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OUTLOOK FOR AIR TRANSPORT TO THE YEAR 2005

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FOREWORD

Introduction

1. This circular is the third in a series to be issued biennially or triennially (the previous edition — *Outlook for Air Transport to the Year 2003* — was published in 1995 as Circular 252 and the first edition was published in 1992 as Circular 237). The present circular contains information on air transport trends and challenges and long-term airline passenger and freight traffic forecasts, in total and by region of registration, for the period through to the year 2005. In addition, it includes passenger traffic forecasts for international route groups and global forecasts of aircraft movements, again through to the year 2005.

Sources of information

2. In addition to the ICAO Digests of Statistics, use has been made of many of the Organization's economic studies and of the Annual Reports of the Council to the Assembly for the years 1985 to 1995. Sources of information other than ICAO, referred to in the text, include the appropriate and most recently available statistical publications of the United Nations; the United Nations Conference on Trade and Development (UNCTAD); the European Civil Aviation Conference (ECAC); the Organization for Economic Co-operation and Development (OECD); the International Air Transport Association (IATA); the Association of European Airlines (AEA); the United States Department of Transportation (DOT); the World Tourism Organization (WTO); the International Monetary Fund (IMF); the World Bank; and Wharton Econometrics Forecasting Associates (WEFA).

3. Unless indicated otherwise, all references in this circular to "cents" mean U.S. cents, and all references to "dollars" mean U.S. dollars; references to "billion" mean one thousand million.

Status

4. This circular has been approved by the Secretary General and is published under his authority.

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Chapter 1
SUMMARY

1. During the period 1960-1995, the aggregate economic activities of the world measured by Gross Domestic Product (GDP) increased at an average annual rate of 3.7 per cent in real terms. The average annual growth rates for the periods 1960-1970, 1970-1980, 1980-1990 and 1990-1995 were 4.8, 3.6, 3.0 and 2.8 per cent, respectively.

2. Growth in air transport has been much greater than economic growth but is closely linked with it. World airline scheduled passenger traffic (domestic and international) measured in terms of passenger-kilometres performed (PKP) increased at an average annual rate of 8.9 per cent for the 1960-1995 period. For the periods 1960-1970, 1970-1980, 1980-1990 and 1990-1995, traffic grew at an average annual rate of 13.4, 9.0, 5.7 and 3.4 per cent, respectively.

3. World airline scheduled freight traffic (domestic and international) measured in terms of tonne-kilometres performed (TKP) increased at an average annual growth rate of 11.1 per cent over the 1960-1995 period. For the periods 1960-1970, 1970-1980, 1980-1990 and 1990-1995, freight traffic grew at an average annual rate of 17.8, 10.9, 7.2 and 5.6 per cent, respectively.

4. The growth in passenger and freight traffic demand over the 1960-1995 period resulted in comparable growth in terms of aircraft seats and payload, while aircraft movements measured in terms of aircraft departures grew at a much slower rate (2.7 per cent per annum) due primarily to a large increase in average aircraft size during this period.

5. During the period 1960-1995, average world passenger yield measured in real terms (expressed in U.S. cents per PKP) declined at a rate of 2.2 per cent per annum. Freight and mail yield measured in real terms (expressed in U.S. cents per TKP) decreased at a rate of 3.7 per cent per annum. During the same period, unit costs (operating cost per available tonne-kilometres (ATKs)) measured in real terms declined at an average annual rate of 2.3 per cent.

6. Future growth of air transport will continue to depend primarily on world economic and trade growth and airline cost developments (which are in turn heavily dependent on fuel prices). This growth will also be influenced, however, by the extent to which the industry faces up to major challenges such as airport and airspace congestion, environmental protection and increasing capital investment needs. The shape and size of the air transport system will also be affected by governmental decisions, notably those determining the type and extent of economic regulation of airlines.

7. For the forecast period 1995-2005, world economic growth (GDP) is expected to increase at an average annual rate of 2.5 per cent in real terms. Airline yields are expected to decline by 0.5 per cent for the first five years of the forecast period and to remain constant for the last five years of the forecast period.

8. World scheduled traffic measured in terms of passenger-kilometres performed is forecast to increase at a "most likely" average annual rate of 5.5 per cent for the period 1995-2005. International traffic is expected to increase at 7.0 per cent per annum, while domestic traffic is expected to increase at an average annual rate of 3.5 per cent.

9. The airlines of the Asia/Pacific region are expected to show the highest growth in passenger traffic at 8.5 per cent per annum through to year 2005. Airline traffic in the Middle East region is expected to grow at about the world average at 5.5 per cent per annum; in the Latin American and European regions, it is expected to increase at 5.0 and 4.5 per cent per annum, respectively. The airlines of Africa and North America are expected to show traffic growth at around 4 per cent per annum.

10. Forecasts of the number of passengers carried on scheduled services in nine intercontinental route groups show the transpacific and the Europe-Asia markets as the fastest growing, at 7.0 and 7.5 per cent per annum, respectively, for the forecast period through to the year 2005.

11. World scheduled freight traffic measured in terms of tonne-kilometres performed is forecast to increase at a "most likely" average annual rate of 7.0 per cent for the period 1995-2005. International freight traffic is expected to increase at an average annual growth rate of 7.5 per cent compared with a domestic freight traffic growth of 3.5 per cent per annum. The regional pattern of growth is expected to be similar to that of passenger traffic. Airline traffic in the Asia/Pacific region is expected to remain the fastest growing (at 9.5 per cent per annum).

12. Aircraft movements in terms of aircraft departures and aircraft kilometres flown for the period 1995-2005 are expected to increase at average annual growth rates of 2.5 and 4.5 per cent, respectively.

13. Tables 1-1, 1-2 and 1-3 provide summaries of global, regional and route group forecasts, respectively.

Table 1-1. Summary of ICAO air traffic forecasts for the year 2005
(world-wide)

	Actual 1985	Actual 1995	Forecast 2005	Average annual growth rate (per cent) 1985-1995	1995-2005*
TOTAL SCHEDULED SERVICES					
Passenger-kilometres (billions)	1 367	2 228	3 807	5.0	5.5
Freight tonne-kilometres (millions)	39 797	83 082	163 950	7.6	7.0
Passengers carried (millions)	899	1 285	2 010	3.6	4.5
Freight tonnes carried (thousands)	13 742	21 488	34 600	4.6	5.0
Aircraft-kilometres (millions)[1]	10 598	18 279	28 400	5.6	4.5
Aircraft departures (thousands)[1]	11 953	16 754	21 400	3.4	2.5
INTERNATIONAL SCHEDULED SERVICES					
Passenger-kilometres (billions)	590	1 241	2 395	7.7	7.0
Freight tonne-kilometres (millions)	29 384	70 273	145 720	9.1	7.5
Passengers carried (millions)	194	373	680	6.8	6.0
Freight tonnes carried (thousands)	5 884	12 982	24 400	8.2	6.5

* Rounded to the nearest 0.5 percentage point.
[1] Excludes the Commonwealth of Independent States (CIS).

Table 1-2. Summary of ICAO air traffic forecasts for the year 2005
(by region of airline registration)

	Actual 1985	Actual 1995	Forecast 2005	Average annual growth rate (per cent) 1985-1995	1995-2005*
TOTAL SCHEDULED SERVICES					
Passenger-kilometres (billions)					
Africa	36.7	51.0	77	3.3	4.0
Asia/Pacific	222.3	549.7	1 260	9.5	8.5
Europe	428.2	549.3	870	2.5	4.5
Middle East	42.7	67.0	115	4.6	5.5
North America	569.2	902.7	1 310	4.7	4.0
Latin America and Caribbean	68.3	107.9	175	4.7	5.0
Freight tonne-kilometres (millions)					
Africa	1 163	1 418	2 050	2.0	4.0
Asia/Pacific	9 605	28 346	71 000	11.4	9.5
Europe	14 422	24 607	40 900	5.5	5.0
Middle East	1 880	3 775	6 800	7.2	6.0
North America	10 622	21 253	36 200	7.2	5.5
Latin America and Caribbean	2 105	3 683	7 000	5.8	6.5
INTERNATIONAL SCHEDULED SERVICES					
Passenger-kilometres (billions)					
Africa	28.6	42.1	65	3.9	4.5
Asia/Pacific	150.2	372.9	870	9.5	9.0
Europe	202.7	426.8	735	7.7	5.5
Middle East	35.2	57.1	100	5.0	6.0
North America	125.3	271.7	495	8.0	6.0
Latin America and Caribbean	36.5	70.3	130	6.8	6.5
Freight tonne-kilometres (millions)					
Africa	1 070	1 320	1 920	2.1	4.0
Asia/Pacific	8 589	26 243	66 900	11.8	10.0
Europe	11 589	23 815	40 000	7.5	5.5
Middle East	1 807	3 694	6 700	7.4	6.0
North America	4 842	12 162	24 000	9.6	7.0
Latin America and Caribbean	1 487	3 039	6 200	7.4	7.5

* Rounded to the nearest 0.5 percentage point.

Table 1-3. Summary of ICAO air traffic forecasts for the year 2005
(by international route group)

	Passengers carried (thousands)			Average annual growth rate (per cent)	
	Actual 1985	Actual 1995	Forecast 2005	1985-1995	1995-2005*
North Atlantic	20 964	38 100	59 168	6.2	4.5
Mid Atlantic	1 471	2 570	4 186	5.7	5.0
South Atlantic	1 244	3 260	5 838	10.1	6.0
Transpacific	8 028	19 213	37 795	9.1	7.0
Between Europe and Asia/Pacific	5 870	20 400	42 045	13.3	7.5
Between Europe and Africa	9 280	11 000	14 783	1.7	3.0
Between Europe and Middle East	3 920	7 080	9 987	6.1	3.5
Between North America and South America	2 622	7 445	14 100	11.0	6.5
Between North America and Central America/Caribbean	15 562	24 684	38 333	4.7	4.5
Total above routes	68 961	133 752	226 237	6.8	5.5
Other routes	124 974	239 007	453 763	6.7	6.5
Total world	193 935	372 759	680 000	6.8	6.0

* Rounded to the nearest 0.5 percentage point.

Chapter 2
AIR TRANSPORT TRENDS AND CHALLENGES

ECONOMIC GROWTH AND AIRLINE TRAFFIC PATTERNS

1. Air transport has for many years experienced greater growth than most other economic sectors. Increasing demand for passenger and freight services, rapid technological development and associated investment have combined to multiply the output of the industry by a factor of nearly 23 since 1960 (in terms of tonne-kilometres performed). To put this in perspective, the total world Gross Domestic Product (GDP), which is the broadest available measure of world output, has multiplied by 3.8 times over the same period.

2. While growth in world air traffic has been much greater than world economic growth, economic theory and analytical studies indicate that there is a high correlation between the two and that the demand for air transport is primarily determined by economic development. Developments in personal income affect the level of consumer purchasing power and the propensity to undertake leisure travel. Commercial activity and trade have a direct impact on the demand for business travel and for air freight. Figure 2-1 provides evidence of the relationship between the economy and traffic demand by illustrating the fluctuations in the rate of growth of each for the period 1960 to the present. The economic recessions of 1974-1975, 1980-1982 and 1990-1991 and their impact on air traffic are clearly visible.

3. Other factors which have affected traffic demand include changes in airline costs, and hence fares and rates, availability of air services, regulatory developments and tourism. Rapid growth in the 1960s coincided with the replacement of piston-engined aircraft with jet aircraft which led to reduced real fares and increased speed and comfort of travel. Sharp changes in oil prices have had important effects on traffic demand. In addition to an adverse effect on the world economy, the ten-fold increase in crude oil prices in 1973-1974, and further escalation in 1979-1981 (since ameliorated), greatly increased aviation fuel prices and hence air fares and rates.

SCHEDULED PASSENGER, FREIGHT AND MAIL TRAFFIC

4. The growth experienced by the total demand for air transport has been shared by each of its major components — passenger, freight and mail traffic. As shown in Table 2-1, however, the average growth in each of these components has declined since the 1960s. The decline in the growth in mail traffic has been particularly severe, partly because of increasing competition from telecommunications.

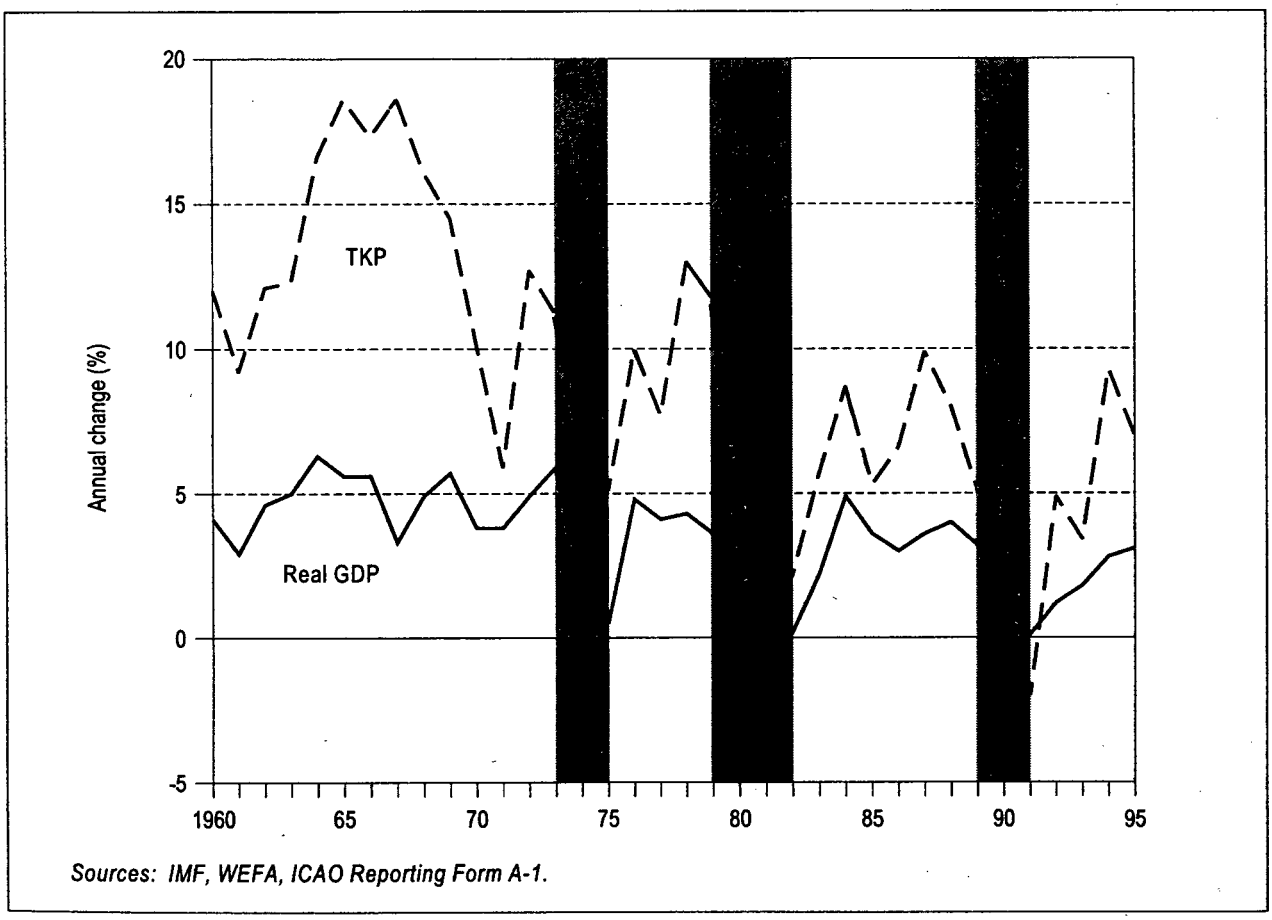
5. In 1995, the world's airlines carried 1.3 billion passengers and 21.5 million tonnes of freight on scheduled services. Airlines generated 2 228 billion scheduled passenger-kilometres (equivalent to 203 billion tonne-kilometres), 83 billion scheduled freight tonne-kilometres and 5.6 billion scheduled mail tonne-kilometres in 1995.

