Chapter 12

The economics of freight transport

Learning Outcomes:

On reading this chapter, you will learn:

- The overall trends of freight carriage in Great Britain
- Reasons why nations trade and the major institutional developments that have occurred since 1950 that have led to a significant increase in international freight transport
- Some of the major economic issues surrounding road haulage, rail freight, air cargo and maritime transport.

INTRODUCTION

The economics of freight is an often overlooked and considerably under-researched area. One of the main reasons for this is that freight transport conforms far more to the principles of the free market than passenger transport. In simple terms, if a profit cannot be made from the sale of the goods in a different location because for example of high transport costs, the freight won't go anywhere, and in fact will not even be produced in the first place. Even this book is a case in point of far less attention being paid to freight than passenger transport. The importance of freight transport however should not be understated. In purely financial terms, the carriage of freight and distribution services was estimated to be something in the order of £74.45bn in 2006 to the British economy (Keynote, 2007), which compares for example to some £3.7bn in passenger receipts from the bus industry or £6.6bn from passenger rail.

This chapter will examine the overall issues surrounding freight transport, beginning with an overview of the trends in freight carriage. Considerable space however is given to the major external factors that have impacted upon the freight transport industry since the 1950s. Freight, even more so than passenger transport, does not operate in a vacuum and external factors can and have had a major impact upon freight transport levels. This is particularly true of the international dimension, thus the chapter will introduce a very simple theoretical explanation of why nations trade before going on to consider institutional and economic developments that have led to considerable increases in trade, and thus international freight transport, since the 1950s. The second part of the chapter examines some of the economics involved in the individual modes of

freight transport. The form and content of this chapter is very different to those that have gone before, as it deals far more with practical developments rather than theoretical issues; in many respects this chapter is about using the tools of economic analysis to examine freight transport modes in order to come to a better understanding of some of the issues facing these modes of transport.

AN OVERVIEW OF FREIGHT TRANSPORT

The 18th and 19th centuries saw firstly the rise of the canal network in Britain and then the railways. Railways historically carried most of the freight in Britain, certainly all freight that needed to be transported over a relatively long distance. As has been highlighted in Chapter 2, railways were the driver of the Industrial Revolution in Britain, which saw a shift from an agricultural-based to a manufacturing-based economy. All of these lines were built using private finance, and a large number constructed based upon the freight-carrying potential (although one that often was never realised).

These are the origins of today's freight transport industries, and Figure 12.1 outlines the trends, by mode, of freight transport in the UK since 1953.

With regard to the overall figures for total freight tonne kilometres hauled, this has been seen before in Figure 2.1 in Chapter 2. Across the whole period shown, the overall level of freight transport has risen by a factor of almost three, with most of this increase coming from increases in road haulage. At the beginning of the period, road haulage had a 36 per cent market share, and this had almost doubled to 64 per cent by 2006. More revealingly, road haulage accounted for around 80

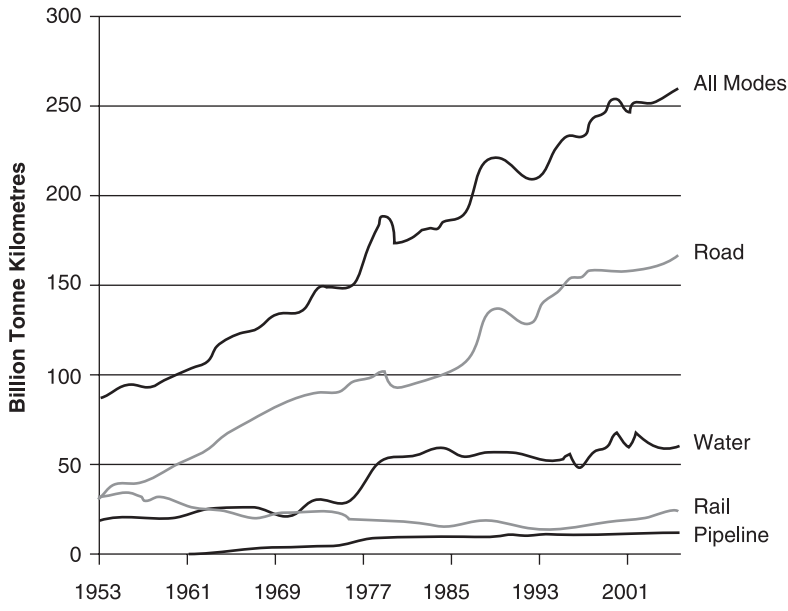

Figure 12.1 *Trends in the carriage of freight, 1953 to 2006*

Source: Compiled from DfT (2007)

per cent of the total increase in all freight moved over the period, and even this figure understates the dominance of this mode. This is because if the impact of North Sea Oil (see below) is taken out of these figures, the total would be nearer 100 per cent. Rail freight over the period has been in long-term decline, with tonne kilometres falling from 1953 onwards, making a minor recovery in the late 1980s as a result of the aforementioned Lawson boom, and then increases again in the period immediately after privatisation. After that initial increase, however, freight levels on the railways have remained fairly constant with about 8 per cent of total freight hauled in the last year shown. Transport by pipeline rose in the 1970s, almost exclusively due to North Sea Oil, but accounts for only 4 per cent of the market. Waterways is the only mode that has held its market share constant over the whole period, at around 22 per cent. Most of this however is again due to North Sea Oil, as around 80 per cent of freight moved by water is petroleum-related products. This increase occurred in the late 1970s to early 1980s when the North Sea oil fields came fully on stream, from which point it has hovered around 60bn tonne kilometres per year. As will be seen later in the chapter, water-borne freight transport has an even stronger market share at the European Union level.

The internationalisation of freight transport

Ever since the beginning of the 1950s there has been a constant and steady growth of international freight transport. This in some ways reflects the times and one that has seen the ongoing globalisation of the world economy. This growth is due to significant political and institutional developments, mainly in the form of the lessening of international trade restrictions. Before we examine these, however, it is worthwhile to consider why nations actually trade, as this has a significant impact on the level of international freight transport.

Why do nations trade?

A simple explanation as to why nations trade is that one country is better than the other at producing a certain good or commodity, hence where there is a 'double coincidence of wants' then it makes sense to make some form of exchange. This could be in commodities where it is very difficult for one or the other to produce; hence for example Britain may trade Scotch whisky, which it is relatively good at producing due to certain natural advantages, for bananas with Jamaica, which are very difficult if not impossible to grow in Britain. Trade therefore allows nations to specialise production in areas where they have an advantage and this should benefit both parties to the trade. An early piece of economic theory however from David Ricardo expanded this simple idea to consider the case where a country had only a comparative advantage. This differs in that one nation may have an advantage in the production of all goods. Table 12.1 attempts to illustrate this idea, where the basic assumption is that only two products are produced, food and manufactures, and the trade occurs between Britain and America.

What Table 12.1 shows is that in Britain it takes five units of labour to produce a single unit of food, and 2 units of labour to produce a single unit of manufactures. In America, however, it takes 6 units and 12 units respectively, thus it would appear that there is nothing to be gained from Britain trading with America as Britain would be said to have an absolute advantage in producing both commodities. Closer inspection of the table however reveals that there are comparative differences between the two nations. This is based on the principle of the opportunity cost of switching production from one commodity to the other. If Britain was to switch its labour from the

Table 12.1 *Ricardo's Law of comparative advantage*

Labour per unit of output in	*Britain*	*America*
Food	5	6
Manufactures	2	12
Total	7	18
	Total: 25	

Table 12.2 *Ricardo's Law of comparative advantage*

Labour per unit of output in	*Britain*	*America*
Food	–	12
Manufactures	4	–
Total	4	12
	Total: 16	

production of food to manufactures, then for each unit of food not produced 2.5 extra units of manufactures would be produced. In America, however, if the same switch were to occur, then each unit of food not produced would only increase the production of manufactures by 0.5. America therefore has a comparative advantage in food. This is because food is less 'valuable' in terms of labour productivity in America than it is in Britain, as it is only 'worth' half a unit of manufactures as opposed to 2.5 units in Britain.

There is therefore an advantage to be gained for both nations if each was to specialise in the commodity that has the lower opportunity cost in terms of the other. Put another way, each nation should specialise in the commodity in which it has to give up the least in terms of production of the other. The results of such specialisation are shown in Table 12.2.

In this simplified example, all production in Britain has been switched to manufactures whilst in America concentration is on food production. However, in both cases each country now requires double the labour input, as it is assumed that only one of the produced units is for domestic consumption whilst the second is exported. Before this specialisation, 25 labour units were required to produce 2 units of food and 2 units of manufactures across both countries; however, after specialisation only 16 labour units are required to produce the same quantities. Note also that not only has the total labour requirement fallen, but both countries will benefit from the trade. In Britain before trade a total of 7 labour units were required and this has now fallen to 4, whilst in America a total of 18 labour units were required and this has now fallen to 12. This should result in a net increase in benefit to both societies, thus it makes sense for both nations to trade even although Britain has an absolute advantage.

Note however that the biggest limitation of Ricardo's theory is that it does not consider the terms of trade, which can have a significant impact upon the trade question. Although both nations benefit, the key is how that benefit is distributed between the two and it is the terms of trade that will by and large resolve the issue. In the previous example, Britain has almost doubled its

production capacity as a result of the trade, where as America has only increased it by half. Whilst this may at first appear to be 'fair' as Britain had an absolute advantage in both commodities, such an argument completely ignores the key issue that both countries need each other and hence why should Britain apparently benefit by far more? Despite such limitations, the theory nevertheless clearly illustrates that trade can be of major economic benefit to the parties concerned and this has been one of the main drivers behind reducing trade restrictions.

