantage of a particular country? There are several different explanations. The Heckscher-Ohlin theorem argues that if goods require different factor inputs and there are diminishing returns when factors are substituted for each other, the comparative advantage is determined by the distribution of factors of production. Thus countries specialize in the goods which make the best use of their most abundant resources. Differences in technology, tastes, transport costs and cyclical surpluses and shortages are other reasons why countries trade.

We discussed the commodity supply and demand model which is often used for the analysis and forecasting of trade. The basic tool is supply–demand analysis, but we also examined the role of prices and substitution in this model, in particular the demand function which recognizes the impact of price changes on consumer demand and income (the Slutsky equation) and on the factor substitution by manufacturers.

We should expect the trade of a country to change over time. Starting from the proposition that GNP drives trade, we looked at the composition of GNP which we divided into nine categories. Some of these activities, especially manufacturing, make extensive use of sea transport, while others, such as services, do not. In practice, we find that as a country grows the structure of its economy changes. The early stages of growth tend to use large quantities of physical materials – infrastructure developments such as roads, railways, ports, and building a stock of cars, ships and industrial plant.

Consequently, there is a rapid expansion of import trade, matched by a corresponding export trade in primary produce or simple manufactures to pay for the imports. Whilst the early stages favour the bulk shipping business, when the economy reaches maturity, the liner business gains from the almost unlimited potential for shipping components and finished goods between developed markets.

The trade development cycle summarizes this dynamic relationship between the sea trade and economic growth. Each country has its own unique cycle which depends on its factors of production as well as cultural and commercial considerations. At the earliest stages of development, imports of manufactures are paid for by cash crop exports. As industry expands, raw materials generate demand for sea transport. The imports of countries with few natural resources slow down, but in countries which were initially resource-rich the depletion of domestic supplies may lead to growing imports of some commodities. Imports and exports of manufactures continue to grow as domestic import and export markets widen. Thus the trade development cycle has different implications for the bulk and liner businesses.

Finally, we explored some of the economics of shipping logistics that will enter into the discussion of the bulk, specialized and liner trades in the following chapters.