Table 2-1. Growth of passenger, freight and mail air traffic, 1960 to 1995

	Average annual growth (per cent)		
	1960-1975	1975-1985	1985-1995
Passenger-kilometres	11.7	7.0	5.0
Freight tonne-kilometres	15.3	7.5	7.6
Mail tonne-kilometres	9.7	4.3	2.4
Total tonne-kilometres	12.4	7.1	5.7

Source: ICAO Reporting Form A-1.

Note.— Includes domestic and international scheduled traffic.



Sources: IMF, WEFA, ICAO Reporting Form A-1.

Figure 2-1. World economic and airline traffic growth
(GDP in real terms and total scheduled tonne-kilometres performed)

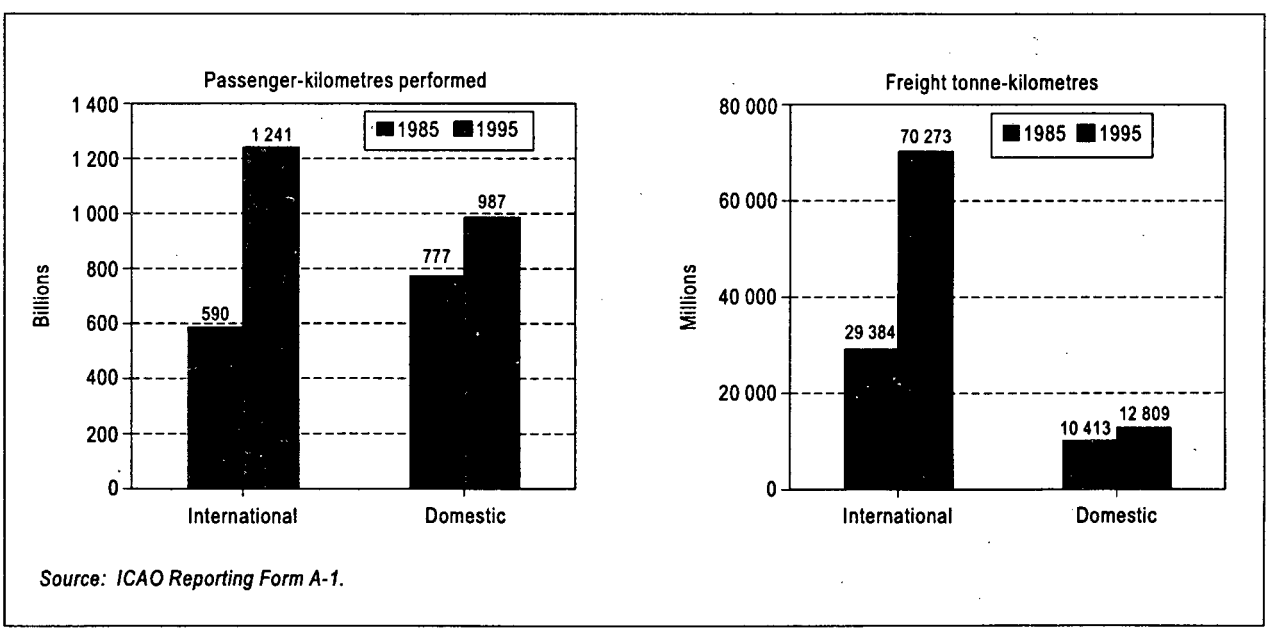
SCHEDULED INTERNATIONAL AND DOMESTIC TRAFFIC

6. International traffic has tended to grow more rapidly than domestic traffic, particularly in the case of freight. Figure 2-2 shows the increases over the period 1985 to 1995 in the international and domestic components of both scheduled passenger and scheduled freight traffic. The United States and the Commonwealth of Independent States (CIS) are the dominant producers of domestic air traffic (traffic between CIS States being considered as domestic until very recently), accounting for 70 per cent of total domestic passenger and freight traffic.

SCHEDULED INTERNATIONAL TRAFFIC BY REGION

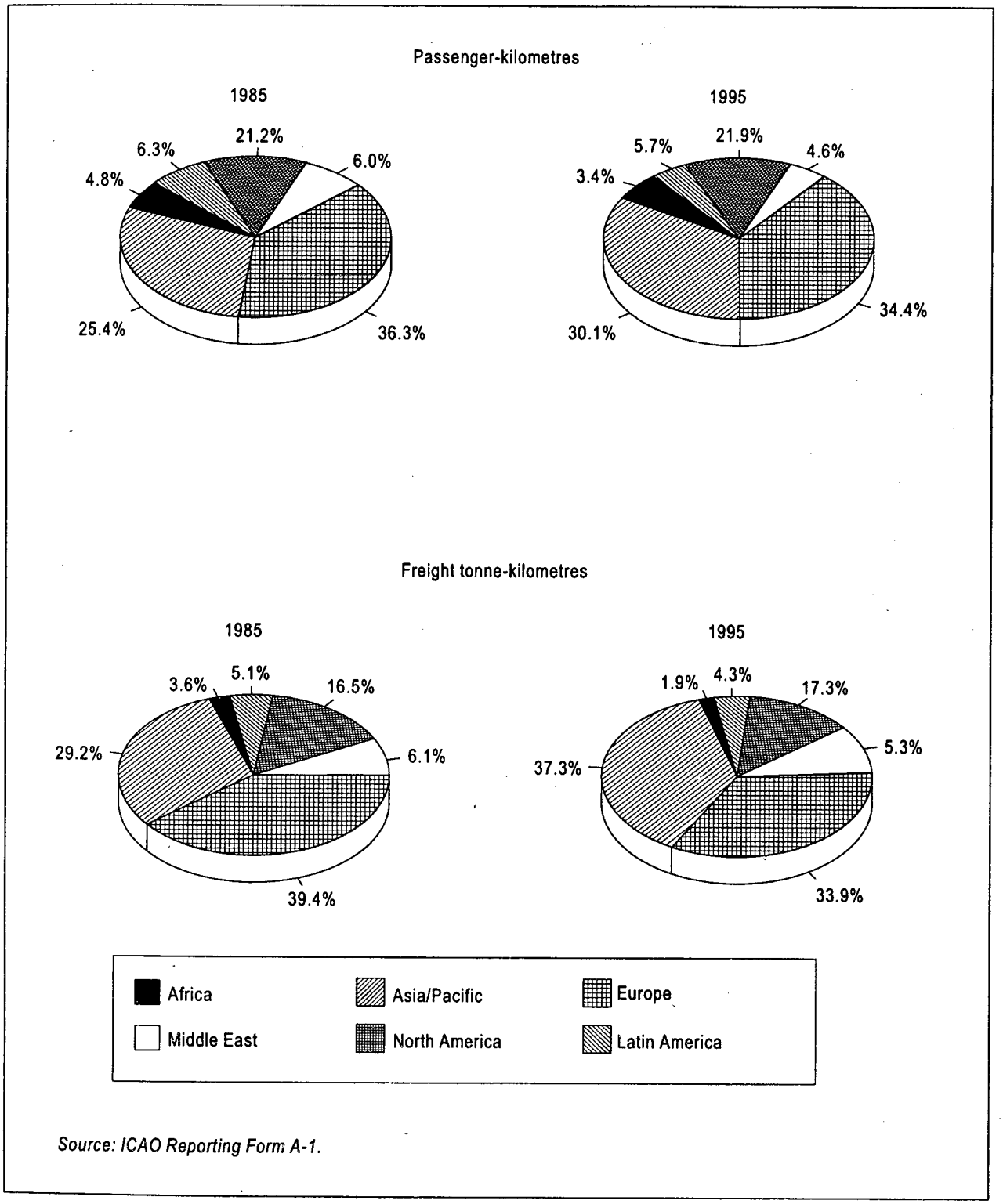
7. Turning to the regional pattern of scheduled international traffic, Figure 2-3 shows the shares of international traffic by region of airline registration in 1985 and 1995. European airlines retain the largest share of both passenger and freight traffic, but their share declined over the period concerned, while the share of Asia/Pacific airlines grew substantially.

8. Scheduled passenger traffic trends between 1985 and 1995 on some intercontinental route groups are illustrated in Figure 2-4. The strength of the North Atlantic market, in terms of its size (38 million passengers in 1995) and growth (82 per cent between 1985 and 1995), is clearly illustrated. However, the fastest growing markets were the transpacific and Europe-Asia/Pacific route groups.



Source: ICAO Reporting Form A-1.

Figure 2-2. Trends in international and domestic traffic
(scheduled operations, 1985 and 1995)



Source: ICAO Reporting Form A-1.

Figure 2-3. Regional shares of international traffic
(scheduled operations, 1985 and 1995)

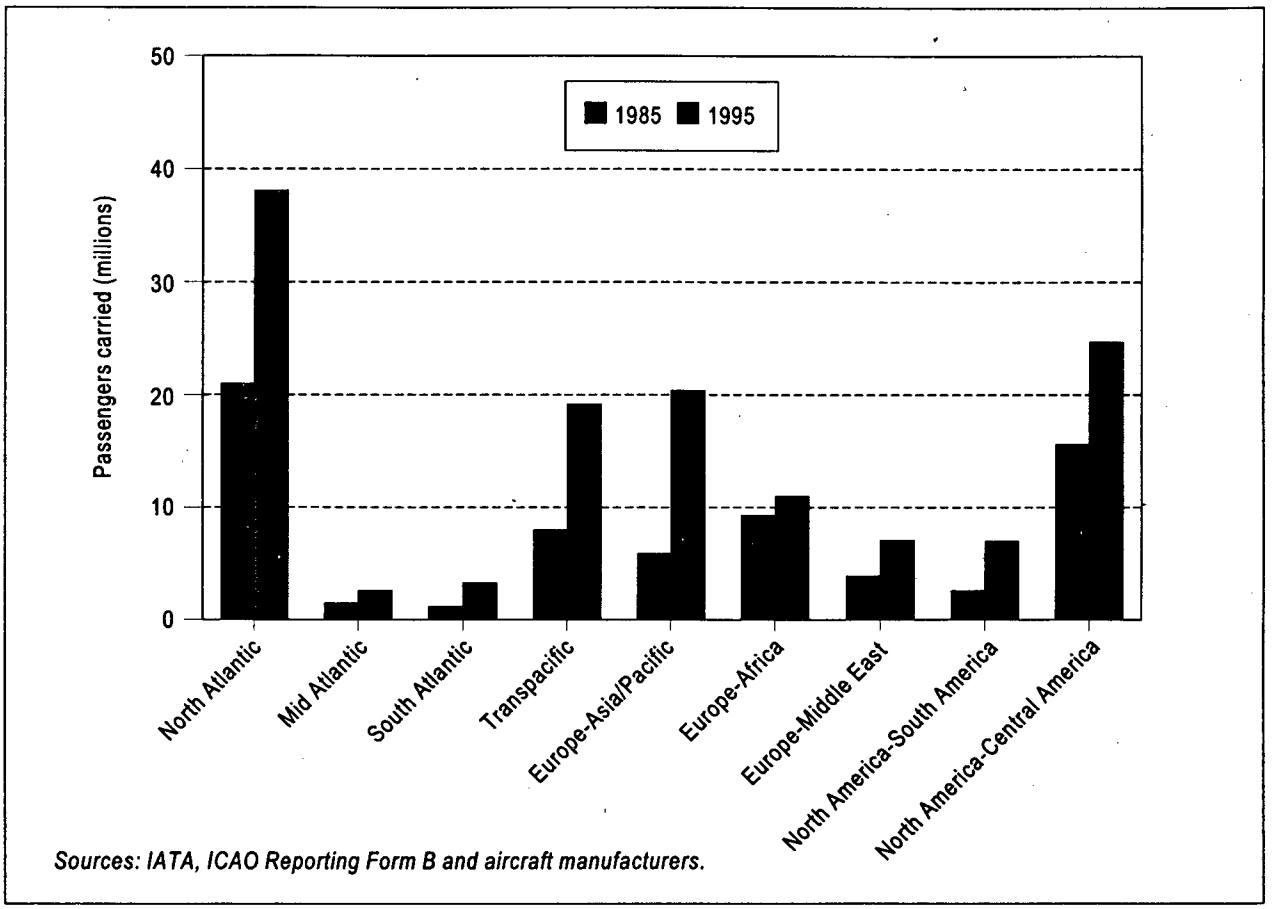


Figure 2-4. Passengers on intercontinental route groups
(scheduled operations, 1985 and 1995)

NON-SCHEDULED TRAFFIC

9. The global development of non-scheduled traffic has been partially masked by some statistical reporting deficiencies among non-scheduled air carriers. Available data, however, permit some indications of the development and importance of charter traffic.