The rise of international trade

Figure 12.2 clearly shows the increase in world trade since the Second World War, basically the period 1948 to 2005, all of which has had a direct impact on transport levels as these goods have needed to be transported from one country to another. Interestingly, in all periods percentage increases in trade have exceeded percentage increases in production; however, this in some respects is slightly misleading, as in terms of absolute amounts the total level of production by far exceeds the total level of commodities traded. Consequently, although output has risen by smaller percentage increases, the absolute increase in production will considerably outweigh the absolute increase in trade. Nevertheless, over the whole period shown, goods for export have taken a progressively larger share of total output. The graph is broken down into six time periods, and whilst all have seen strong growth, this was particularly true in all periods up to 1973. This rate of increase however significantly tailed off in the next three periods shown, almost certainly as a result of the oil crises of 1973/4 and 1978/9. This had a dramatic effect on most of the world's developed economies and also to a certain extent led to the pursuit of more protectionist policies. Even given such factors, however, trade still increased in the period 1973 to 1983 by an average of around 5 per cent per year. When compounded over the whole period, this produces an overall increase of 65 per cent. The last period shown shows a return to strong growth, at levels considerably in excess of those of the 1950s and 60s; however, more recent economic events almost guarantee that this will not be sustained over a longer period.

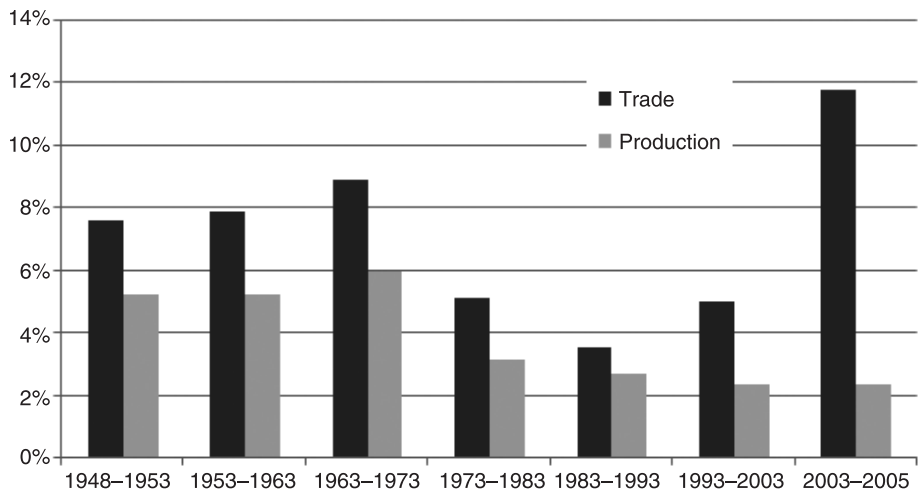

Figure 12.2 *Trends in international trade, 1948 to 2005*

Source: Drawn from World Trade Organisation Statistics

The question arises as to why such strong growth has occurred over this time, which is considered below under the two headings of institutional and other developments.

Institutional developments

With regard to international trade, major institutional and political reforms began even before the Second World War had ended. All institutional developments that have occurred since have their origins in the Bretton Woods Conference held between the Allied powers in 1944. At that time, the outcome of the war was clear; what remained unknown was how long it would take to resolve and the human cost involved. Bretton Woods therefore was convened to discuss the shape of the monetary and financial order in the post-war world, and in particular consider the issue of international trade in an attempt to end economic nationalism. It was recognised that pre-war economic conditions had played a significant part in the origins of the Second World War, particularly the effect of the Great Depression on the appeal of extreme politics. The Bretton Woods Conference laid down the foundations for the development of three organisations which would enhance global trade, of which the main one was the General Agreement on Tariffs and Trade (GATT). This was established in 1948 and originally signed by 23 member states. One of the principal reasons that Bretton Woods specifically considered international trade was the world-wide economic depression of the late 1920s/early 1930s. During that time the declining or negative rate of economic growth led to most nations adopting highly protectionist policies such as increasing import duties, a reduction in import quotas or even complete embargoes, which resulted in trade 'partners' taking retaliatory measures. Instead of improving the economic situation, therefore, such measures only succeeded in making economic matters worse (as trade is never a zero sum game). At Bretton Woods the importance of non-restrictive trade agreements was recognised so that previous mistakes were not repeated.

The main mechanism through which this was to be done was the GATT. The precepts of the GATT are that all trading partners are treated equally and that imports are treated the same as national goods. Negotiations are in the form of 'rounds', the most significant being the Tokyo Round (1973 to 1979) and the Uruguay Round (1986 to 1993), with the latter leading to the creation of a permanent body to supersede the GATT, the World Trade Organisation (WTO). The latest round of trade talks, known as the Doha Round, began in 2001 and includes 141 nations, although at the time of writing these are currently suspended due to various disagreements between the developed and the developing nations. Negotiations were expected to resume in 2009.

The other two bodies created at Bretton Woods were the International Monetary Fund (IMF) and the International Bank for Investment and Re-Development (IBIR, later the World Bank). The IMF was set up to oversee the global financial system after the war, whilst the World Bank now provides assistance to debt-ridden countries that may have no other means of raising the significant levels of capital funds required to help get them out of current economic difficulties.

Other developments

- Increasing sophistication of international financial markets.
  This has been a major driving force behind the trends in international transport created by increased trade. As highlighted above, exchange rates have moved from a system of fixed

exchange rates with a wholly cumbersome and costly process of changing currencies to the situation today where all major currencies are floated on the free market. Whilst that concerns simple spot exchange rates, e.g. how many Euros will I get for £1 today, there is also a system of forward exchange rates where currency can be bought or sold forward at a rate agreed today, thus overcoming any exchange rate risk. There are also far more complicated international payments systems such as credit swap agreements (for investments) and other such measures.

- Development of the concept of the whole supply chain.
  This is the whole idea of logistics, and the entire process of moving goods from the factory to the market is now viewed as a single process. Whole markets and industries have developed around these ideas and the net effect has been to significantly reduce costs and increase efficiency. This not only includes the transport element, but also relates to issues such as warehousing, packaging and the integration of all elements in the supply chain.
- Improvement in political/economic stability.
  Generally speaking major firms are not going to trade or invest in a politically or economically unstable country. Over the period reviewed, however, for a variety of reasons ranging from democratic revolutions to the external overthrowing of political dictators, there are far more politically stable places in the world today than there were fifty or sixty years ago. Many areas however still remain politically unstable.

These are the main drivers behind developments in world trade and thus the rise of international freight transport; however, note that this list is far from exhaustive and there have been many other developments that have led, and continue to lead, to the increasing globalisation of the world economy. It is important to end this section with a reminder that 'globalisation' is not something that happened in the 1990s, but rather is a process that continues to evolve today and consequently is a process that will continue to have a major impact on levels of international freight transport.

MODES OF FREIGHT TRANSPORT

From this and previous chapters, we have seen that the economic environment in which freight transport has been operating is one of a world of continually rising real incomes and increasing levels of globalisation. In this section we take these ideas forward and examine the impact that these and other factors have had upon the main modes of freight transport. As may be expected in a book on the economics of transport, particular emphasis is given to the economic characteristics of each mode where these have not been considered before in earlier chapters. This should also further reinforce some of the economic principles already examined, as well as giving a practical perspective to these concepts. We begin with road haulage, which has already been extensively studied in Case study 6.1 in Chapter 6.

Road haulage

Development of road haulage in the UK

Road transport first emerged as a serious competitor to what had been the premier position of the railways during the 1930s, in the main due to advances in the technology of road vehicles and

the development of the road network. At that time, railways were heavily regulated in terms of the prices they could charge for the carriage of freight. These were published in advance and were fixed, hence there was no 'market pricing'. Perhaps more significantly, railways had a duty to carry, which meant that any freight that was presented for carriage had to be accepted and charged at the published prices, no matter how difficult, inconvenient or unprofitable such loads were for the railway to transport. Road haulage was also heavily regulated under the provisions of the Road and Rail Traffic Act 1933 which empowered area Traffic Commissioners to broadly set fares, the rules of carriage and restrict market entry. It is generally agreed however that such regulations were far less restrictive than for the railways (see for example Glaister *et al.*, 2006). This gave those in the industry a degree of competitive advantage over their rail counterparts.

Large segments of the industry were nationalised along with the railways in 1947 as part of the Attlee post-war Labour government's extensive nationalisation programme. All long-distance road services of over 40 miles came under the control of the British Transport Commission (BTC); however, local hauliers remained largely in the private sector. Under the provisions of the 1947 Act, the BTC had a remit to provide 'an efficient, adequate, economical and properly integrated system of public inland transport and port facilities within Great Britain for passengers and goods' (Lloyd Wilson, 1950). The overall aim of the nationalisation was thus to produce a unified and planned network of road haulage services in Britain. When this failed to materialise, most of the component parts were transferred back to the private sector, interestingly labelled as 'de-nationalisation' measures (i.e. as opposed to privatisation).