10. Non-scheduled air transport is primarily devoted to international passenger traffic, with freight traffic and domestic traffic being relatively small by comparison. Non-scheduled passenger traffic represents about 17 per cent of the total international passenger traffic. Table 2-2 provides estimates for 1985 and 1995 of non-scheduled passenger traffic carried by non-scheduled carriers and by scheduled carriers. Growth in their combined non-scheduled international traffic was around 6.5 per cent per annum on average during the 1985 to 1995 period, below the 7.7 per cent per annum growth rate for scheduled international traffic.

11. Non-scheduled traffic is very important on intra-European routes, where it accounts for about half of all passengers. Intra-European non-scheduled traffic accounts for more than 50 per cent of the total world charter market in terms of passengers. Non-scheduled traffic remains quite important on North Atlantic routes, accounting for around 10 per cent of the total North Atlantic market.

Table 2-2. World international non-scheduled passenger traffic
(passenger-kilometres)

	1985 (billions)	1995 (billions)	Average annual growth (per cent)
Non-scheduled carriers	63.8	101.6	4.8
Scheduled carriers	49.9	112.5	8.5
Total	113.7	214.1	6.5

Source: ICAO Reporting Form A-2.

AIRCRAFT MOVEMENTS

12. The growth in passenger and freight traffic demand over the past 35 years has resulted in comparable growth in air carrier capacity. Growth patterns in passenger numbers, aircraft departures and aircraft-kilometres are portrayed in Figure 2-5. A statistical smoothing technique has been used to eliminate large short-term fluctuations in order to better illustrate the trends in the relationships between the variables.

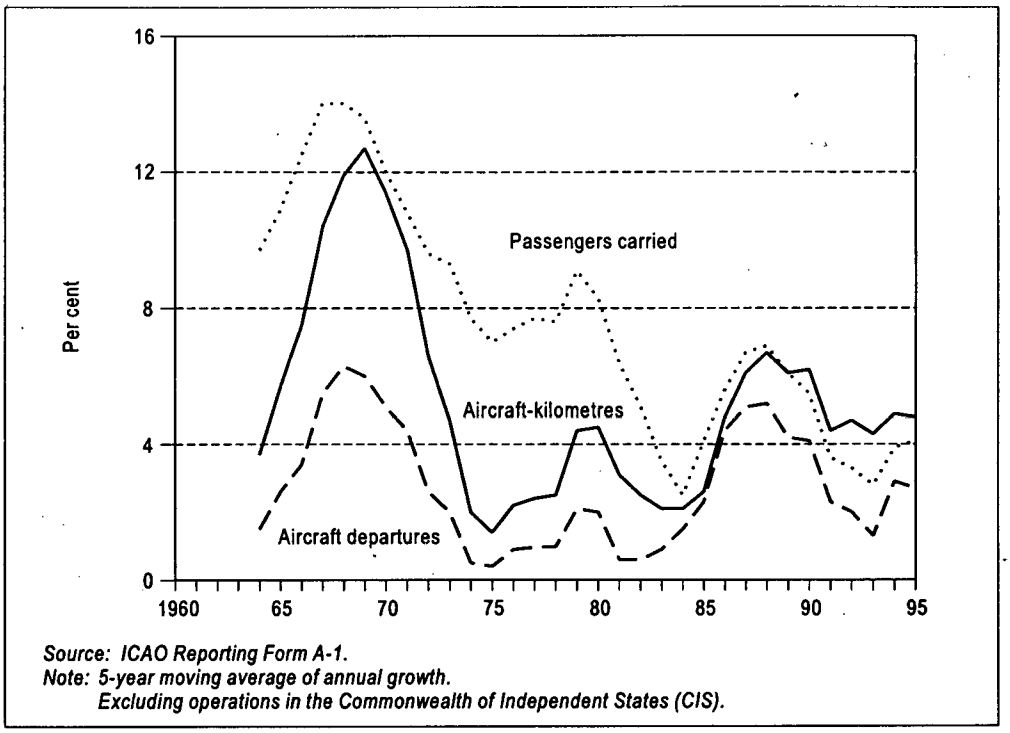
13. The large gap between the growth rates for passengers carried and aircraft departures that existed in the 1960s and 1970s is primarily a reflection of the increases in average aircraft size over this period. In the 1980s, the growth rate for aircraft departures increased towards the passenger growth rate, as this trend in aircraft size levelled out.

14. The growth in aircraft-kilometres has been consistently higher than the growth in aircraft departures, with a particularly large gap in the 1960s and early 1970s, since the average aircraft stage length has been increasing. The rate of increase in average stage length was greatest when jet aircraft were replacing piston-engined aircraft.

FLEET COMPOSITION AND PRODUCTIVITY

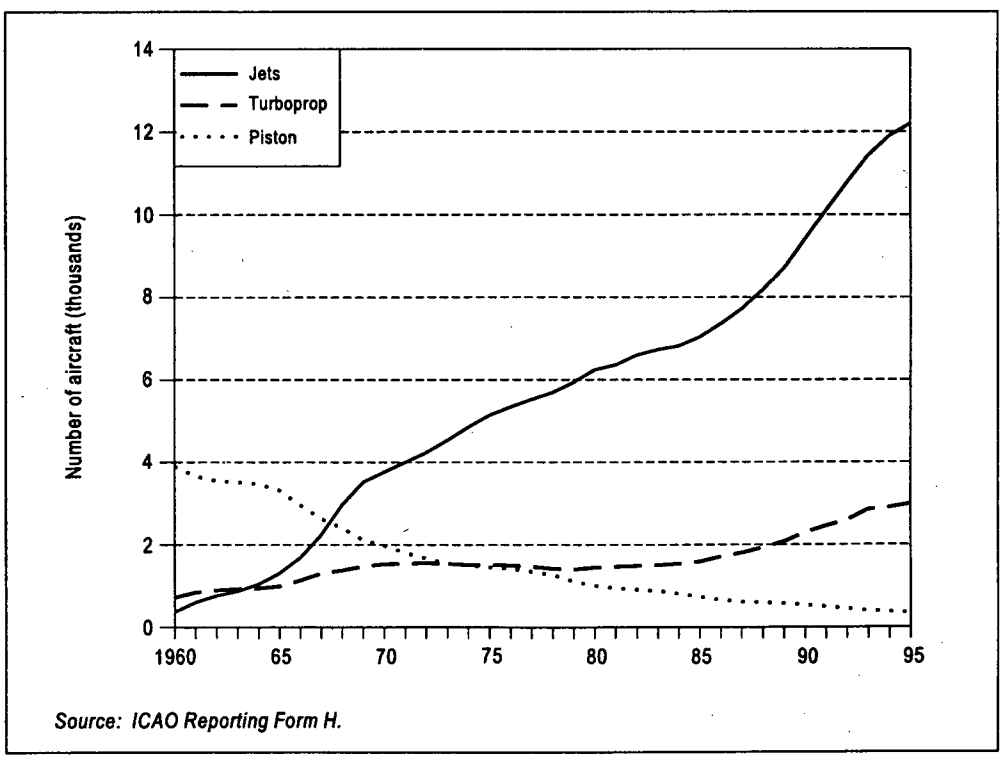
15. At the end of 1995, the scheduled and non-scheduled carriers of ICAO Contracting States (excluding China and the CIS) had a combined fleet of about 15 540 aircraft of over 9 000 kg maximum take-off weight (MTOW) for their international and domestic operations. This is an increase of about 66 per cent over the 1985 fleet. The number of jet aircraft at the end of 1995 was about 12 200, which is an increase of about 73 per cent over 1985. Jet aircraft obviously account for an even larger proportion of carrier capacity than indicated by the relative number of aircraft.

16. Figure 2-6 contrasts the strong upward trend in the number of jet aircraft since 1960 with the slow growth in the number of turboprop aircraft and the decline in piston-engined aircraft. Figure 2-7 illustrates the changing composition of the jet fleet among narrow-body and wide-body and two-, three- and four-engine aircraft. The two-engine narrow-body category has shown the most sustained growth over the whole period and is now dominant in terms of numbers of aircraft (although much less so in terms of total capacity or payload). The number of two-engine wide-body aircraft (now increasingly providing long-haul services) grew rapidly during the 1980s.



Source: ICAO Reporting Form A-1.
Note: 5-year moving average of annual growth.
Excluding operations in the Commonwealth of Independent States (CIS).

Figure 2-5. Growth in passengers and aircraft movements
(total scheduled operations, 1960 to 1995)



Source: ICAO Reporting Form H.

Figure 2-6. Composition of world commercial transport fleet
(aircraft of 9 000 kg MTOW and over)

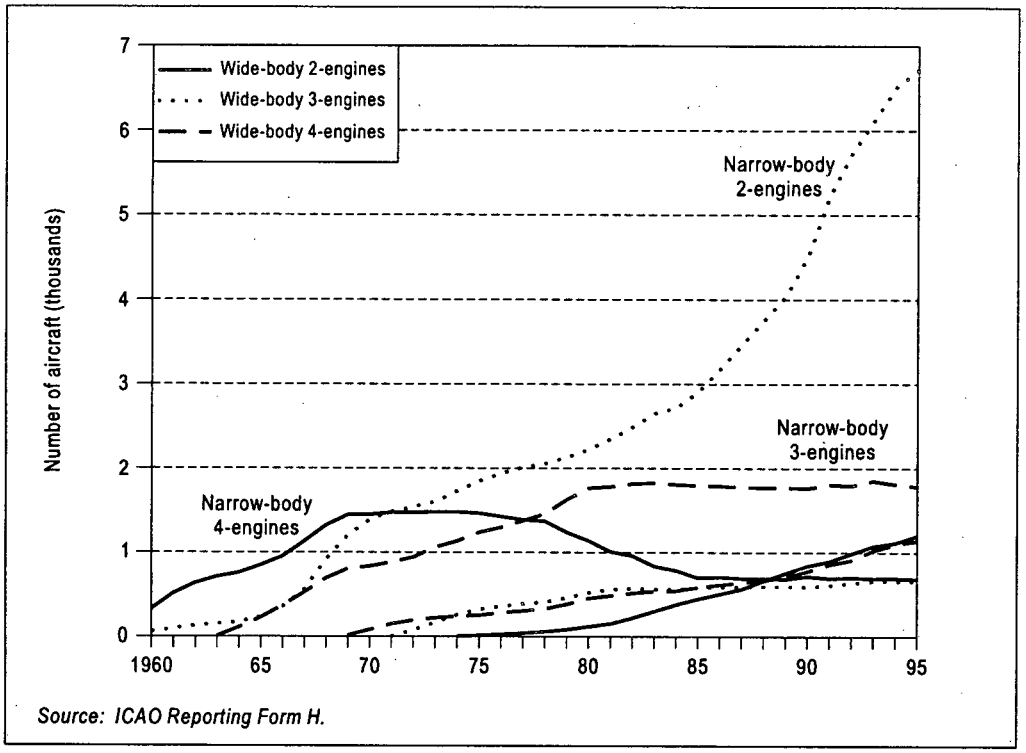


Figure 2-7. Composition of world commercial jet fleet
(aircraft of 9 000 kg MTOW and over)

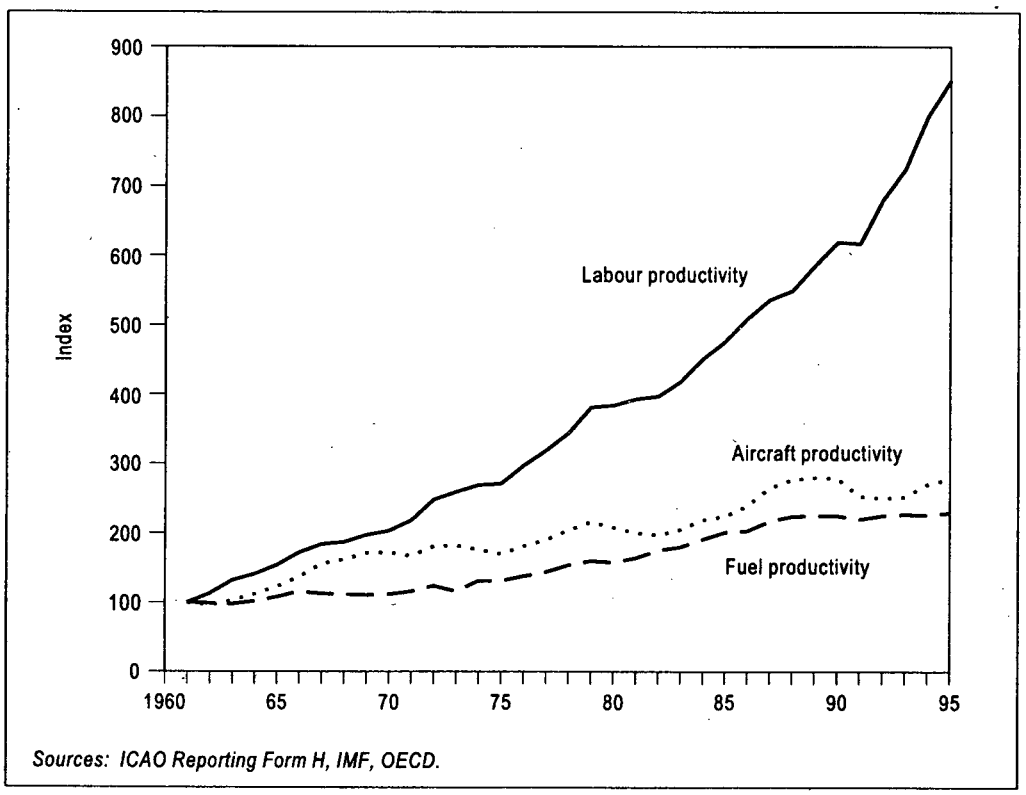


Figure 2-8. Trends in airline productivity

17. The progressive absorption of new technology aircraft into airline fleets has been a major source of productivity improvement for the air transport industry, as measured by the quantity of output per unit of input. A single comprehensive measure of productivity requires comprehensive measures of output and input. For the airline industry, tonne-kilometres performed (TKP), including both passenger and freight traffic, is a good measure of output. However the measurement of productivity is complicated by the diversity of inputs, which include aircraft, labour and fuel among other resources, and also by the complexity of the production process. Several partial productivity measures are shown in Table 2-3 for the aggregated operations of international scheduled airlines. Aircraft productivity refers to the quantity of TKPs that are obtained from the total payload of the scheduled airline fleet. Improvements in the average load factor (the percentage of the capacity provided by aircraft flights which is occupied with revenue-earning passengers and freight), aircraft speed, and aircraft utilization (the extent to which aircraft are kept flying on revenue-earning missions) have all contributed to growth in aircraft productivity, although increased aircraft utilization has had the largest impact over the past 35 years. The three components of aircraft productivity have been combined into a single measure of aircraft productivity whose trend is included amongst those illustrated in Figure 2-8. There have been some fluctuations in performance related to business cycle conditions. Over the whole 35-year period, aircraft productivity has advanced at an average annual rate of about 3 per cent.

18. Estimates for labour productivity, in terms of TKP per employee, are also given in Table 2-3, and the trend in labour productivity is also illustrated in Figure 2-8. The introduction of labour-saving technology and systems has resulted in an impressive 6.5 per cent per annum growth (on average) since 1960. The impact of improvements in aircraft and engine design is also seen in the improvement in fuel productivity which has grown at an average rate of about 2.5 per cent per annum over the same period.

19. Productivity benefits have come from economies of scale as well as from the adoption of new technology. Some of the scale economies are closely related to the new technology. In the 1960s, the new jets were much larger than the propeller aircraft they were replacing. The next generation of jet aircraft, which began replacing the early jets in the 1970s, were larger again. Aircraft size increased from an average capacity of nine tonnes in 1960 to 23 tonnes in 1982. Average aircraft size has not changed much since 1982.

Table 2-3. Developments in airline productivity
(international scheduled airlines)

Productivity measure	Average levels			
	1965	1975	1985	1995
Aircraft productivity				
Aircraft load factor (per cent)	52	50	59	60
Aircraft speed (km/h)	469	619	634	644
Aircraft utilization (hours per aircraft per year)	1 678	2 064	2 179	2 751
Labour productivity				
TKP per employee (thousands)	43	82	144	258
Fuel productivity				
TKP per litre of fuel (index)	100	123	187	213

20. An over-all index of airline productivity has been derived by combining the indices for aircraft, labour and fuel productivity into a single average measure (presented in para. 23 below). The average growth in this measure was about 6 per cent per annum between 1960 and 1995.

RELATIONSHIP BETWEEN PRODUCTIVITY, PRICES AND FINANCIAL PERFORMANCE

21. Having estimated the improvement in productivity performance achieved by the airline industry, the questions of how the improved productivity was used and who received the benefits can be addressed. By reducing the quantities of inputs required to produce a unit of output, productivity growth has the effect of reducing the cost per unit of output. These cost reductions may be used either to reduce real fares and rates paid by passengers and shippers, or to provide airlines with improved financial results.

22. Changes in the real prices paid for inputs (e.g. labour, fuel) purchased by the airlines are also reflected in the cost per unit of output, and hence in real fares and rates or in financial performance. The price trends of two of the most important inputs, labour and jet fuel, are indicated in Figure 2-9, which also shows the trend in the Consumer Price Index (CPI). International Monetary Fund (IMF) indices for industrial countries are used for the labour price and the CPI. The importance of labour cost in the total cost structure of airlines, and the high rate of increase in wage rates suggested in the figure, have together acted as a powerful incentive for the improvement in labour productivity observed in Figure 2-8. Fuel is another key item on the expense side of the accounts. The impact on expenses of the very large fuel price increases in 1973-1974 and 1979-1980 was partly reversed by the price declines in 1985.

23. The trends in productivity, input prices, yields (i.e. fares and rates), and financial performance are summarized in Figure 2-10. A log scale is used so that the slopes of the trend lines represent percentage changes. The productivity measure is the over-all index referred to above. An over-all input price index has also been developed from individual input prices. Input prices and yields are expressed in real terms (i.e. after removing the impact of general inflation). Financial performance is represented by the ratio of revenues to expenses, where expenses are defined to exclude taxes and interest.

24. By and large the productivity gains have not been retained by the airlines over the long term. Most of the cost savings associated with the full range of labour, fuel and aircraft productivity improvements have been passed on to the consumer in the form of lower fares and rates. The impact of productivity improvements has been offset to some extent by the increases in real input prices in the 1970s.

25. Although there have been relatively large changes in the operating results of the airline industry in the short and medium terms, there has been neither an improving nor declining trend in financial performance over the long term. A significant upward or downward trend would not be expected because of the magnified impact such a trend would have on the levels of industry profits or losses.

SAFETY AND QUALITY OF SERVICE

26. Air transport has a strong tradition of giving top priority to safety. While the traffic growth, productivity improvement and cost and yield reductions described above have been occurring, a large improvement in the safety of air travel has been achieved. The number of passenger fatalities per 100 million passenger-kilometres flown has fallen from 0.8 in 1960 to 0.1 in 1975, 0.1 in 1985 and 0.03 in 1995.

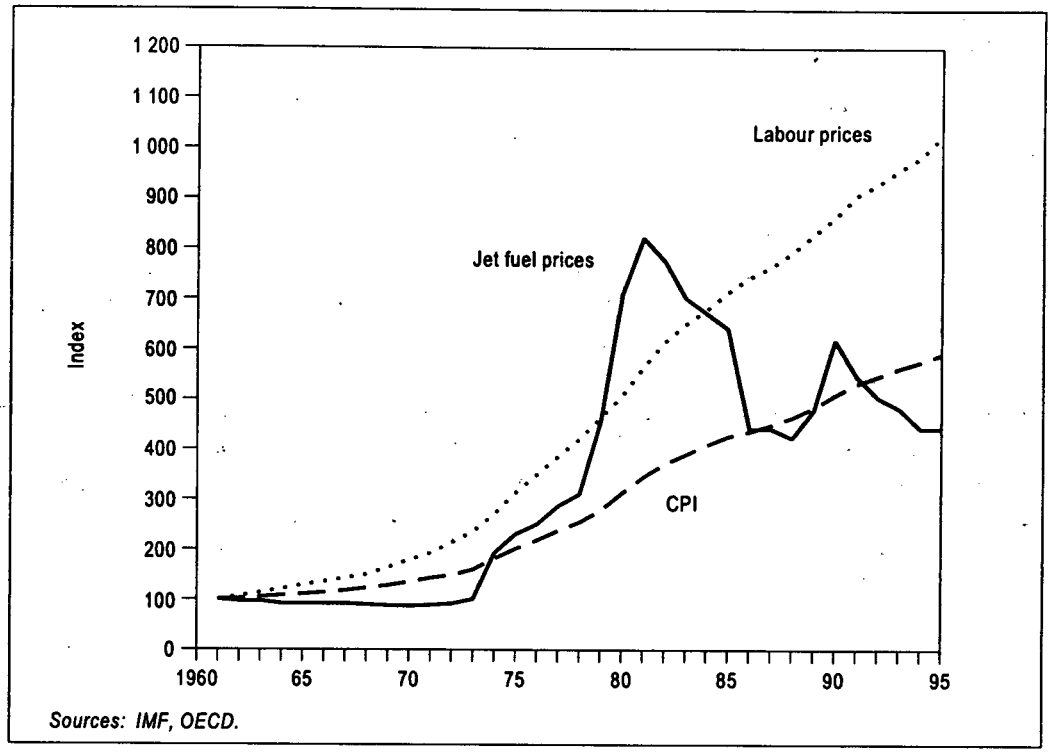


Figure 2-9. Input price trends

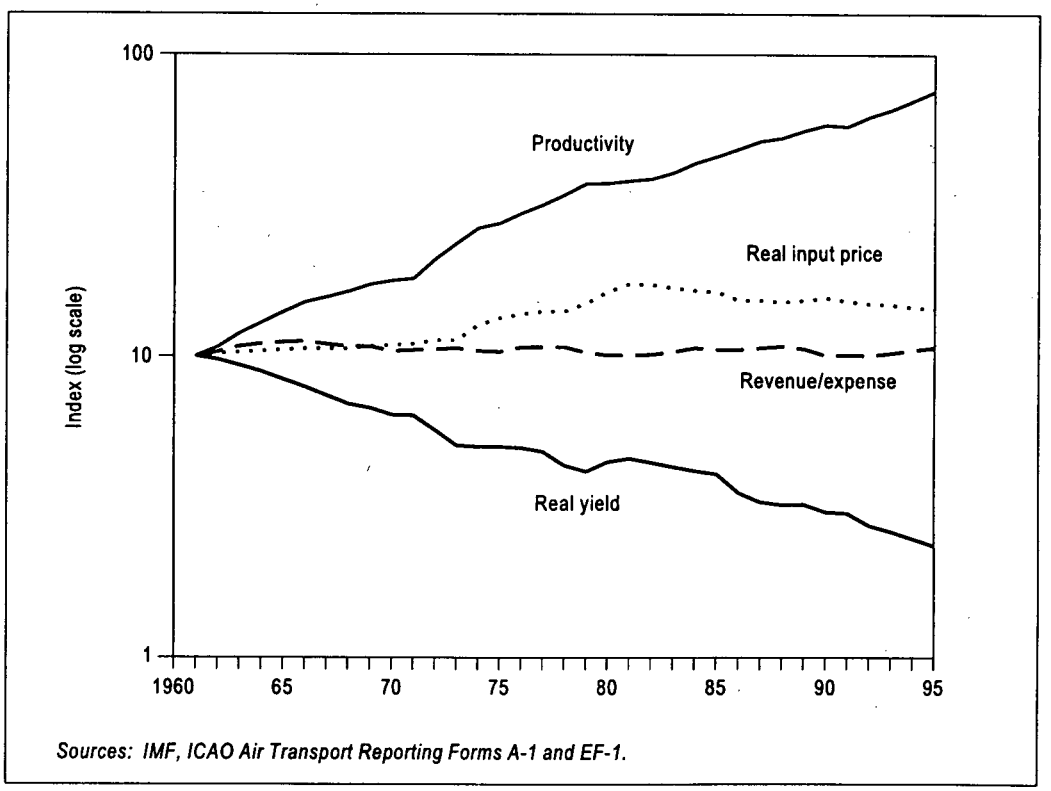


Figure 2-10. Trends in airline industry performance

27. There have also been significant enhancements in the quality of service provided to airline customers. There are many dimensions of the quality of service, including journey time, convenience and reliability of service, comfort in the aircraft cabin and the range of on-board facilities. Some of these factors are difficult to measure in an objective fashion. However, increases in aircraft speed and average stage length (i.e. average length of non-stop flights) have been achieved, with positive consequences for journey times and passenger convenience. The global average block-to-block aircraft speed increased from 360 kilometres per hour in 1960 to 620 kilometres per hour in 1980 (an increase of 72 per cent). There has been little change in block speed since 1980. The average stage length has more than doubled from 470 kilometres in 1960 to 1 091 kilometres in 1995. This latter trend has been associated with more direct flights and fewer stopovers for refuelling, and hence a greater level of convenience for the passenger. The combined effect of increased aircraft speeds and fewer stopovers reduced the total journey time from Sydney to London from three and a half days in 1950 to under one day in 1995. Over the same period, the journey time from New York to London was reduced from 17 hours to just under 7 hours for most flights and less than 4 hours for Concorde flights.

28. With the growth in air transport demand in response to factors such as general economic development, airlines have been able to increase service frequency and introduce non-stop flights for a greater range of city-pairs without increasing costs. This improved service has, in turn, led to growth stimulation of demand. While it is not possible to isolate cause and effect, the fact that aircraft departures have increased by 155 per cent between 1960 and 1995 is evidence of improvement in service frequency and convenience.

AIRPORT AND AIRSPACE CONGESTION

29. During the 1980s, growth in passenger numbers of over 50 per cent and in aircraft departures of about 35 per cent resulted in airport and airspace congestion in some regions. A pause in traffic growth and measures to increase capacity provided some relief in the early 1990s. With vigorous growth in aircraft movements now occurring, however, further pressure on facilities is expected. In some congested areas, the limits to terminal and runway expansion are being reached at some major airports. The land-intensive characteristics of airports and their environmental impact are serious barriers to the provision of extra runway capacity and, to a lesser extent, terminal capacity. Furthermore, many air traffic control systems are aging and in need of upgrading.

30. Technological developments and investment in aircraft, airports and air navigation equipment will create more capacity in the air transport system to help meet future demand. A number of new airports as well as airport expansion projects are due for completion over the next few years; much of this activity is in the Asia/Pacific region. The new global communications, navigation and surveillance/air traffic management (CNS/ATM) systems being implemented through ICAO are expected to lead to significant improvements in the management of air traffic in all phases of flight. These systems will utilize the services of networks of navigation and communications satellites to replace existing line-of-sight systems and provide more accurate navigation, more comprehensive surveillance and greatly improved communications.

31. There are also various technical procedures, such as revisions to separation criteria, which can improve the flow of air traffic and reduce congestion delays. The provision of access and exit taxiways can increase runway capacity. In regard to congestion inside terminals, a number of States are reaching the goals of ICAO's facilitation programme such as clearing all arriving passengers (requiring normal

inspection) through international airports within 45 minutes. The progressive introduction of machine readable travel documents and the general streamlining of procedures will be of increasing importance in the continuing search for improvements.

32. These are essentially supply-side measures which can effectively increase the capacity of the infrastructure. Other policies under consideration include pricing structures and regulatory controls such as slot allocation which act on the demand side.

33. The continuing development of high-speed rail services in Europe, in Japan and, to a limited extent, in the United States is expected to draw some air traffic from congested facilities.

ENVIRONMENTAL PROTECTION

34. Future growth in civil aviation will take place against a background of increasing public concern regarding the environment, particularly with regard to aircraft noise and the impact of aircraft engine emissions.