The parts that remained in the BTC had their own executive under the title of British Road Services (BRS). With the passing of the Transport Act 1962, however, the BTC was abolished and its constituent parts split into separate organisational bodies, with road haulage passing into the control of the Transport Holding Company (THC), along with the nationalised bus companies, shipping lines and bus manufacturers. The THC was relatively short lived, with the 1968 Transport Act transferring control of road haulage over to a new dedicated body, the National Freight Corporation (NFC). The 1968 Act also abolished all economic regulation from the industry, effectively deregulating the market. The only regulation that remained related to qualitative measures over driver qualifications, driving standards, the condition of the vehicles and (in 1977) operator qualifications and business practices. Following the passing of the 1968 Act, the number of operators in the industry rose sharply as a direct result of the abolishment of market entry controls; however, they levelled off after 1977 following the introduction of the professional competence requirement (Lacey, 1990). This largely continued to be the position of road haulage until the election of the Conservative government two years later under Margaret Thatcher.

The privatisation of the nationalised road haulage sector was one of the early privatisations under the Thatcher government and probably one of the few taken for purely economic ideological reasons. The initial proposal was to privatise the industry through a stock market flotation; however, this was dropped due to the prevailing economic recession at the time. The company was therefore sold to a management–employee buyout. Some 37 per cent of employees initially bought

shares in the company, rising to 80 per cent by 1989, at which point the company obtained a stock market listing. Profits rose throughout the 1980s but the 1990s proved far more difficult, with profits falling and the share price dropping considerably. This was largely due to increasing competition within the industry brought about in part by the increasing globalisation of the whole logistics market, causing prices to fall dramatically.

By 1998 the NFC had changed its name to Exel plc and had developed into a full logistics provider, not only providing road haulage services but also all aspects of supply chain management. Pickfords, the removal company, was sold to Sirva Inc in 2002. Exel itself was then subsequently acquired by DHL and integrated into their existing operations from December 2005 onwards.

Market segments

As has been highlighted before, road haulage tends to be split into two distinctive market segments – truck load and less than truck load. The truck load sector is characterised by a very high number of small firms that operate local haulage services or point-to-point carriage over longer distance. This market sector tends to be dominated by small companies with a high proportion of one person owner-driver operations; the classic 'loneliness of the long distance lorry driver'. This sector we have already identified in Chapter 6 as being near to the conditions of perfect competition. The less than truck load (LTL) sector is far more sophisticated, and these days increasingly operates at an international level and hence necessitates the inclusion of modes other than road. A large part of the LTL sector is the parcels or small packet market, which requires a nationwide network of depots and local collection/delivery services, in which loads for longer distance carriage are assembled at the depot and made up into full consignments. These are then sent to the depots in other parts of the country where they are then broken into local loads and added to other longer-distance loads coming from other parts of the country.

Cost structures

For the road haulage industry, the main fixed costs are licence fees for vehicles, property taxes, management salaries and the cost of terminals, with the highest capital cost related to the vehicle. This cost however is relatively low in comparison to other modes such as the railways or air freight carriers. Variable costs are the same as those associated with any form of road transport, hence includes drivers' wages, depreciation, maintenance, fuel, lubricants and some marketing costs. Clearly in LTL markets, fixed costs will tend to be a higher proportion due to the network of depots required to service the market. Nevertheless, the few past studies of the road haulage industry that have been carried out suggest that fixed costs tend to be relatively low. Whilst very dated, the ICC (1954) found fixed costs to be only around 10 per cent of all operating costs. Fifteen years later, however, Shirley (1969) estimated fixed costs to be in the order of 25 per cent, which strongly suggests an increase in the capital intensity of the industry over the intervening years, which was mainly attributed to the increased sophistication of terminals. Another reason for the difference however may be the considerable rise in the LTL market between the two time periods.

Economies of density

Economies of scale in road haulage have been examined in Chapter 6; however, what was not considered was economies of density. Whilst scale relates to firm size, density relates to the size of

the vehicle. With regard to truck size, there exists the two thirds rule where the outer dimensions of the vehicle will increase by considerably less in size than the volume, and in the carriage of freight it is of course vehicle capacity (volume) that is important. Furthermore, due to the high proportion of variable costs in the operation of road haulage, the marginal costs of operating a larger lorry will be relatively small in terms of the additional operating and capital costs. A second important consideration is that what is important in terms of costs is the cost per tonne carried, not the cost per vehicle km. If larger trucks are operated the cost per vehicle km will increase; however, if fully laden the cost per tonne carried should fall. There is therefore some scope to reduce average costs through economies of density. The extent to which such economies can be exploited however is limited by what the actual infrastructure, i.e. the roads, can take in terms of the weight and dimensions of vehicles. These tend to be heavily regulated with regard to road haulage.

Road haulage summary

As highlighted in Chapter 6, of all of the transport industries studied in this text truck load road haulage is the one that most closely resembles perfect competition. With significant barriers to entry, economies of scale and few sellers, the LTL market on the other hand clearly fits into the oligopoly model, although one in which competition is fairly intensive and heavily based on the price charged. Due to the relatively low proportion of fixed costs and high level of variable costs, road haulage is one of the most flexible forms of freight transport. Combined with the highly competitive nature of large sectors of the industry, this means that over time the economic characteristics of the mode have been well suited to the changing industrial environment, and hence road haulage has made very large gains in market share. As we will see, other modes, particularly rail freight, have found it difficult to adapt to such changing business conditions.

Rail freight

Of all of the transport modes examined in this text, rail freight operations around the world contrast the most in terms of form and structure. Unlike for example buses or road haulage, where some differences may exist but the basics of operation are broadly similar, this is not the case for rail freight. Whilst the underlying economic characteristics are common to all freight railways, the extent to which these affect the structure and form of the industry is largely determined by organisational considerations and even more so by historical precedent. In Europe, for example, due to the nationalisation of the railways in the first half of the 20th century, rail freight has operated as part of a nationalised state operator that has had to share most of the rail network with a high volume of passenger traffic. Because of state ownership and the desire to enact reforms, more recent years have seen many European countries restructure their railways by separating infrastructure from operations. Rail freight in Europe has also increasingly faced strong competition from road haulage which has resulted in a considerable loss of market share. This is probably best exemplified by Britain, where as we saw above rail's market share fell from 30 per cent of tonne kilometres hauled in 1960 to 8 per cent in 2006. Whilst severe, such declines in market share are not unusual in a European context. This situation contrasts quite radically to rail freight in other parts of the world, particularly North America, where market share has always been considerably higher mainly due to the sheer distances involved. For example, statistics for

2002 show that in America rail carried 3 per cent of the value of freight, 10 per cent of the weight and 31 per cent of the tonne miles (US Department of Transportation, 2006). This last figure contrasts with a 34 per cent share for road. The actual type of operation in the US is also very different, consisting of privately owned freight-dedicated operators, each with their own network of rails and depots.

Key economic characteristics of rail freight

Rail freight is characterised by a number of features that are outlined below.

Barriers to entry

Within the rail freight industry there are very high barriers to entry. In Europe these have been in the form of legislative measures, where the state-owned operator has had a legally protected monopoly on all rail operations. This was the case in most European countries up until the early 1990s. With the passing in 1991 of the first EU Directive aimed at railway reform, 91/440, this partially removed this particular barrier to entry for freight operations in all EU member states. Further reforms followed in 2003 with the implementation of the Trans European Rail Freight Network which opened up 50,000 route kilometres to freight operations. While this removed the legal obstacles to access, without further measures control of the infrastructure by the existing operator would remain as a barrier to entry. As noted above, in some countries therefore this has led to an organisational separation of infrastructure from operations, where the infrastructure is owned and operated by a separate state-owned company. Alternatively where the infrastructure has remained in the control of a single company, normally the state-owned railway, regulatory measures have been introduced to lay down access rights and control the infrastructure charges imposed.

A second major barrier to entry is that rail freight operations usually incur very high start-up costs. Investment requirements in railway technology, whether relating to infrastructure or rolling stock, tend to be very high and this may deter potential new companies from entering the industry. Furthermore, because rail freight has increased advantages over a certain distance, this also has implications on firm size, suggesting that small firms may find it difficult if not impossible to enter the industry unless under some form of partnership agreement.

Despite the reforms outlined above, few new entrants have entered the rail freight market in Europe. The main reasons cited for this lack of entry is the difficulty in assembling the required inputs and the problems faced with conflicts in technical standards and regulations across continental Europe (Gómez-Ibáñez, 2004). This in many respects reinforces the point made in the opening statement of this whole section, and further suggests that radically different operational differences are a further barrier to entry.

Outside of Europe, the major barrier to entry is also high start-up costs; however, because in virtually all cases these are vertically integrated railways (i.e. track and services), a new entrant would have to construct a complete railway in order to compete in the market. In most countries outside of state-run passenger services, there is also no legal right to access as the infrastructure is privately owned. Even in the case of the small Class III railroads in America, where the largest line lengths are somewhere in the order of 500 kilometres, such a barrier would prove insurmountable. This is because of a very high level of sunk costs and market structural barriers, where most if not

all of the existing railroads were built over a hundred years ago and simply would not be constructed today. In simple terms any new entrant could not compete with the incumbent due to the very much higher capital cost associated with new line construction. Even without direct rail competition, due to such costs any new line would fail to produce a profit. Consequently, the only competition that these railroads will ever face is from other modes of transport. This has led to moves for some form of reform of the US rail freight industry under the provisions of the Rail Competition and Service Improvement Act of 2007, which attempts to clarify the policy position of ensuring effective competition between rail carriers and eased the standards used when shippers challenge the reasonableness of carriage rates.