35. Noise levels near airports are subject to two opposing trends: the replacement of noisy aircraft by quieter ones and the increasing number of aircraft movements. ICAO has developed noise certification Standards (Annex 16, Volume I) and in 1990 adopted a world-wide policy enabling States to phase in operating restrictions on the older, noisier ("Chapter 2") aircraft covered by these standards between 1995 and 2002. Aircraft noise is therefore likely to decline in general terms over this period but may eventually increase again.

36. Initially, the main concern regarding aircraft engine emissions was the impact on air quality in the vicinity of airports, as a result of which ICAO developed Standards for the control of gaseous emissions through an engine certification scheme (Annex 16, Volume II). More recently, there have been increasing concerns that these emissions may be contributing to global atmospheric problems.

37. One such problem is global warming. A recent Intergovernmental Panel on Climate Change (IPCC) scientific assessment[1] indicates that the current aircraft fleet has a direct influence on global warming, although this is comparatively small — it is estimated that aircraft contribute approximately 3 per cent of the total carbon dioxide (the principal greenhouse gas) from fossil fuel combustion. In addition, nitrogen oxides (NO_x) emitted at the altitudes where subsonic aircraft fly are currently thought to lead to the formation of tropospheric ozone, which at these altitudes is also a greenhouse gas. Although the total amount of NO_x emitted by aircraft is not large, the altitude at which it is emitted enhances its effect on ozone formation. While the over-all effect of NO_x on global warming is uncertain, IPCC has attempted to put an upper limit on its impact. Its best estimate is that it could be of similar magnitude, or smaller, than the effect of carbon dioxide from aircraft. In addition, IPCC notes that aircraft also emit carbon monoxide, water vapour, soot and other particles, sulphur gases and other trace constituents which have the potential to cause radiative forcing, but the impact of these emissions has not yet been properly assessed.

1. Summary for Policymakers of the 1994 Working Group 1 Report on *Radiative Forcing of Climate Change*, Intergovernmental Panel on Climate Change.

38. A second global atmospheric problem of relevance to civil aviation, particularly for any future generation of supersonic aircraft, is depletion of stratospheric ozone. The most recent Montreal Protocol scientific assessment[2] indicates that the peak level of stratospheric ozone depletion occurs at the altitudes at which these aircraft would fly. Estimates of the effect of a large fleet (500) of future supersonic aircraft indicate a possible ozone decrease of 0.3 to 1.8 per cent for the Northern Hemisphere, but these figures are based upon many assumptions about the fleet which may not be accurate and are derived from atmospheric models which are still under development.

39. Against this background ICAO, through its Committee on Aviation Environmental Protection (CAEP), has been intensifying its efforts to address aircraft engine emissions. ICAO has initiated contacts with other international organizations aimed at reaching a consensus regarding the extent to which aircraft engine emissions are contributing to such problems, based on as complete and accurate information as possible. In September 1996, it was agreed that the IPCC would prepare a Special Report on "Aviation and the Global Atmosphere", which would be completed, in conjunction with the Montreal Protocol Science Panel and in association with ICAO, in late 1998.

40. Once there is a clear understanding of aviation's contribution to global atmospheric problems, CAEP will try to identify appropriate solutions as necessary. Such solutions could include further development of the existing ICAO Standards. In the case of the pollutants that are controlled by the Standards, the focus of attention is likely to be on NO_x, which is produced when fuel is burned at high temperatures. Technology offers the prospect of improvement here, although this is by no means straightforward and will take some time. In the case of carbon dioxide (which is not controlled by the present Standards), this is an unavoidable product of fossil fuel combustion and therefore improvements can only be achieved by reducing the amount of fuel used or by using non-fossil fuels. In addition to further development of ICAO Standards, other solutions that might need to be considered are operational measures and the possible use of pricing mechanisms.

FINANCIAL RESOURCES

41. The implications of aging equipment, traffic growth and technology developments for investment in civil aviation were explored in an ICAO study on *Investment Requirements for Aircraft Fleets and for Airport and Route Facility Infrastructure to the Year 2010* (Circular 236). It was estimated that some $800 billion of investment funds will be required between 1991 and 2010 for air carrier fleets and about $250-$350 billion for airport and en-route facilities. The study also identified many different types of financing (e.g. debt, equity, leasing arrangements, cash flow from operations) and sources of funds (e.g. governments, commercial and development banks, export credit institutions) and noted the need for further innovation in order to meet the funding requirements.

42. Investment in new aircraft generally follows a cyclical pattern. The latter part of the 1980s was a period of high investment. Investment levels fell away during the recession of the early 1990s but are beginning to build up again. The expected future funding requirement over the long term is substantially larger, in real terms, than was required over comparable periods in the past. This is consistent with the ongoing growth in traffic that is forecast over the long term.

2. Executive Summary of the WMO/UNEP *Scientific Assessment of Ozone Depletion: 1994.*

ECONOMIC REGULATION

43. The shape and size of the air transport system will continue to be influenced by governmental decisions at the national, bilateral and multilateral levels. Although these decisions continue to be made largely by air transport authorities, bodies outside of the traditional aviation regulatory regimes have become increasingly involved in airline regulation. For example, the establishment of the World Trade Organization on 1 January 1995 by the Final Act of the Uruguay Round of trade negotiations, and the coming into force of the General Agreement on Trade in Services (GATS) with an Annex on Air Transport Services (which includes the repair and maintenance of aircraft, the sale and marketing of air transportation, and computer reservation systems), brought another entity onto the aviation regulatory scene as well as new obligations in the three specific air transport services in the GATS. Another example is the increasing tendency to apply or rely on competition laws with respect to certain international air transport activities.

44. Three significant developments within the aviation regulatory structure have been: the actions taken by many governments towards less detailed regulation of the commercial activities of airlines coupled with promotion of competition and greater reliance on airlines responding to market forces as opposed to governmental decisions to determine the type and amount of air services provided; the widespread use of alliances and co-operative devices such as codesharing to obtain access to new markets and to better serve existing ones; and industry concentration in both domestic and international markets. These developments have involved aviation regulatory authorities in questions such as what measures are needed to ensure fair competition in not only the operation of international air services but also their sales and marketing, what effect subsidies have, and when and under what conditions should airline alliances and codesharing arrangements be approved.

45. At the national level, a number of regulatory authorities continue to be occupied with complete or partial privatization of government-owned airlines and the often-related question of foreign investment in airlines, with several governments changing or clarifying their positions concerning foreign investment in their national airlines. Minority equity participation in national airlines by foreign airlines, often a means of indirect market access, has occurred with increasing frequency in all regions. The permissible levels of such foreign investment generally range from 20 to 49 per cent, are often accompanied by other requirements, such as reciprocity, and have become an issue in some bilateral negotiations.

46. Bilaterally, States continue to expand the international air transport network using air service agreements, some of which increased opportunities in existing markets and others which included new markets. For example, in 1995, a significant number of new bilateral air service agreements were concluded involving unrestricted route rights and free market access provisions. Some of the more recent bilateral air service agreements contain provisions dealing with computer reservation systems and airline codesharing.

47. At the regional level, groups of States have created multilateral regulatory regimes based on membership in their respective groups. The States of the European Union have, over a period of ten years and in three distinct phases, established a regulatory regime designed to create a single market for air services within Europe. The States of the Andean Pact agreed in 1991 to establish an "open skies" area in which the five freedoms of the air would be granted unrestrictedly at an intra-subregional level to the airlines of the member States. Most recently, in 1996, 14 governments concluded a Multilateral Agreement Concerning the Operation of Air Services Within the Caribbean Community to provide for a more liberal and transparent exchange of commercial route rights within the Community. The establishment of regional multilateral aviation arrangements has led to an expansion of air services within the regions concerned but

has also evoked concerns about their effect on the national airlines of States not part of the regional arrangement and on the existing national and bilateral air service regulation of States parties to such regional arrangements.

48. The move to a less regulated environment, increasing competition in domestic and international markets, efforts to reduce the cost of airline operations, and concentration in the industry have also raised important regulatory questions. Will increased flexibility for airlines result in more air services when major airports are becoming increasingly congested? How can regulatory authorities ensure that so-called "flags of convenience" do not appear in international air transport? Will bilateral co-operative arrangements such as joint services, blocked space, codesharing and changes in traditional ownership and control criteria for the use of market access encourage the effective and sustained participation of all States in international air transport in an era of globalization and megacarrier alliances?

49. Shortly after computer reservation systems (CRSs) began to be in widespread use, concern that they could be used in anti-competitive ways through, for example, biased displays of flights which disadvantage certain airlines led to several detailed national regulations, two regional codes involving European States and the adoption by the Council of ICAO in 1991 of a Code of Conduct for the Regulation and Operation of Computer Reservation Systems. Subsequently these national regulations, regional codes and the ICAO Code have been expanded and updated to address competitive issues, consumer interests and new developments such as airline codesharing.

50. Other more general governmental measures also affect air transport. Such measures include competition law, environmental regulations, the imposition of various taxes, the expansion of airline responsibilities associated with national entry requirements (particularly for inadmissible passengers), more stringent health standards for entry and national narcotics control efforts.

INDUSTRY STRUCTURE

51. The most noteworthy changes in airline industry structure, arising from the need to meet increased traffic demand and competition, are the use of automation, computer reservation systems and personal communication systems to respond to the challenges of less regulated domestic and international markets, and ongoing moves towards globalization.

52. An important innovation in the United States which is also increasingly found elsewhere is the refinement of the "hub and spoke" system which employs large banks or complexes of interconnecting flights to maximize the number of city-pair markets that can be served on each flight. Megacarriers and the trend to globalization arose from a perceived need to operate several hubs and to achieve critical mass (i.e. a size sufficient to ensure independent survival and the ability to influence market conditions). Both as a part of this development and as a method of quickly achieving and improving market access (albeit indirectly), there has been a continuing process of formation of intercarrier (often transnational) alliances, as well as joint marketing arrangements, often involving the sharing of airline designator codes. These developments have caused some small- and medium-size airlines concern for their survival and have prompted efforts by some airlines either to develop a particular part of a market or to compete as low-cost, point-to-point airlines or to enter various alliances of their own. The success of low-cost, point-to-point air carriers has prompted some larger carriers to create subsidiaries or separate units to compete with them.

53. Two of the ways automation is changing industry structure involve the use of computers. First, computer reservation systems became the principal airline distribution tool in a number of countries, particularly in markets where there are many travel agents and frequent changes in schedules and fares

(e.g. North America, Europe). With participation in a CRS now considered by international air carriers as essential in many markets, these systems are expected to continue to expand in all regions with the systems tending to be owned/controlled by groups of carriers, with participation open to all carriers world-wide. Second, the creation of sophisticated yield management systems for airlines, associated with usage of a CRS, has enabled the airlines concerned to adjust the mix of high and low fare passengers on each flight in order to maximize revenues. In less regulated markets, yield management has enabled established higher-cost airlines in certain instances to compete selectively with new lower-cost airlines often reliant upon low fares to achieve market penetration.

54. An important development in the airline distribution and sales area which combines computers and personal communication systems is direct sales to consumers, for example, via the Internet. Another important development in this area is electronic ticketing, initially offered for domestic flights in the United States but now becoming available for international flights in several countries. In an era of increased competition, these developments offer considerable cost savings for the airlines as well as diversification of their distribution outlets.

55. In the area of air cargo, the specialized service provided by highly sophisticated parcel express delivery companies which emerged in the past decade continues to expand. These companies operate large jet cargo fleets combined with surface delivery systems to provide continental overnight deliveries and second day intercontinental services via strategically placed sorting hubs. The concept has also been adopted by a limited number of postal administrations.

Chapter 3
WORLD ECONOMIC ENVIRONMENT

HISTORICAL TRENDS

1. As indicated in Chapter 2, the world economy is subject to economic cycles but has steadily grown over the long term. During the 35-year period 1960-1995, the aggregate world economy measured in terms of Gross Domestic Product (GDP) increased at an average annual rate of 3.7 per cent in real terms.

2. Following the recession of 1980-1982, the world economy experienced its longest period of sustained progress (1983-1989) since the Second World War, achieving an average annual growth rate of 3.6 per cent before a slowdown in 1990, due primarily to fuel price increases in the wake of the Gulf crisis in the second half of the year.

3. However, the 1990 oil price increases did less damage to the world economy than did previous increases in 1973 and 1980. The 1990 increases were smaller, and the capability of the economies of the industrialized countries to cope with them was greater because of reduced energy dependency and the effects of structural reforms in the 1980s. They also lasted for a shorter period, with both crude oil and jet fuel prices returning to pre-crisis levels by March 1991.

4. World economic growth measured in terms of real GDP declined from almost 3.5 per cent in 1989 to 0.7 per cent in 1990. Some major economies, including those of the United States, United Kingdom and Canada, entered into a recession in 1991 and a slowdown was observed in Germany and Japan. As a result of the continued weakness in these economies, the world economy increased only by 0.1 per cent in 1991, the most difficult year globally since 1982. In spite of the fact that continental Europe and Japan remained in recession, the world economy improved in 1992 and 1993, experiencing growth rates of 1.1 and 1.7, respectively, with North America leading in the commencement of recovery. World economic growth regained momentum in 1994 and 1995, increasing by 2.2 and 2.5 per cent, respectively.

5. World population growth between 1980 and 1995 increased at an average annual rate of 1.6 per cent. Hence, growth of the world's GDP per capita between 1980 and 1995 increased at an average annual rate of 1.1 per cent, lower than the growth of GDP itself, as indicated in Figure 3-1.

OUTLOOK

6. There appears to be consensus among economic forecasters that the world economic and financial conditions remain generally encouraging and the global economy will continue to expand over the medium term with the recovery of the Japanese economy in 1996 and as the conditions in the

"countries-in-transition" improve. World economic activity is expected to gradually accelerate towards a moderate growth path of 3.5 to 4 per cent per annum with continued progress towards low inflation. Most countries appear to be engaging in austerity programmes to reduce government deficits and inflationary pressures.

7. The strength of economic activity appears particularly impressive in the emerging markets of developing countries where structural reforms have occurred. Industrialized countries also are likely to show stronger growth for the 1996-1998 period, with continued success in containing inflation. Inflation is expected to moderate to around 3 to 3.5 per cent per annum. As a result, the world GDP is expected to increase by 3.4 per cent in 1996 followed by a 3.5 to 4.0 per cent increase in 1997 and 1998.