Cost structures

As has been highlighted before, railway cost structures are such that given the very high level of capital costs, fixed costs tend to be very high. Nash (1985) for example estimated the proportion of fixed costs for railways in Europe to be in the order of 53 per cent. Although this was based on both passenger and freight operations, freight-only railways will have considerably higher fixed costs than a combined passenger/freight railway due to the added cost of depots and freight marshalling yards. Variable and marginal costs however tend to be relatively low. As a result, there is a considerable separation of outgoings from revenue, a high break-even point and a need for the careful planning of operations.

Economies of scale and scope

We have already seen in Chapter 5 that there are significant economies of scale in railway operation due to the high level of fixed costs. There is also however some evidence of economies of scope; these are said to exist when the unit cost is reduced due to common costs being spread across two or more outputs. Thus passengers and freight trains can share the same track, which spreads the fixed costs of the track across both types of operations. As a consequence a lower unit costs for each type of service is achieved than if either one was operated on its own. At a very basic level such as the construction of a new railway, this is obviously true as the costs of construction can be shared between the two types of operation, hence producing lower average costs in each. There are other shared facilities however not only associated with the permanent way that also lead to some economies of scope, the most obvious one being a network of stations/depots.

High break-even point

As briefly highlighted, a further economic characteristic of freight railways is that the break-even point is very high. If fixed costs are very high then it follows that a large volume of output (i.e. freight services) must be sold before any profit is made at all. This may even suggest that a profit can only be achieved if there is only one firm in the market, i.e. a natural monopoly. It is worth highlighting however that profitability above the break-even point is highly inelastic. This is because any additional revenue generated from sales will be virtually all profit as the marginal costs are close to zero.

These economic characteristics such as high barriers to entry, economies of scale, very high break-even points etc has meant that rail freight has been a highly concentrated industry with very few firms in the market. For example, following the Stagger's Act of 1980 which deregulated rail

freight in America, a series of mergers and acquisitions resulted in industry consolidation to the point where now there exist only four 'Class I' US railroads, i.e. major railways. Canada has only two Class I railroads and although at a much smaller scale, in Britain after privatisation there are now only two 'national' operators, EWS for Wagons and Freightliner for containers (although some much smaller companies do operate on parts of the network). Railion on continental Europe is a combination of the freight operations of the German, Dutch and Danish state railways, and has since expanded its European operation by acquiring rail freight companies in Switzerland, Italy, Spain and finally the aforementioned EWS in Britain. Rail freight markets therefore would appear to follow the pattern we saw earlier in Chapter 7 of industry consolidation following reform and hence similarly move towards imperfect market structures.

Advantages and disadvantages of rail freight

Advantages

Environmental impact – the first advantage of rail freight is its impact on the environment. Of all of the available freight transport modes, rail, particularly when hauled by an electric loco, is probably the least environmentally detrimental. This is something we have already touched upon in Chapter 9. Note however that this first advantage is not recorded in the market place as this is an externality. Furthermore, because in many countries rail freight operations are run entirely on a profit basis with little or no government support, this is an advantage that currently presents limited opportunities in which to be exploited. It is nevertheless one that does position it well in the face of increasing environmental concerns.

Distance – rail has a major advantage over medium to longer distances over road transport. This is shown in Figure 12.3.

What the figure shows is that as distance increases, average cost per unit moved by rail falls whilst average cost per unit moved by road increases. This is almost entirely due to the division of costs between fixed and variable in the two modes; road has few fixed costs, thus average costs increase directly with distance. Rail however has a very large proportion of fixed costs, thus as distance increases these costs are spread over more tonne kilometres and average cost per unit falls. The cross-over point between the two is usually quoted as somewhere between 300 and 500 kilometres, thus shown at 400 kilometres on Figure 12.3. To a certain extent, however, this advantage of distance is limited by the size and form of many countries – Britain for example is a long/thin island, hence such advantages can only be exploited on north–south flows. In other countries, natural geographical barriers may also limit the extent these advantages can be achieved. As an example, Denmark consists of a large number of islands and the north Jutland peninsula, with most of the population located on the island of Zealand. These factors however can be overcome by large infrastructure projects, such as was the case with the Channel tunnel in Britain and the construction of two fixed links to Zealand in Denmark. In these examples capital has been substituted for land in the production of rail services and thus some of these distance advantages can be exploited. Nevertheless, few actually have been due to other factors covered under disadvantages.

This advantage of distance however is what TSSA (2008), the rail union for salaried staff, describes as one of the myths of rail freight transport, as the implication is that over shorter distances rail has a disadvantage, as indeed shown in Figure 12.3! What they argue however, similar

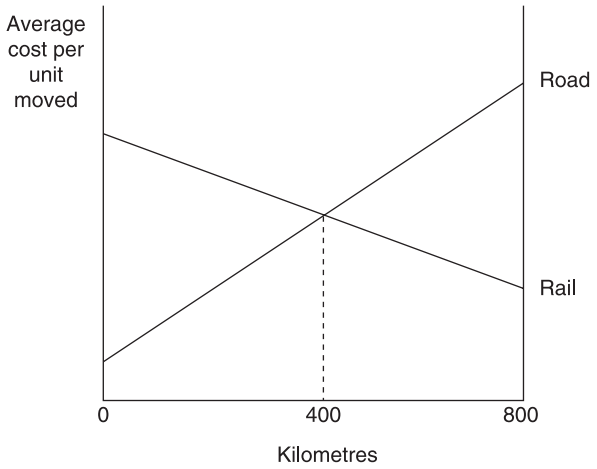

Figure 12.3 *Average cost per unit moved, rail versus road*

to Erickson (2001), is that whilst rail does have advantages over longer distances in certain sectors it can also have advantages over shorter distances, particularly where there are regular flows of freight traffic. The key to these counter arguments is that fixed costs need to be spread over something before the average cost of rail freight becomes competitive; however, distance is only one 'thing' that it can be spread over. The other of course would be volume, thus over high volumes, irrespective of distance, rail freight may also have a cost advantage.

Capacity – capacity to some extent is both an advantage and a disadvantage of rail freight, but the advantages are considered first before the drawbacks are examined below. Unlike road transport, rail has a far higher level of capacity which can extend up to a whole train size. Train size however tends to vary from country to country, with Germany for example limiting the length of its freight trains to 700 metres, countries in Eastern Europe to 1000 metres but in the US and Canada freight train size tends to be considerably longer. Irrespective of any restrictions on length, the capacity of a freight train is considerably larger than that of road trucks. Rail therefore has the potential to move large volumes of freight over short and long distances quickly and efficiently.

Power costs – in simple terms, rail transport per tonne hauled has a very low power cost. This is due to the very high level of capacity of rail, hence relatively speaking less power is required to carry a big load. The implication of these two factors (capacity and power costs) is that rail is good for carrying low-value high-volume freight such as coal, aggregates, shale etc. This is something that has already been seen in the case of the US, where 3 per cent of value goes by rail but 31 per cent of tonne mileage. A further myth highlighted by TSSA however is that the carriage of such traffic is all that rail is good at. It should be thus noted that although it does have certain advantages in the transport of such cargo it does not mean that it cannot also compete for other more general cargo.

Weather constraints – a final advantage briefly highlighted is that of all of the alternative modes that are realistically available, rail tends to be one of the least weather constrained. It is thus the least subject to delay due to poor weather conditions.

Disadvantages

Accessibility – unlike road transport which has an infinite number of access points to the road network, rail only has a relatively limited number of points of access. These essentially are the marshalling yards and collection points. This means that in order to be fully competitive, rail companies need to employ other transport modes to increase accessibility and offer point-to-point carriage.

Shipment size – certainly within Britain, the nationalised British Rail withdrew from the less than wagonload market in the early 1990s simply because it was becoming increasingly unprofitable. This highlights one of the major disadvantages of rail freight, which is that in order to capture the benefits of rail transport there is a requirement for a minimum shipment size. For direct access this will either be a full wagon load or a full container load. Third parties in the form of freight forwarders can make up such shipments; however, the process becomes far more complex and difficult – it is not only more expensive but also needs a variety of shippers who all want to send items of cargo between the same two points.

Security – trains have been known to lie in marshalling yards for days on end and hence can become subject to vandalism and pilferage. This could almost be viewed as an externality of rail freight, where those that benefit (the thieves!) do not pay directly for the cost of the activity, unless of course they are caught in the act! Road haulage on the other hand is generally viewed as more secure as the driver usually accompanies the vehicle at all times.

Frequency – due to high capacity levels, rail freight services tend to be fairly infrequent. To simplify, once a lorry is full it can depart. Considerably more tonnage however needs to be loaded or assembled on a train, and thus by implication such services will be less frequent. As a consequence, regular rail freight services tend to occur only on routes where there is strong demand between the locations. This can lead into intermodal services based around some form of hub and spoke operation. In theory intermodal takes the advantages of rail over long distances and combines these with the advantages of road over shorter distance. The rail terminals act as the hubs with road haulage servicing the spokes. Intermodal freight however is an issue that tends to be much discussed at government level but one that in reality has seen little major movement. The Marco Polo II programme for example, the main EU initiative on intermodal transport, has a relatively small total budget of 400m Euros to spend over the period 2007 to 2013. This is used to provide financial assistance with the start-up cost of intermodal operations.

Key issues facing rail freight

We end our examination of rail freight by considering some of the major issues currently facing the rail freight industry in Europe. Some of these arise as a result of the economic characteristics of the mode, others as a result of more general economic change.

Firstly, the industry has been facing falling or stagnate freight tonnage. Even over a relatively short period from 1995 to 2005, rail's market share within the EU fell from 12 per cent to 10 per cent (Eurostat, 2007). The development of road transport has over time taken much of the market away from the railways. However, whilst now historical, the point has wider implications. With the development of the Single European Market, road hauliers have been able to take more advantage of the opportunities presented, in particular the development of European-wide road haulage networks. Railways on the other hand have tended to have a national focus and there is only recent

evidence that some are now beginning to respond to the effective removal of political and economic barriers across Europe (Lewis *et al.*, 2001). The previously highlighted Railion rail freight company is one of the few examples of a pan-European focus to rail freight; nevertheless, even its operations are still very much centred upon the German market.

Passenger oriented rail networks. European railways are much more dependent upon passenger traffic and in many cases view the movement of freight as a secondary business. Austria for example is at the top end of the spectre with 55 per cent of customer receipts in 2007 coming from freight activities. This however is very much the exception, with the Norwegian state operator, NSB, nearer the norm with 27 per cent of all rail revenue coming from freight. Others have considerably lower figures again. Passenger trains tend to receive priority on the network and move uninterrupted across national borders and any major developments in rail networks appearing to mainly concentrate upon passenger services. For example, the TGV in France, ICEs in Germany, the Eurostar (Channel Tunnel services) between Britain and France and the Thalys between Germany, France, Belgium and Holland are all mainly passenger focused. Only one of these projects has a major freight element (the Channel Tunnel). This is an area in which there appears to be some shift in thinking, however, with the Swiss AlpTransit project very much freight driven, as is the Lyon–Turin tunnel project. Both projects surround the construction of lengthy rail tunnels through the Alps. Finally the Betuweroute is a 4.7bn Euros investment in a new freight-only line between Rotterdam and Germany which opened in June 2007.

Lack of harmonisation of standards, regulations and standards in the EU. Freight trains (more so than passenger trains) face a complex patchwork of conflicting standards and requirements for rolling stock, locomotives, signalling and information systems. Whilst road also faces differences in standards across borders, with the most basic being driving on different sides of the road in some European countries, such differences tend to be inconveniences. This is not the case with rail, where different operating practices impede the cross-border movement of goods by rail and act as major barriers. Even where these are overcome there still remains a high variation in the level of infrastructure development in the international context. This has resulted in a number of bottlenecks appearing in the system, such as around Milan, Vienna, Munich and Rotterdam to name but four. These are major problem areas and as regards a European wide network are ones that need to be addressed before rail can be seen as a major competitor to road over these distances.

Structural economic change. As has been stressed in this chapter before, freight transport cannot be looked at in isolation and this point in particular relates to on-going structural change in the wider economy. Over the last thirty years there has been a significant move away from traditional heavy industries such as steel and coal to more advanced lighter industries such as electronics etc. Whilst rail is well suited to be the transport provider for heavy industry, i.e. low-value bulk commodities, it has been far less suited to the new industries. Going hand-in-hand with this development is also a change in production processes, with a movement away from Fordism-type big fixed production to Post-Fordism flexibility in production and the implementation of systems such as just-in-time inventory. These practices tend to be less suited to rail transport and more suited to road. This is one of the main reasons that rail has lost market share throughout most of Europe.

Rail freight summary

Rail freight is one of the great areas of potential to reduce road congestion and its impact upon the environment by switching large volumes of freight from the roads to the railways. That however is far easier said (as it often is) than can be done. In this section we have looked at some of the key economic characteristics of rail freight and the ensuing advantages and disadvantages that follow from these. Rail freight in recent times has existed in a period of outright decline in tonnage carriage, that even after major reformatory measures such as privatisation in Great Britain have failed to address the situation. Operating under purely free market principles the changing industrial structure has not suited rail. Much more requires to be done, such as increasing capacity on certain parts of the rail network and rail gauge enhancements, to allow freight to be carried on more of the network. In a purely free market environment, whilst there is some potential for rail in a hub and spoke type operation with rail taking the long haul in the operation, other opportunities appear to be limited.

Air freight

Many air services have their origins in freight-orientated services. In North America, for example, many companies began operating air mail services where the mail could be transported in a much reduced time than had been previously achievable by overland transport. In other parts of the world where natural geographical obstacles considerably slowed transit times, air services also developed very quickly. For example, the air services route map around the west coast of Scotland, which is made up of a large number of islands, had been quickly established by the early 1930s. This was initially based around mainly mail and newspaper carriage, and the route map as such has remained little changed since that period. Despite such early origins, of all of the modes examined in this chapter air freight has by far seen the largest growth in recent times. This is due to many different factors, but the two strongest drivers have been increases in international trade and technological advances in civil aviation, particularly lifting capacities. As a result air freight is far more international in its focus than the passenger market (Gardiner and Ison, 2007), and thus has generally grown in size with the growth of international trade, assisted by the vast increases in the lifting capabilities of civil aircraft. This phenomenal rate of growth in air freight is clearly shown in Figure 12.4, which expresses revenue tonne kilometres (RTK) on scheduled flights since 1970.

At the start of the period outlined the level of freight moving by air was negligible. At that time most of this carriage would have been mainly related to specific mail or newspaper cargo type activities in addition to small levels of international air freight. Not only was the total low, therefore, but also very low levels of 'freight' were carried on each flight due to limitations on gross weight. Since 1970, however, the market has grown considerably as a result of the development of specific freight-dedicated aircraft, considerable increases in the cargo-carrying capacity of passenger aircraft and the establishment and development of international logistical networks and specific package-related carriers. This has taken place with a backdrop of continuing evolution of the globalisation of production and sales in consumer goods. The net result has been that shippers have tended to move shipments in smaller consignments, more often and require faster delivery times. All of these characteristics suit air freight transport. Boeing (2007), in their regular 'World Air Cargo Forecast' series, forecast that such trends are likely to continue well into the foreseeable

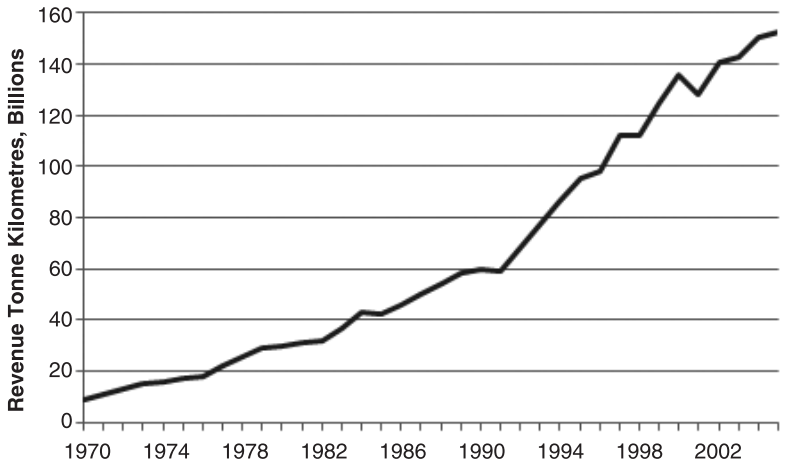

Figure 12.4 *Growth in air freight, international RTK 1970 to 2005*

Source: Compiled from IATA statistics

future, with rates of growth estimated at a low of 5.3 per cent per annum and a high of 6.9 per cent. Even at the lower value of 5.3 per cent this would represent an increased rate of growth in the future and would result in almost a trebling in the size of the market. This section will examine the economic characteristics of air freight operations in order to help explain the phenomenal increase in this sector of the market.

Structure of the air freight industry

In very general terms there are three types of operators that provide air freight transport services:

Line haul operators

Line haul operators only move cargo from airport to airport, relying on third parties in the form of freight forwarders and consolidators to deal directly with customers and cater for their overall requirements. This is the classic transport firm that only deals with the transport leg of the whole logistical chain. These line haul operators can be divided into three further sub-categories:

- All cargo operators
  All cargo operators move freight in dedicated cargo aircraft and mainly specialise in large-volume, long-distance flows. Better known examples of all cargo operators are companies such as Cargolux, who base their operations at Luxembourg-Findel International Airport and are one of the largest all cargo air operators in Europe. The company operates a fleet of 15 Boeing 747-400F with a further 15 747-8Fs on order, and a global network consisting of 45 destinations throughout the world. It works with other operators to provide worldwide coverage based upon a hub-and-spoke network centred upon three core airports – Luxembourg, Hong Kong and Glasgow Prestwick. The company operates both regular scheduled freight services as well as ad-hoc one off type operations.

- Combination passenger and cargo operators
  These companies tend to be large multinational airlines, such as Lufthansa, United Airlines and so on, that use both dedicated cargo planes as well as the cargo hold of passenger aircraft that operate on an extensive worldwide network of air routes. Operations are mainly long haul, with interlining to and from short haul feeder services. This is the classic hub-and-spoke type operation, and hence in some ways the freight operation is piggy backed onto the passenger service.
- Passenger only operators
  All other air operators that carry some form of air freight fall into this last category. These operators only carry freight in the cargo hold of passenger aircraft, and this often means little attention paid to the requirements of the cargo, although the revenue generated from such operations should not be underestimated. Various reliable sources estimate this to be in the order of 15 to 16 per cent of all revenue (Lobo and Zaira, 1999; Boeing, 2007), which although a relatively small proportion does represent a very strong contributor to profitability, particularly given the relatively low marginal costs of carrying this cargo.