8. For the rest of the forecast horizon, annual inflation is expected to remain fairly stable at around 3.5 per cent, and GDP for the period 1999-2005 is expected to increase at an average annual rate of just over 2.0 per cent per annum in real terms, resulting in an annual average growth rate of 2.5 per cent for the 1995-2005 forecast horizon.

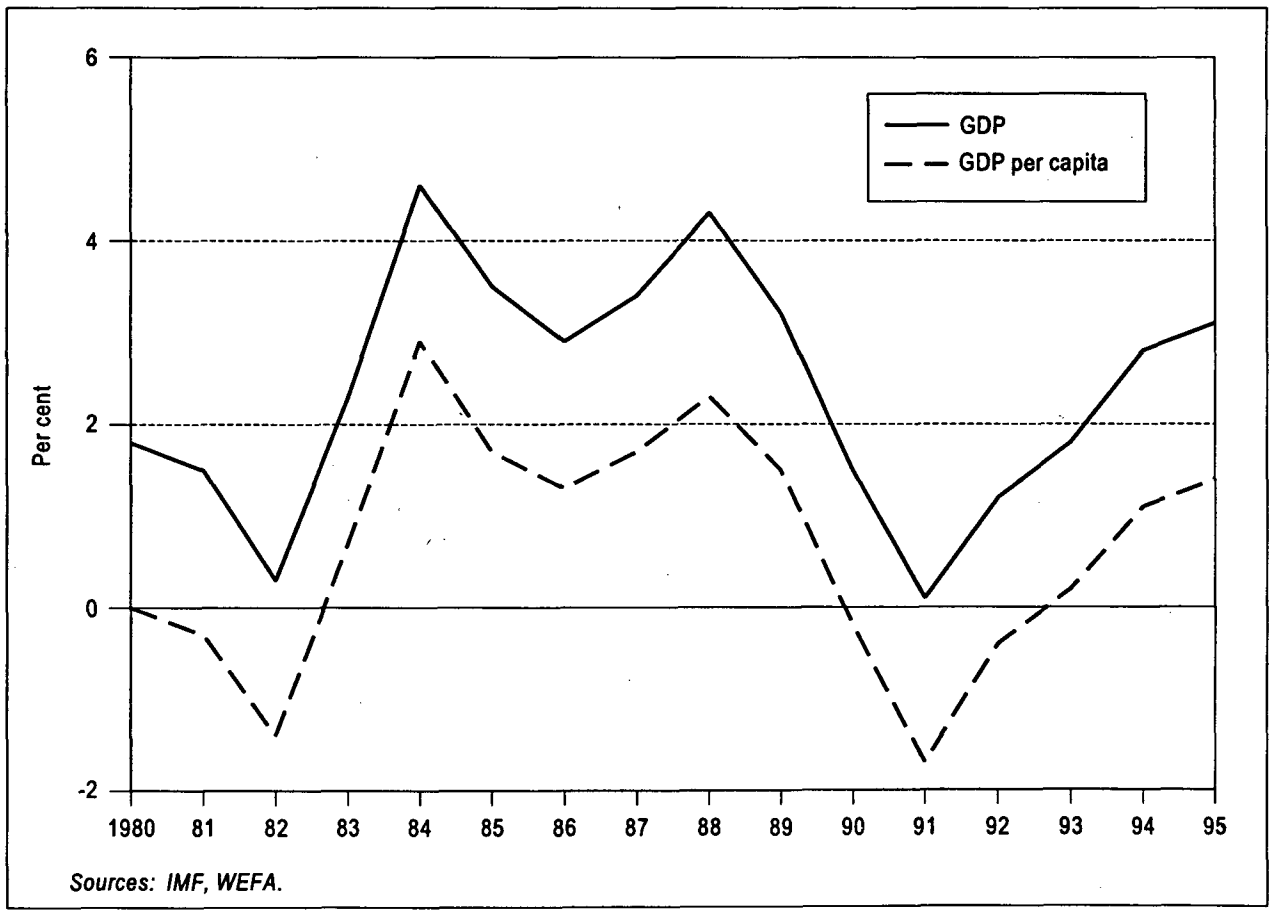


Figure 3-1. World GDP, GDP per capita growth
(real terms, 1980-1995)

Chapter 4
AIRLINE FINANCIAL TRENDS

OPERATING REVENUES, EXPENSES AND RESULTS

1. This chapter indicates general trends in airline financial data for the years 1965 and 1975 and for the decade 1985 to 1995 and, in broad terms, the outlook for the next decade. The treatment is global in nature, dealing with totals and averages for the airlines as a whole, and for this reason does not show the wide differences that exist between individual carriers. Since the available information on non-scheduled operators is incomplete, the analysis is confined to the scheduled airlines of ICAO Contracting States (although the non-scheduled operations of these airlines are included).

2. Financial data for the period concerned, categorized by major components of operating revenues and expenses, are given in Table 4-1.

3. The trends in over-all annual operating revenues and expenses for the period 1984 to 1995 are illustrated in Figure 4-1. Although there has been neither an improvement nor a decline in the long-term trend in the financial performance of scheduled airlines as a whole, there have been relatively large changes in the operating results in the last ten years. During the 1983-1989 period, a decrease in fuel costs, along with other cost reduction and yield control measures, brought about an improvement in the financial results of the industry which generated a positive net result of 4.4 per cent of operating revenues over this period. This trend was reversed in 1990 as a result of both a steep increase in fuel prices caused by the Gulf crisis and the slowdown in the world economy. The market conditions changed as the demand weakened and the utilization of airline resources tended to decline. The emergence of excess capacity and consequent competitive pressures put downward pressure on yields. These factors combined to produce negative operating results in three consecutive years (1990-1992). In 1993, the airline industry started to move towards a more appropriate balance of supply and demand and achieved a small operating surplus. Operating results improved significantly in 1994, and by 1995 the industry delivered an operating surplus of $14 billion, with a positive net result of $4.5 billion.

4. As shown in Table 4-2, from 1985 to 1995 in terms of current money values, the total operating revenues of the world's scheduled airlines from all their services, scheduled and non-scheduled, and including incidental revenues, increased at an average annual rate of 9.3 per cent, from $112 200 million to $274 000 million. During the same period the corresponding total operating expenses increased at a rate of 9.2 per cent, from $108 100 million to $260 000 million. The growth in world airline operating revenues during this period was associated with an average annual growth in traffic of 6.8 per cent in terms of cents per tonne-kilometre performed and a rise in airline yields (average operating revenue per tonne-kilometre performed) from 72.0 cents in 1985 to 91.3 cents in 1995 (at an average annual rate of 2.4 per cent). The unit cost in terms of tonne-kilometres performed increased from 40.3 in 1985 to 51.8 cents in 1995, at an average annual rate of 2.5 per cent.

5. As with over-all revenues and costs, unit revenues and costs varied from year-to-year over the 1984-1995 period, as shown by Table 4-2 and Figure 4-2.

Table 4-1. Operating revenues and expenses — 1965-1995

(scheduled airlines of ICAO Contracting States[1], total domestic and international services)

Description	1965	1975	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995[2]
	(millions of dollars)												
OPERATING REVENUES													
Scheduled services (total)	7 881	35 166	102 000	111 900	131 240	148 680	158 350	174 050	178 470	187 590	193 930	211 390	234 000
Passenger	6 748	30 174	87 000	94 900	111 820	127 250	137 200	153 290	156 760	165 140	171 440	185 170	205 000
Freight	755	4 196	13 300	15 200	17 450	19 380	19 110	18 510	19 400	20 110	20 270	23 860	26 600
Mail	378	796	1 700	1 800	1 970	2 050	2 040	2 250	2 310	2 340	2 220	2 360	2 400
Non-scheduled operations	358	1 612	3 500	4 500	5 410	6 360	6 650	7 020	8 260	7 870	8 230	10 150	10 000
Incidental	195	1 513	6 700	8 200	10 350	11 160	14 000	17 630	18 770	22 340	23 840	25 860	30 000
Total operating revenues	8 434	38 309	112 200	124 600	147 000	166 200	179 000	198 700	205 500	217 800	226 000	247 400	274 000
OPERATING EXPENSES													
Flight operations (total)	1 971	12 215	34 930	32 710	36 790	39 270	44 520	56 060	56 420	57 360	59 270	60 910	67 500
Flight crew salaries and expenses	705	3 292	7 250	8 300	9 480	10 530	11 350	13 650	15 220	15 790	16 520	17 700	19 500
Aircraft fuel and oil	944	7 305	23 780	19 110	20 740	20 690	23 520	30 510	27 120	26 800	26 840	26 720	30 000
Other (insurance, rental, training, etc.)	322	1 618	3 900	5 300	6 570	8 050	9 650	11 900	14 080	14 770	15 910	16 490	18 000
Maintenance and overhaul	1 331	4 688	11 070	13 850	15 900	18 320	19 590	22 790	23 120	23 830	22 530	23 990	25 500
Depreciation and amortization	845	3 065	7 770	9 070	11 050	12 150	12 520	14 030	14 310	15 380	15 580	18 050	20 000
User charges and station expenses (total)	1 199	6 351	17 340	21 340	24 770	28 440	29 080	32 200	34 460	37 880	38 740	41 410	45 000
Landing and associated airport charges	212	1 424	3 540	4 270	5 100	5 920	6 170	7 580	8 160	8 460	9 260	10 200	11 300
Other	987	4 927	13 800	17 070	19 670	22 520	22 910	24 620	26 300	29 420	29 480	31 210	33 700
Passenger services	647	3 514	10 310	12 140	14 540	15 900	17 880	20 880	21 380	23 630	23 580	25 610	27 500
Ticketing, sales and promotion	1 183	5 491	18 470	21 480	24 440	27 080	30 070	32 960	34 340	36 050	36 590	37 510	40 500
General, administrative and other operating expenses	450	2 255	8 210	9 410	12 310	14 840	17 540	21 280	21 970	25 470	27 410	31 520	34 000
Total operating expenses	7 626	37 579	108 100	120 000	139 800	156 000	171 200	200 200	206 000	219 600	223 700	239 000	260 000
Operating result [profit or loss (–)]	808	730	4 100	4 600	7 200	10 200	7 800	–1 500	–500	–1 800	2 300	8 400	14 000
Operating result as a percentage of operating revenues	9.6	1.9	3.7	3.7	4.9	6.1	4.4	–0.7	–0.2	–0.8	1.0	3.4	5.1
Net result	488	–67	2 100	1 500	2 500	5 000	3 700	–4 300	–3 500	–7 900	–4 400	–100	4 500
Net result as a percentage of operating revenue	5.8	–0.2	1.9	1.2	1.7	3.0	2.1	–2.2	–1.7	–3.6	–1.9	0.0	1.6

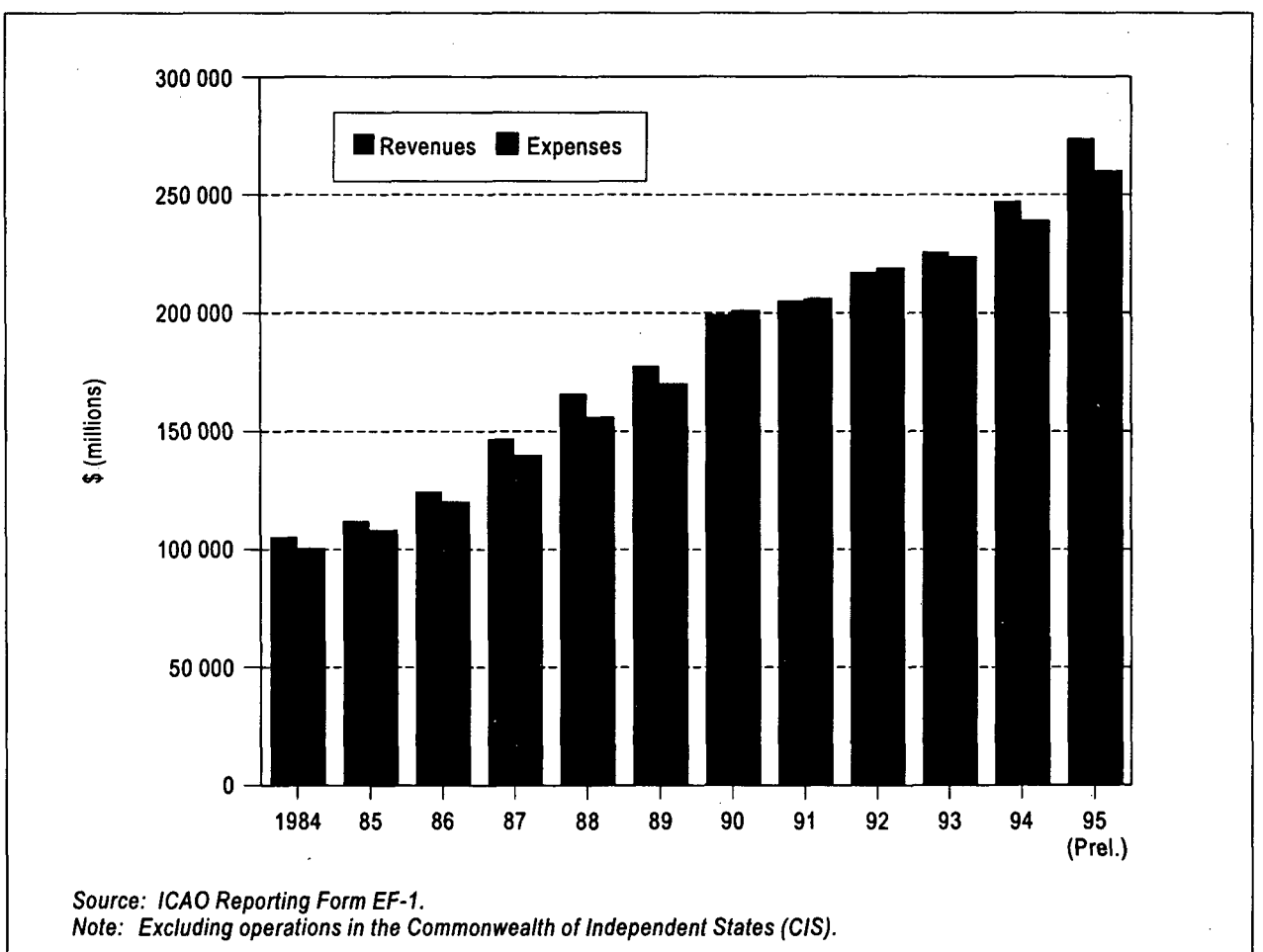
1. Excludes domestic operations in the Commonwealth of Independent States (CIS).
2. Preliminary results.