Integrated operators

These are specialists in the door-to-door consignment market, generally with guaranteed time delivery services; the main carriers in this sector of the market include UPS, Federal Express, TNT and DHL. These companies operate land modes in addition to air services and thus offer an integrated service aimed to fully meet customers' demands, they will therefore both collect and deliver consignments. To meet the requirements of next-day deliveries, many of the flights operate at night time, particularly those meeting regional demands and again most are based around a hub-and-spoke type network. Of all of the air freight operators these companies have by far the largest fleet sizes, with many fleet sizes larger than most recognised passenger airlines. FedEx, for example, is the largest integrated operator, and with a fleet size of over 670 aircraft, has the largest civil aircraft fleet in the world.

Niche operators

The final sector of the market relates to niche operators. As the name suggests, these operators cater for extraordinary demands, usually of large and heavy items that the standard operators are unable to carry. These tend to be non-scheduled services and are provided on a one-off basis.

Market shares

The ten largest air freight operators in 2004 are given in Table 12.3 along with, where these were available, equivalent figures from 2001.

As can be seen from Table 12.3, the largest carriers of air freight mainly consist of line haul and integrated operator airlines. FedEx are by far the largest single company, having around 10 per cent of the total global market, with the other nine airlines shown accounting for a further 40 per cent of the total market in 2004. The difference between the two years underlines the strong growth that this particular market has experienced in recent years, with growth rates averaging just under 30 per cent over a very short three-year period. Interestingly, however, the top 10 air freighters experienced considerably larger growth than the actual market size, hence its share

Table 12.3 *10 largest air freight carriers, revenue tonne kilometres, 2001 and 2004*

Operator	*2001*	*2004*
FedEx Express	11.0	14.6
Korean Air	5.6	8.3
Lufthansa Cargo	7.1	8.0
United Parcel Service (UPS)	5.9	7.4
Singapore Airlines Cargo	5.9	7.1
Cathay Pacific	n/a	5.8
China Airlines	n/a	5.6
Eva Airways	n/a	5.5
Air France	5.1	5.4
Japan Airlines	4.2	4.9

Source: Compiled from IATA statistics

increased from 40 per cent in 2001 to 48 per cent in 2004, thus the market appears to be consolidating.

Despite such a high level of market concentration and consolidation, Boeing (2007) report that yield levels from air cargo have been falling, with close to a 3 per cent per annum decline since 1985. Yield levels today are thus some 50 per cent of the size in 1985. This however does not necessarily mean stronger competition in the market, as basic economics would dictate that as supply increases, then the price, and hence the yield, will fall. Nevertheless, there are clear indications of increased competition and a renewed focus by passenger airlines on the carriage of freight.

Air Freight – key economic characteristics

Goods in joint supply

In terms of the economic characteristics of air cargo, goods in joint supply are undoubtedly the most defining feature. These exist because a large percentage of air freight goes in the cargo hold of commercial passenger aircraft; therefore, the production of more passenger services automatically produces a higher supply of freight operations, as these 'extra' passenger aircraft all have cargo holds. Therefore strong demand in the passenger market will result in increased capacity in the freight market. Boeing estimated in 1998 that 70 per cent of freight was carried in passenger planes (Boeing, 1998); however, now due to a significant increase in freight-only operations, that figure is probably nearer 60 per cent. Not all passenger airlines however carry cargo; low-cost airlines for example in general do not carry freight, and most of this joint traffic tends to be on intercontinental and longer-haul flights.

Barriers to entry

Within the air cargo market, barriers to entry tend to be very high, with one of the major constraints being access to key locations. Air cargo needs to be transported directly to the area of highest value, as many of the advantages of air freight can be offset when this is not the case, e.g. a

long timely connection between point of set down and the final destination. Freight operators are therefore in direct competition with passenger airlines for airport access, as areas of high demand for passenger destinations tend to be the same as areas of high demand for freight. For passenger-only operators, this is not a barrier as passenger and freight services are goods in joint supply. This is the main reason for example why almost half of the air freight in the UK is handled through the busiest passenger airport, London Heathrow. For freight-only operators, however, this is a considerable barrier. The DETR (1998) further highlight that airports may prefer to handle passenger aircraft due to the added overall revenue they bring through passenger tolls and spend within the airport. This lack of access is why some freight-only operations tend to be at night and based around regional airports rather than key (passenger) hubs.

Firm size

The cost structures of air freight operators, with a high proportion of fixed costs, would suggest that there exist considerable economies of scale in air freight operation. This is primarily due to the high level of start-up costs and high proportion of fixed costs involved in the operation of air freight services. However, under the banner of firm size there also exist economies of density, as is also true with passenger operations and which have been broadly exploited by the low-cost carriers. If a company can increase the output produced in terms of revenue-generating traffic by working the existing assets more intensively, then unit costs will be significantly lower. In more basic terms this increases aircraft utilisation in which less time is spent on the ground and more time spent in the air. Whilst economies of density are undoubtedly an important aspect in the operation of line haul operators, it appears at face value to be far less in evidence with the integrated and niche operators. Many of these carriers only fly at night, indicating long periods when the aircraft is on the ground. This would strongly suggest clear market segments and market niches, with large firms dominating the integrated sector and smaller operators competing in the line haul and specialised markets. In many respects such a diversified market structure is very similar to the road haulage sector examined earlier in this chapter.

Price and non price competition

Within all sectors of the air freight sector, price and non price competition play a clear role. Competition for business tends to be very high, thus there is very strong downward pressure on prices. Within the line haul sector, for example, the strong market position of freight forwarders who make up complete consignments tends to drive prices down, whilst the integrated operators market is keenly contested. Price is therefore clearly a factor; however, with a few exceptions prices will tend to vary by very small amounts. How firms compete therefore is not only on price but also on non price factors, particularly the speed and reliability of delivery. For example, slow movers have been quoted as being eaten up by the fast ones in the market (Lobo and Zaira, 1999). Speed of delivery covers a multitude of sins that would also include where it can be sent, when it can be sent and how often it can be sent out, all of which add up to the speed of delivery.

Another form of non price competition clearly in evidence in the air freight industry is firms buying out rival operators in order to enhance their own market position. It is through such business strategies that the major integrated operators, such as FedEx and UPS, have attained their strong market positions. In this respect it follows a similar pattern examined in Chapter 7, where

the process of competition tends to be through merger and acquisition which ultimately results in the emergence of large dominant operators.

Yield management

We have already seen in Chapter 9 that airlines practise price discrimination in order to fill the available seat capacity in passenger services. Yield management however is also a key characteristic of the air freight market. Nevertheless, until the recent past it was a topic that had not received a great deal of attention due to the perception of air cargo as an almost 'add-on' and the low marginal costs associated with the activity. Rising competition in the sector, falling yield levels (see above) and increased competition from other transport modes particularly on shorter haul routes, have all considerably changed this perception with a renewed focus on maximising the return on air freight through yield management. There are important differences however between yield management in freight as opposed to passenger air services, and Kasilingam (1997) groups these under the following four broad headings:

- Uncertain capacity
  In the passenger market the total number of seats is known well in advance and hence ticket prices can be controlled in order to fill that available capacity. In the freight market, however, the available capacity is dependent upon a number of other issues, hence cannot be deterministically established before hand
- Three dimensional capacity
  Passenger operations exist in only one dimension, the total number of available seats, and these are filled by standardised units, i.e. one passenger per seat. In air freight, however, the capacity to be filled is in three dimensions, weight, volume and number of container positions. It can thus be very difficult to maximise the load in all three dimensions, and this can lead to under utilisation in one or more of these dimensions. It is mainly this characteristic that airlines seek to overcome through better yield management.
- Itinerary control
  Both passengers and freight forwarders will look to travel or move freight from A to B by the most direct route; the difference with freight however is that within given time constraints, as long as it starts in A and finishes up at point B the route by which it gets there is far less important, although improved tracking has impacted upon this flexibility. Nevertheless, this considerably increases the complexity of the whole operation, as clearly revenues can be maximised by the careful management of priority and non-priority loads and hence the route along which they can be moved. This in some respects adds a fourth dimension to the three stated above.
- Allotments
  Allotments are pre-booked slots that still lie at the heart of the air freight market. These are spaces that are allocated to large regular customers and generally take up a major proportion of the available capacity.

To these four key differences, Becker and Dill (2007) also highlight unequal trade lanes, where passengers tend to go out and back but air freight has imbalances of flows between different locations, and also the customer base – a passenger airline has many hundreds of thousands of

individual customers, hence a no show or a problem with one passenger will not have a major impact on the whole business. This however is not the case with air freight, where there is far higher buyer concentration and thus most clients tend to be large and give regular business, hence each single shipment becomes far more critical and no shows or any other problems tend to have a far larger and longer-lasting impact.

Nevertheless, yield management in air freight is a critical aspect and one that is becoming far more important over time as the whole size, structure and development of the industry changes.

The major economic advantages and disadvantages of air freight

Gubbins (2003) highlights four reasons why companies choose to send freight by air. Firstly, the shorter journey times means that the financial outlay in the goods that are being transported is tied up for a shorter period than for other modes. Intercontinental freight by maritime transport can take a considerably longer period of time than air freight, with typical transit times ranging from four to six weeks and in many cases even longer than that. More of the company's finance therefore is tied down in the goods that are being transported and this can have considerable implications on cash flow. A second related advantage is that faster journey times means that goods are at risk from damage, theft or deterioration in quality for a shorter time as compared to other modes of transport. Thirdly, air can be used in an emergency, where speed is of paramount importance and cost is unimportant, e.g. when a sale will enhance goodwill and lead to further business, or to counter a problem such as providing spare parts for machinery that has failed. In addition to this direct benefit a related advantage is that air can be used as a mode of last resort due to the critical nature of J-I-T concepts. It therefore may allow such a system to operate at a critical level in the sure knowledge that a plan 'B' does exist should something go wrong with the normal modes of carriage. Finally, air freight can lower the costs of storage and distribution in the country of sale. This can lead to the centralisation of such activities which may have certain cost advantages.

Against these advantages, the main disadvantages are that firstly the high charges tend to be prohibitive and thus air freight is only used in relatively high-value markets. This considerably lessens and restricts many of the advantages outlined above. Secondly, even in these days of 110 tonne freight capacity, aircraft capacity can be considered as limited. Thirdly, congestion around airports is often cited as a disadvantage of air freight, the argument being that points of access and egress tend to be heavily congested and thus access to and from the airport limited and time consuming. Thus time gained in the air is partly offset by increased transit times on the ground. As highlighted above, the demand for freight destinations, particularly air freight, tend to be in areas of high population, hence road access will inevitably be congested. Whilst in many locations this is undoubtedly true, this disadvantage should not be overstated and viewed in the wider context. For example, in most cases such transfers are only likely to occur over relatively short distances. Fourthly, security is a major issue in air freight, and one heightened by the 9/11 terrorist attacks of 2001. This is because a high percentage of freight is transported in passenger planes, and thus must pass through security checks and controls before being loaded onto the aircraft. This increases lead times and also adds further to the already high cost. Finally, per tonne kilometre transported air freight has the highest detrimental impact on the environment, even higher than road haulage. It may initially be countered that as a high percentage of air freight is transported on passenger aircraft, this represents a very low marginal cost and hence the impact on the environment

minimal. Such an argument however is far too naïve and completely ignores the revenue generated from freight carriage. Without this revenue the cost of passenger air tickets would be significantly higher, thus reducing demand which in turn would lead to a contraction in supply.

Air freight summary

Air freight has been the fastest growing mode of freight transport in recent times. Despite economic forecasts of a downturn, these recent trends are predicted to continue well into the future. This is strongly tied with the globalisation of the world economy, where retail outlets have taken a far larger share of sales. Most freight however goes by passenger aircraft with the main economic characteristic being goods in joint supply. Increasing environmental concerns however may limit future growth.

Maritime shipping

This brief outline of maritime shipping is not intended to be a complete overview of the main economics concerning the transport mode. As may be imagined, maritime shipping is a massive area and there are many books that cover the economic characteristics of the shipping industry in some depth, notably Martin Stopford's *Maritime Economics* (Stopford, 2008) and Kevin Cullinane's *Shipping Economics* (Cullinane, 2005). What is outlined here therefore is purely introductory and a general overview of the main economic characteristics of the shipping industry that underline or develop further some of the points raised earlier in the book.

Market segments

In very simple terms, maritime transport can be broken down into roughly four different market segments – inland shipping, coastal shipping, short sea and deep sea shipping. Inland and coastal shipping is based upon navigable rivers such as the Rhine and the Danube, inland lakes and coastal waters. Short sea shipping is difficult to define but consists of relatively short sea crossings, with the main shipping routes in Europe being found in the English Channel, the North Sea, the Baltic, the Black Sea and the Mediterranean. Ferry type operations therefore usually take place in the short sea and coastal shipping sectors. Finally deep sea shipping concerns intercontinental shipping, and this the long distance sector of the mode.

Coastal and short sea shipping are perhaps the great unknowns as regards freight transport. As a common view may be that more freight should be taken off the roads and put on the railways, coastal and short sea have fairly high market shares as it stands. In Britain, for example, as highlighted above 23 per cent of tonne kilometres are carried by boat, compared to only 8 per cent for rail. For the European Union as a whole, shipping's share of freight carriage is considerably higher at around 40 per cent, second behind road (44 per cent) and again considerably higher than rail (8 per cent). Whilst British and European Union figures are not directly comparable, as for example mainland Europe has considerably more navigable rivers and areas of short sea crossings, it does nevertheless show the potential of the mode to take a greater share of the freight transport market.

The international organisation of shipping

Maritime transport, like a number of other services such as the post and telecommunications, has a strong international dimension to it. Over the years, therefore, there have been several attempts to set up an international body to support the needs of the shipping industry. This was eventually achieved at the UN Maritime Conference held in Geneva in 1948, out of which was formed what is now known as the International Maritime Organisation, or IMO for short. The IMO was established to provide the machinery for the co-ordination and co-operation of government regulations in international shipping with the aim of achieving the highest standards possible in terms of safety and efficiency in navigation. It was also established to encourage the removal of discrimination against foreign flags, i.e. foreign registered vessels, engaged in international shipping. The final original three aims of the IMO concerned the monitoring of unfair restrictive practices by shipping concerns, any shipping matters referred to it by UN agencies and finally to provide for the exchange of information between Governments. Two further aims have since been added in the form of maritime pollution, notably liability for oil spillages, and the protection of the marine environment. Today the IMO has 168 member states and 3 associate members.

The IMO is restricted to purely technical matters, and hence does not involve itself in economic or commercial activities, as these remain the preserve of national governments. Its functions can be best summarised by the five standing committees of the organisation. The Maritime Safety Committee is the highest technical body of the IMO. Its remit in simple terms is to examine all technical aspects of safety at sea, both in terms operational aspects that have a safety implication and the construction and instrumentation of sea going vessels. The main activities of the Maritime Environment Protection Committee surround the prevention and control of pollution from ships at sea. The Legal Committee is authorised to deal with any legal issues that arise within the scope of the IMO. The Technical Co-operation Committee is concerned with the implementation of technical co-operation projects. Finally the Facilitation Committee is tasked with enhancing the flow of maritime services through reducing the administrative burden, i.e. red tape, that arise from shipping goods between two different countries. In some ways therefore the IMO performs a regulatory function in the operation of maritime shipping, with all of these aspects relating to qualitative rather than economic regulation. Its role is also as an international forum for international sea shipping services.

Economies of scale

Economies of scale are an essential component in the economics of shipping. In some ways, however, what is commonly known as 'economies of scale' is not what it actually refers to in shipping. The normal view of an economy of scale is where the larger firm has a lower average cost. In shipping, however, as can probably be guessed, economies often refer to ship size rather than firm size, or sometimes a division is made between economies at the firm size level and at the plant (ship) level. In some ways, ship size economies are what would be known in other transport modes as economies of density, as costs fall as more 'output' is spread across the infrastructure. Whilst with roads and railways this makes sense, the infrastructure within shipping is associated with ports, and similar to air transport, there is no infrastructure along which the vessels travel. Hence economies of scale generally relate to ship size.

Economies of scale in shipping are known to be considerable, and hence are central to shipping economics. These arise from two main sources. Firstly, there will be some economies in manufacture, and thus in the associated capital costs of vessels. If for example we were to considerably simplify the problem and assume that the cost of a new ship will rise in direct proportion to its outer surface area, then as size increases the volume will increase by considerably more. A basic mathematical property is that if the size of a box was to increase, the surface area would rise by that number squared but the volume by the number cubed. This was loosely referred previously under road haulage as the 'two thirds rule'. Hence if this was applied to a ship, or indeed a lorry, then the carrying capacity inside would considerably increase. The simple conclusion is that larger ships cost less to build per cubed metre of carrying capacity. Although (over) stressing one of the basic properties, it is nevertheless a considerable oversimplification of the issue. As should be obvious, larger ships require larger engines and more heavy duty materials, but what might not be so obvious is that in the case of container vessels most containers are carried on deck, hence it is the buoyancy that becomes the issue and not the storage capacity. Capital costs in shipping however are fairly significant, with Stopford (2008) illustrating that capital costs in medium-life vessels account for around 40 per cent of the total operating costs, and an even higher 48 per cent in newer vessels. Economies of scale also exist in the operation of vessels, where operating costs do not rise proportionally with the size of the vessel. Unlike say rail freight, where although there are considerable economies in hauling more wagons, there nevertheless comes a point where another locomotive will be required and hence the whole process effectively 'reset', this is far less apparent in shipping. Hence larger ships significantly reduce unit costs. In the past, the whole economies of scale argument, both in terms of ship size and firm size, has led some to investigate if the industry suffered from excessive scale economies and hence certain sectors in danger of becoming natural monopolies. Where a maximum size can be identified however is in port facilities and capacities, where larger vessels will be restricted to only operating between ports that have the capacity to handle ships of such a size.

The shipping business cycle and the shipping 'risk'

One of the main features in the economics of maritime transport is what is known as the 'shipping risk'. This is connected to the shipping business cycle, which tends to go through large highs and very low troughs. When business is good, it is very good, when business is bad, it is very bad. Given such uncertainties about the future, therefore, major question marks arise over the decision of when to invest in new ships and scrap old vessels and when not to. Large tankers, like large passenger aircraft, are large investments. For example in September 2008 a medium-sized ship of around 54500DWT would have cost around €43m from Wright International (Wright International, 2008). If an upturn in trade is expected, then prices would be expected to rise, and these can rise quite considerably, then any owner who does invest in new ships is well positioned to take advantage of this upturn. Not only would they have the new capacity available, but given high prices they could delay scrapping the existing vessels that these ships will ultimately replace. However, if the upturn fails to materialise, then in a period of decline the owner would be burdened with the debt incurred in purchasing the vessel and reduced haulage prices. This in essence is the shipping risk.