Table 4-2. Total and unit operating revenues and expenses, 1985 and 1995
(scheduled airlines of ICAO Contracting States[1], total domestic and international services)

	Operating revenues ($ millions)	Operating expenses ($ millions)	Total traffic (TKP millions)	Unit revenue (cents/TKP)	Total capacity (ATK millions)	Unit cost (cents/ATK)
1985	112 200	108 100	155 940	72.0	268 260	40.3
1995	274 000	260 000	300 088	91.3	502 280	51.8
Average annual growth (%)	9.3	9.2	6.8	2.4	6.5	2.5

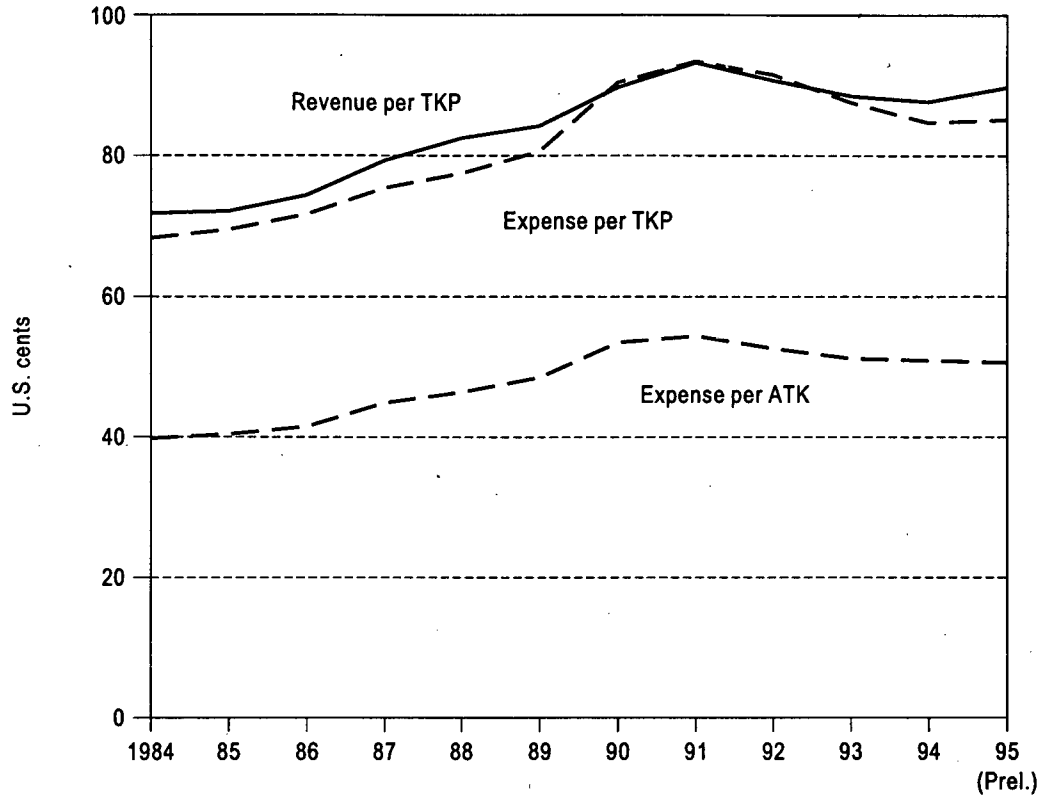
Source: ICAO Reporting Forms A-1 and EF-1.

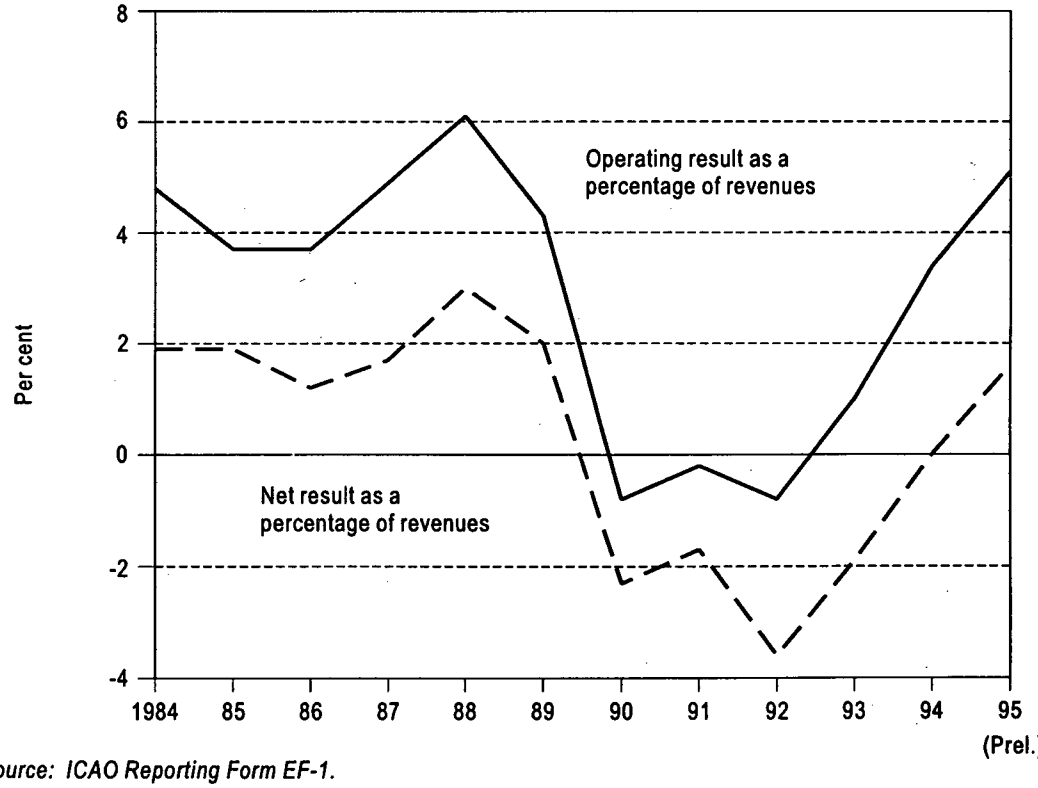
1. Excludes operations within the Commonwealth of Independent States (CIS).



Source: ICAO Reporting Form EF-1.
Note: Excluding operations in the Commonwealth of Independent States (CIS).

Figure 4-1. World scheduled airline operating revenues and expenses, 1984-1995





Source: ICAO Reporting Form EF-1.

Figure 4-2. Financial data for scheduled airlines, 1984-1995

DISTRIBUTION OF REVENUES AND OPERATING EXPENSES

6. As illustrated by Table 4-3, in terms of shares of total revenues, passenger revenues of scheduled airlines declined from 77.5 per cent in 1985 to 74.8 per cent in 1995; freight and mail revenues declined from 13.4 per cent in 1985 to 10.6 per cent in 1995; non-scheduled revenues increased from 3.1 per cent in 1985 to 3.7 per cent in 1995; and incidental revenues (which include sales of services and maintenance, and the leasing of aircraft to other airlines) increased from 6.0 per cent in 1985 to 10.9 per cent in 1995.

7. Among airline operating expenses, the most significant increase between 1985 and 1995 was attributable to "general, administrative and other operating expenses", which rose at an average annual rate of 5.6 per cent, compared to an average annual decline of 6.3 per cent for "aircraft fuel and oil". The former increased from 7.6 per cent of total operating expenses in 1985 to 13.1 per cent in 1995 while the latter decreased from 22.0 per cent in 1985 to 11.5 per cent in 1995. "Flight operations — other", which includes rental of aircraft from other carriers, also increased its share significantly from 3.6 per cent of total operating expenses in 1985 to 6.9 per cent in 1995, while the costs of "user charges and station expenses" and "passenger services" increased from 16.1 to 17.3 per cent and from 9.5 to 10.6 per cent, respectively. The proportion of direct aircraft operating expenses dropped from 49.7 per cent to 43.4 per cent and that of indirect operating expenses increased from 50.3 per cent to 56.6 per cent of total expenses from 1985 to 1995.

REGIONAL TRENDS IN REVENUES AND EXPENSES

8. Estimates of the distribution of total operating revenues and expenses according to the region of airline registration are given in Table 4-4 for 1985 and 1995, together with the corresponding operating results. In 1995 about 35 per cent of operating revenues and expenses of the world's airlines were attributable to the North American airlines, 30 per cent to European airlines and 25 per cent to airlines of Asia and the Pacific, with the remaining 10 per cent divided among those of Africa, the Middle East and Latin America/Caribbean. Compared to 1985, the 1995 shares of operating revenues and expenses of the airlines of Asia/Pacific represented a gain of about 8 percentage points of the world total, while that of the North American carriers declined significantly by about 10 percentage points.

YIELDS AND UNIT COSTS

9. Historically, airline fares have reflected the trends in operating costs and changing competitive conditions. Airline yields have declined in real terms almost every year since the advent of jet aircraft. The reductions in fares and freight rates, expressed in real terms, which occurred between 1960 and 1995 are reflected in real declines in passenger revenue yield per passenger-kilometre and freight yield per freight tonne-kilometre. These declines in yield contributed substantially to traffic growth. Marketing of air transport was aided by the fact that air fares (average airline yields) represented a steadily improving bargain in comparison with many other services. Figure 4-3 illustrates the annual change in average passenger yield over the 1960-1995 period (excluding operations within the Commonwealth of Independent States) as well as annual change in freight yield per tonne-kilometre. Average world passenger yield measured in real terms decreased at a rate of 2.7 per cent per annum, and freight and mail yield decreased at a rate of 3.7 per cent per annum. These declines in yield were the result of technological advances, longer average trip lengths, greater competition and certain economies of scale.

Table 4-3. Distribution of operating revenues and expenses in 1985 and 1995
(scheduled airlines of ICAO Contracting States[1], total domestic and international services)

Description	Distribution by item (per cent) 1985	1995	Average annual growth (per cent) 1985 to 1995
OPERATING REVENUES			
Scheduled services (total)	90.9	85.4	–0.6
Passenger	77.5	74.8	–0.4
Freight	11.9	9.7	–2.0
Mail	1.5	0.9	–5.0
Non-scheduled operations	3.1	3.7	1.8
Incidental	6.0	10.9	6.2
TOTAL	100.0	100.0	—
OPERATING EXPENSES			
Direct aircraft			
Flight operations (total)	32.3	25.9	2.2
Flight crew	6.7	7.5	1.1
Fuel and oil	22.0	11.5	–6.3
Other	3.6	6.9	6.7
Maintenance and overhaul	10.2	9.8	0.4
Depreciation and amortization	7.2	7.7	0.7
Sub-total	49.7	43.4	–1.3
Indirect			
User charges and station expenses (total)	16.1	17.3	0.7
Landing and associated airport charges	3.3	4.3	2.7
Other	12.8	13.0	0.2
Passenger services	9.5	10.6	1.1
Ticketing, sales, promotion	17.1	15.6	–0.9
General, administrative and other	7.6	13.1	5.6
Sub-total	50.3	56.6	1.2
TOTAL	100.0	100.0	—

Source: ICAO Air Transport Reporting Form EF-1.

1. Excludes domestic operations with the Commonwealth of Independent States (CIS).

Table 4-4. Regional distribution of total operating revenues and expenses in 1985 and 1995

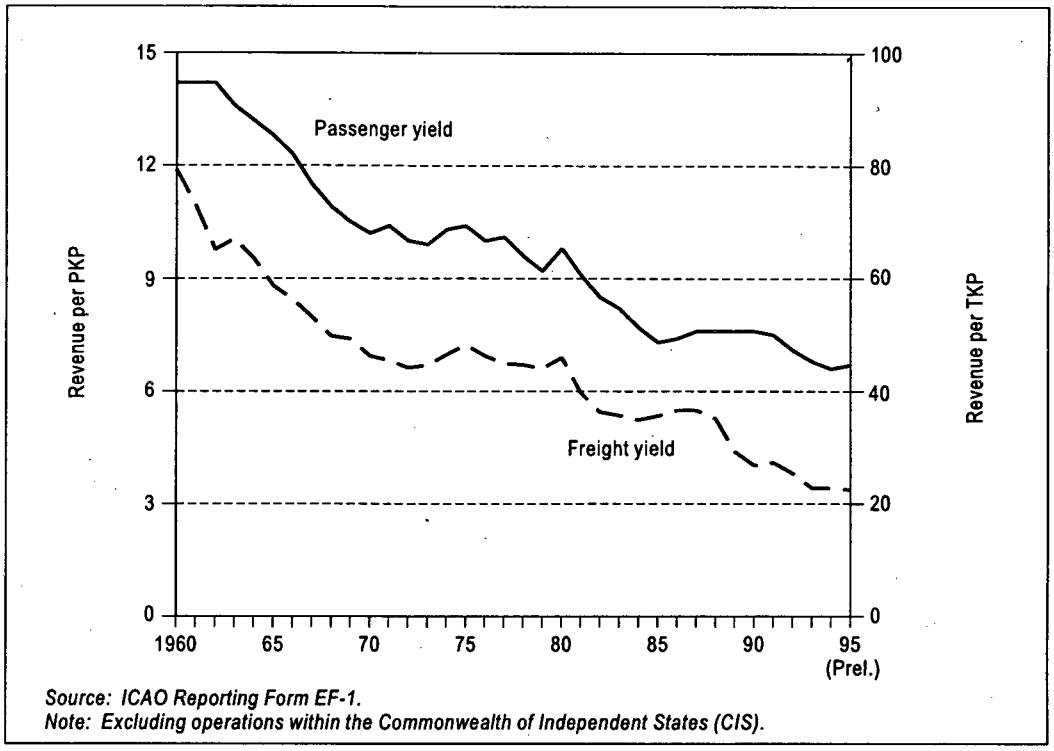
Region of airline registration	Year	Operating revenues		Operating expenses		Operating result	
		Dollars (millions)	Per cent of world	Dollars (millions)	Per cent of world	Dollars (millions)	Per cent of operating revenues
Africa	1985	3 840	3.4	3 890	3.6	–50	–1.3
	1995	6 800	2.5	6 600	2.6	200	2.9
Asia and Pacific	1985	19 100	17.0	18 100	16.8	1 000	5.2
	1995	68 700	25.1	64 700	24.9	4 000	5.8
Europe[1]	1985	27 800	24.8	26 400	24.4	1 400	5.0
	1995	81 200	29.6	78 100	29.9	3 100	3.8
Middle East	1985	5 200	4.7	5 100	4.7	100	1.9
	1995	8 000	2.9	8 100	3.1	–100	–1.3
North America	1985	50 730	45.2	49 110	45.4	1 620	3.2
	1995	95 500	34.9	89 700	34.6	5 800	6.1
Latin America and Caribbean	1985	5 530	4.9	5 500	5.1	30	0.5
	1995	13 800	5.0	12 800	4.9	1 000	7.2
World[1]	1985	112 200	100.0	108 100	100.0	4 100	3.7
	1995	274 000	100.0	260 000	100.0	14 000	5.1

Sources: ICAO Digests of Statistics, Series F — Financial Data.