Liner conferences

Liner shipping is the scheduled services of general and container cargo between the major ports. Historically, these have been very restricted markets, with Button (1993) highlighting that the major shipping lines used to combine to monopolise these routes and restrict market entry by the setting of a limit price, along the same basis as we saw in Chapter 7 for contestable markets. Liner conferences however provide a very good example of the extent to which the market has been opened up in all aspects of transport services. Most of these conferences existed on the routes between Europe and North America and Europe and the Far East. The reasons behind their formation are largely historical, with their origins in the mid to late 19th century. The industry at that time faced over capacity, hence strong downward pressure on shipping rates, and highly seasonal trade, thus a ship running a regular service would run only half full half of the time. In order to bring stability into what was an unstable market, the main shipping lines at the time agreed to charge similar rates and follow scheduled service patterns, even if the vessels still had spare capacity. The conferences introduced a reduction in rates based upon a rebate system to regular clients, hence the reduction was applied after a period of time had lapsed. It was therefore dependent upon the continued loyalty of the shippers concerned. This tended to tie in shippers into certain conferences, and from these origins developed a system of liner conferences with a fairly intricate system of rates, schedules and ports served. As with many of the major airlines prior to deregulation, freight revenues were generally pooled and shared out between the members of the conference.

Stopford (2008) highlights that liner conferences were generally unpopular with the business community at large, and the system reached its peak in the 1950s. Since then major changes have occurred in the liner sector of the industry. The UN Conference on Trade and Development (UNCTAD) introduced a liner conference code of conduct in 1964 which was eventually formalised in 1974. This attempted to give the national shipping lines of developing countries the right to participate on an equal basis with the shipping lines of developed countries. It thus laid down clearer criteria to regulate entry onto the major shipping routes, in part in much the same way as the Bermuda Agreement did so for the airlines in 1946. The code has been signed by 86 nations, but importantly not the US. The 1980s saw a re-affirmation of some of the liner practices, with the US Merchant Shipping Act restating that liner conferences were excluded from US anti-trust legislation and the EU giving a block exemption (whole sector exemption) from their competition laws in 1986. Over the period, however, the role of the liner conferences had dramatically changed since their high point of the 1950s. They no longer held a stranglehold on the major shipping routes; however, they continued to have a very strong market position – by the mid 1990s, for example, around 60 per cent of the liner capacity on the major routes were part of some conference system. The block exemption in the EU however lasted until 2008, when it was finally withdrawn and the fixing of rates and capacities on the main liner routes out of and into the European Union made illegal. Thus for example on checking one of the liner conference websites (Trans Atlantic Conference Agreement – TACA, 2008), potential clients are given the message that as from 30 June TACA has ceased operations and are referred to individual carrier's tariffs for shipping rates. Liner conference systems in other parts of the world however continue to operate.

Flags of convenience

We have already seen in Chapter 10 the type of regulations that are imposed upon all users of transport systems, from 'simple' pedestrians to the more technical train and plane operators. Shipping, particularly international shipping, is no different. There are a set of rules and standards that apply to both the sea worthiness of the vessel and the competence and hence qualifications of the crew. These are mainly imposed and upheld by the vessel's home state. Thus the ship will be registered in a home country. Deep sea shipping by its very nature however is international, and this raises the question of where exactly is the home nation?

What this has led to is a division in shipping registers and the establishment of 'open' registers. The severity of the regulation tends to vary from country to country, and hence the cost of adhering to these regulations varies considerably. An open register allows foreign national ship owners to register their vessels in a different country and thus be subject to the rules and regulations of that state rather than their 'home' country. This not only applies to shipping regulations, but the labour rules and regulations applying to the crews will come under the jurisdiction of whatever state the ship is registered with. It is one method therefore of bypassing costly labour legislation, which is the main reason why the International Transport Workers Federation are strongly opposed to flags of convenience.

Why countries openly seek to attract shippers to register under their flag is because for many this represents an important inflow of hard currency, i.e. a strong globally traded currency that holds its value, examples of which would include the US Dollar, the Euro, the Pound and the Swiss Franc. Thus the largest maritime fleet is registered in Panama, as it has an open register.

Reasons in favour of flags of convenience are firstly that they allow international shipping lines to register under whatever code will best suit their mode of operation. Thus for example there may be certain advantages to an American ship owner to register the ship elsewhere given the markets that they are in. The other main argument is that many of these companies are multinational concerns, and hence it is no different to many other multinational companies who will move around manufacturing plants into countries that suit them the most. By far the biggest drawback however is that flags of convenience are one of the major issues facing regulation of the deep sea fleet, as companies effectively avoid regulation by registering their fleets overseas; however, the spillover effects can at times literally be spill over effects.

Maritime summary

This is the main mode of transport for long-distance international freight, with the vast bulk going by sea. Improvements in moving cargo by ship have significantly underpinned institutional developments in the process of globalisation. The liner sector of the market has seen considerable reform, with the abolishment in the EU and US of the liner conference system, which has opened up competition in this sector of the market. The international dimension of the mode however remains problematic, and there appears to be far less qualitative control in maritime operations than for example for air services, which is partly related to the sheer scale of the mode (maritime is far larger) and historical development, with maritime mainly being based on private sector companies rather than publicly owned 'flag' carriers.

CHAPTER SUMMARY AND REFLECTION

This chapter has examined the economics of freight transport. On reflection, in many ways this is more of a follow on from Chapter 2 on the relationship between economic development and transport activities. In some ways this is no great surprise, and we have perhaps built on some of these ideas. Two clear points emerged from this chapter. Firstly, that freight transport far more so than passenger transport operates along market principles. What this is very strongly tied to is the derived nature of demand, as unlike passenger transport, without the primary demand there will simply be no rationale for the provision of the service. The other factor that came across very strongly is the diverse nature of freight transport services across the globe. This was most exemplified by rail freight, where very different models of provision exist.

CHAPTER EXERCISES

Exercise 12.1 Freight modal comparison

In each cell of Table 12.4 below, enter on a scale of 1 to 10 your estimate of how each mode of transport is rated for each of the cost and performance attributes (1 = very good; 10 = very bad).

Table 12.4 *Factors in comparison of freight transport modes*

	Lorry	*Rail*	*Combined road/rail*	*Air*	*Ship*	*Pipeline*
Economic characteristics						
Terminal costs						
Fuel costs						
Labour costs						
Maintenance costs						
Vehicle/capital costs						
Other characteristics						
Capacity						
Distance						
Speed						
Flexibility						
Frequency						
Reliability						
Weather constraints						
Accessibility						
Environmental impact						
Safety						
Security						

Questions:

a) From carrying out this comparison, what are your overall conclusions regarding the performance of the individual modes of freight transport?

b) To what extent do you consider the 'other characteristics' listed above to be non economic factors?

c) Consider the following freight consignments:

i) Regular large volume/low value
ii) Irregular large volume/low value
iii) High value international merchandise
iv) High value domestic merchandise
v) Short-distance low value.

How would a freight forwarder's choice of mode change with regard to these consignments? You should clearly highlight the main factors from Table 12.4 that lead to these choices.

d) What other factors, apart from those listed in Table 12.4, should a freight shipper consider in their choice of mode of transport, particularly with regard to international freight movements?

Exercise 12.2 Policy options for freight transport

One issue not highlighted in this chapter is that outside of qualitative regulation, policy options for freight transport, particularly road haulage, tend to be very limited at the national level with most policy initiatives arising at the European Union level. In this exercise, you are asked to consider proactive (economic) measures in the freight transport industries. In Chapter 8 a number of policy options were outlined to address the problem of transport's impact on the natural environment. To recap, these were:

- Pigouvian taxes (and subsidies)
- Negotiation and bargaining (Coase Theorem)
- Auctioning pollution rights
- Direct regulation.

a) In this exercise you are asked to consider the practical implementation of these measures to freight transport, by outlining the extent to which each of the measures indicated could be implemented to the freight transport industry in an attempt to control the air emissions of vehicles. You should consider the actual mechanism through which these measures would actually be realised and also consider the extent to which you would seek 'equality' between different modes of transport. Although most of your cases will probably be based upon implementation to the road haulage industry, you should also ensure that you consider what measures you would take with regard to the other modes of freight transport.

b) You should then weigh up the advantages and disadvantages of each of the tools outlined and come to some conclusion regarding which would be your 'preferred' approach. You should highlight the reasons why you favour that particular method giving particular emphasis to the concept of sustainable development.

c) Once you have considered how to implement these measures, you should then identify any potential institutional barriers that may exist concerning the implementation of the policies that you have identified in part (a).

Exercise 12.3 Some thoughts for discussion

1 While we saw in Chapter 10 strong arguments for the co-ordination of public transport services by public sector agencies, do you consider that there are any arguments for similar arrangements to be made for freight transport? As possibly a toned down version of this thought, you may wish to consider more general arguments in favour of greater public intervention in freight transport markets.

2 Why do you consider that little action with regard to addressing the problems facing the freight transport industries occurs at a national level and more at the international level, such as through the European Union? What factors do you believe have to change in order to change thinking on this issue?

3 Are the problems facing the freight transport industry the same as the problems facing passenger transport markets?

4 Why do you consider that freight transport tends to be far lower on the political agenda than passenger transport issues? Do you believe that reading this book has put you in a position that you are now more able to answer this question than you were before?