1. Excludes operations within the Commonwealth of Independent States (CIS).

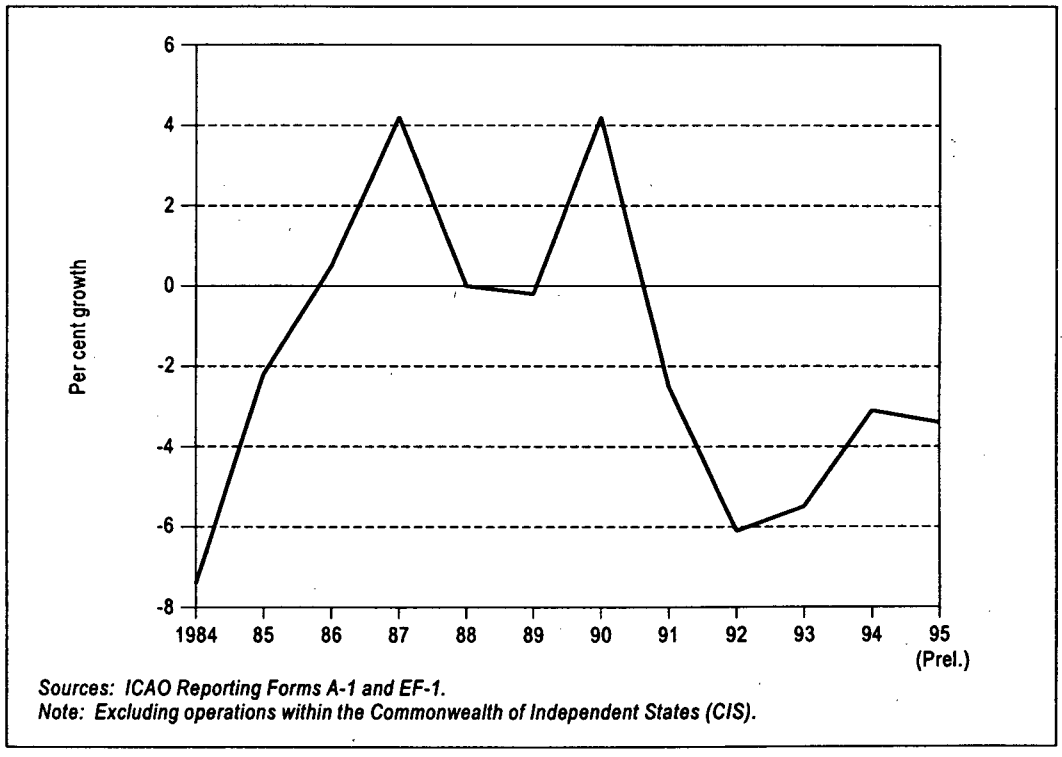
10. Measured in real terms, the operating costs per available tonne-kilometre (ATK) of world scheduled airlines declined, on average, by 1.4 per cent per annum over the 1984-1995 period, with the year-to-year fluctuations illustrated in Figure 4-4.

11. Airline operating costs are heavily influenced by jet fuel prices. Due to large increases in oil prices in 1979, unit costs rose sharply in 1980 with fuel costs accounting for almost 29 per cent of total costs of scheduled airlines. Unit costs declined during the period 1982-1985 partly as a result of declining fuel prices. In 1995 fuel costs accounted for only 11.5 per cent of total operating costs, as illustrated in Figure 4-5. Although the long-term outlook for fuel prices is not clear, prevailing industry expectations are for moderate increases in current terms (at the rate of inflation), which should have a relatively small impact on operating costs. In addition to aircraft fuel costs, aircraft utilization, seating capacity and density have an important impact on unit costs.



Source: ICAO Reporting Form EF-1.
Note: Excluding operations within the Commonwealth of Independent States (CIS).

Figure 4-3. World scheduled passenger and freight yields
(U.S. cents in real terms)



Sources: ICAO Reporting Forms A-1 and EF-1.
Note: Excluding operations within the Commonwealth of Independent States (CIS).

Figure 4-4. World scheduled airlines' unit operating costs, 1984-1995
(U.S. cents per ATK in real terms)

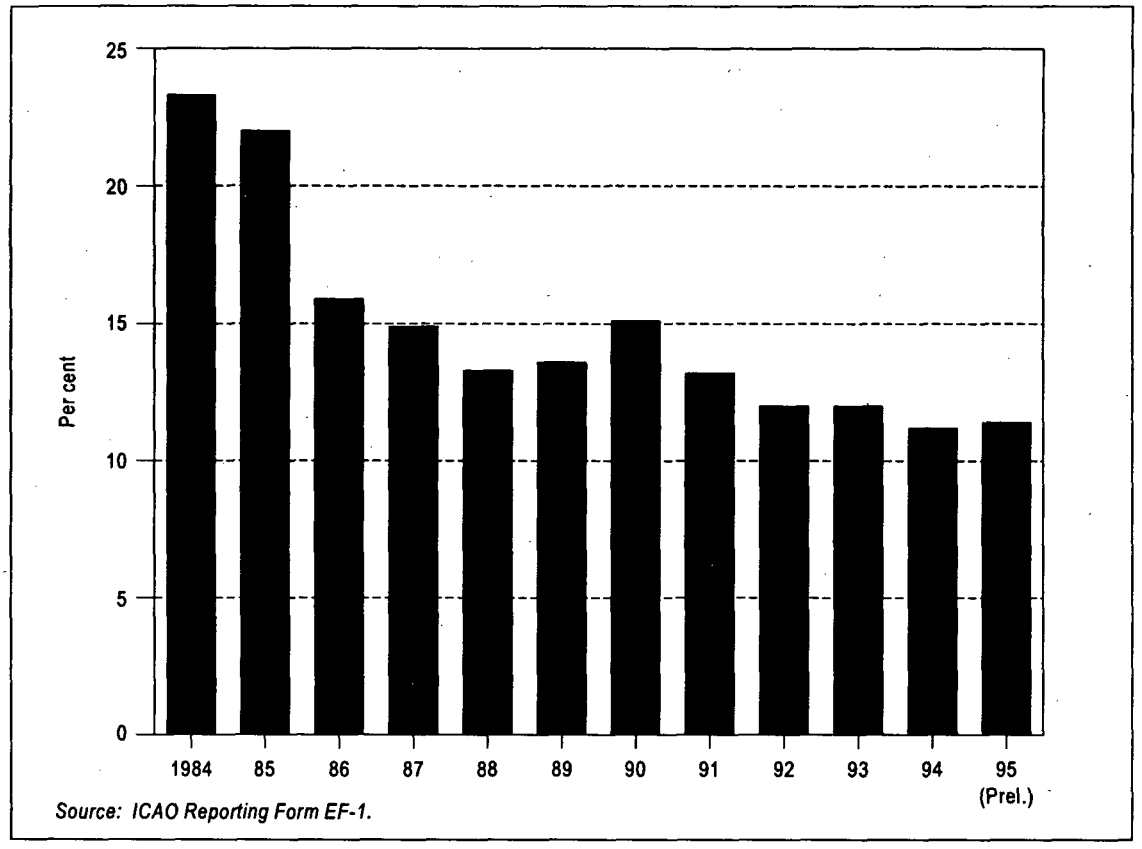


Figure 4-5. World scheduled airlines' share of fuel and oil in operating expenses, 1984-1995

OUTLOOK

12. For the forecast period, the airline industry faces substantial inflationary pressure on operating costs, particularly in the areas of labour and capital. The prospects for airline yields are closely related to cost developments and market conditions in the airline industry. Cost items under particular scrutiny at present are ticketing, sales and promotion (notably in connection with product distribution) and general/administrative expenses. Productivity improvements in the airline industry should continue to produce some cost savings. The magnitude of improvements in cost efficiency resulting from fleet developments, however, is likely to be significantly less than in the past due to the high capital cost of new aircraft and the increase in cost of financing.

13. For the forecast period, airline yields are expected to decline at an average annual rate of 0.5 per cent in real terms for the 1995-2000 period and to remain stable for the following five years in real terms.

Chapter 5
FORECASTS OF AIRLINE TRAFFIC TO THE YEAR 2005

FORECASTING METHODOLOGY

1. As a basis for the preparation of the traffic forecasts for this study, econometric analyses were carried out of the effects of underlying factors on the historic aggregate demands for scheduled passenger and freight traffic. These analyses were used to translate expectations of future world economic development and future trends in international trade and average fares into projections of future traffic demand. The projected traffic growth rates were then reviewed in the light of prospective changes in other factors which could not be accommodated in the econometric analysis.

2. More detailed projections for international and domestic scheduled traffic for the airlines of each geographical region were initially developed from the forecasts of total scheduled traffic by analysing historic traffic trends and market shares for the airlines based on the individual geographical regions. These projections were reviewed in light of economic trends and other factors relevant to particular regions.

3. The procedures described above relate to traffic forecasts in terms of passenger-kilometres performed and freight tonne-kilometres performed. In addition, forecasts of the numbers of passengers carried and freight tonnes carried were prepared for total scheduled international and domestic services. These were derived from the forecasts of passenger-kilometres and tonne-kilometres on the basis of expectations of future trends in the average length of haul for the various types of services.

4. Forecasts of passengers carried by scheduled airline services on selected intercontinental route groups were also developed. For a particular group of routes, the traffic forecasts took into account economic developments in the regions at either end of the route and average airline yield on the route concerned, as well as other factors pertinent to the particular route group. Econometric analyses were used in the forecasting process wherever possible.

MAIN ASSUMPTIONS AND ECONOMETRIC MODELS

5. The following are the main assumptions concerning trends, over the period 1995 to 2005, in the factors which underly traffic growth:

a) a "most likely" average rate of world economic growth of 2.5 per cent per annum (in real terms);

b) moderate growth in world trade at a "most likely" average rate of about 4.0 per cent per annum;

c) a 0.5 per cent per annum decline in average passenger and freight yields (fares and rates) in real terms for the five-year period 1995-2000, and no change in average yield (in real terms) for the five-year period 2000-2005 for the world as a whole; and

d) availability of adequate capital resources for the development of aviation and tourist infrastructure.

6. On the basis of historic data, several econometric models were developed for scheduled passenger travel demand, freight traffic demand and for geographical regions as well as for various route groups wherever possible.

7. The econometric models developed for predicting demand in terms of total world scheduled passenger-kilometres performed (PKPs) and total world freight tonne-kilometres (FTKs) are described in Appendix 1. The first model provided estimates of the effect on scheduled passenger travel of changes in world GDP and average passenger fare levels (both in real terms), and the second provided estimates of the effect on scheduled freight transport of changes in world exports and average freight rate levels (again in real terms).

GLOBAL PASSENGER FORECASTS

8. Inserting the above economic and yield assumptions into these models resulted in growth rates for the next decade for world scheduled traffic of 5.5 per cent per annum for passenger-kilometres. Most of this growth in traffic is attributable to growth in real GDP.

9. As in the past, year-to-year growth is likely to fluctuate considerably. As an indication of the sensitivity of traffic growth to alternative assumptions about economic growth and trends in unit costs, a "low" passenger traffic forecast of 3.5 per cent per annum results from assumptions of 2 per cent per annum for real economic average growth and an increase in real fares (yield) of 1.0 per cent per annum. A "high" forecast of 7.5 per cent per annum results from assumptions of 3.0 per cent per annum for economic growth and an average annual decline in real fares of -1.0 per cent. The "most likely", "low" and "high" trends are illustrated in Figure 5-1.

10. International scheduled passenger traffic (in PKPs) is forecast to grow at an average rate of 7.0 per cent per annum compared with 3.5 per cent per annum for domestic scheduled passenger traffic, as shown in Table 5-1 and also illustrated in Figure 5-1. The slower growth of domestic traffic results from the fact that some 70 per cent of all domestic scheduled traffic is accounted for by the already highly developed domestic systems in the United States and the Commonwealth of Independent States where growth rates are expected to moderate.

11. Forecasts of scheduled passenger traffic in terms of the number of passengers carried are also given in Table 5-1. Growth in terms of passengers carried is expected to be lower than growth in passenger-kilometres because the latter includes the effect of a gradual increase in the average passenger journey distance at an annual rate of approximately 1 per cent. During the 1985-1995 period, the increase in average journey length was more pronounced for international trips than for domestic trips. Total passengers carried on scheduled services are expected to reach 2 billion by the year 2005.

Table 5-1. Summary of ICAO scheduled passenger traffic forecast to the year 2005
(ICAO Contracting States)

	Actual 1985	Actual 1995	Forecast 2005	Average annual growth rate (per cent) 1985-1995	1995-2005*
			Passenger-kilometres (billions)		
Scheduled services	1 367	2 228	3 807	5.0	5.5
International	590	1 241	2 395	7.7	7.0
Domestic	777	987	1 412	2.4	3.5
			Passengers carried (millions)		
Scheduled services	899	1 285	2 010	3.6	4.5
International	194	373	680	6.8	6.0
Domestic	705	912	1 310	2.6	3.5

* Rounded to the nearest 0.5 percentage point.

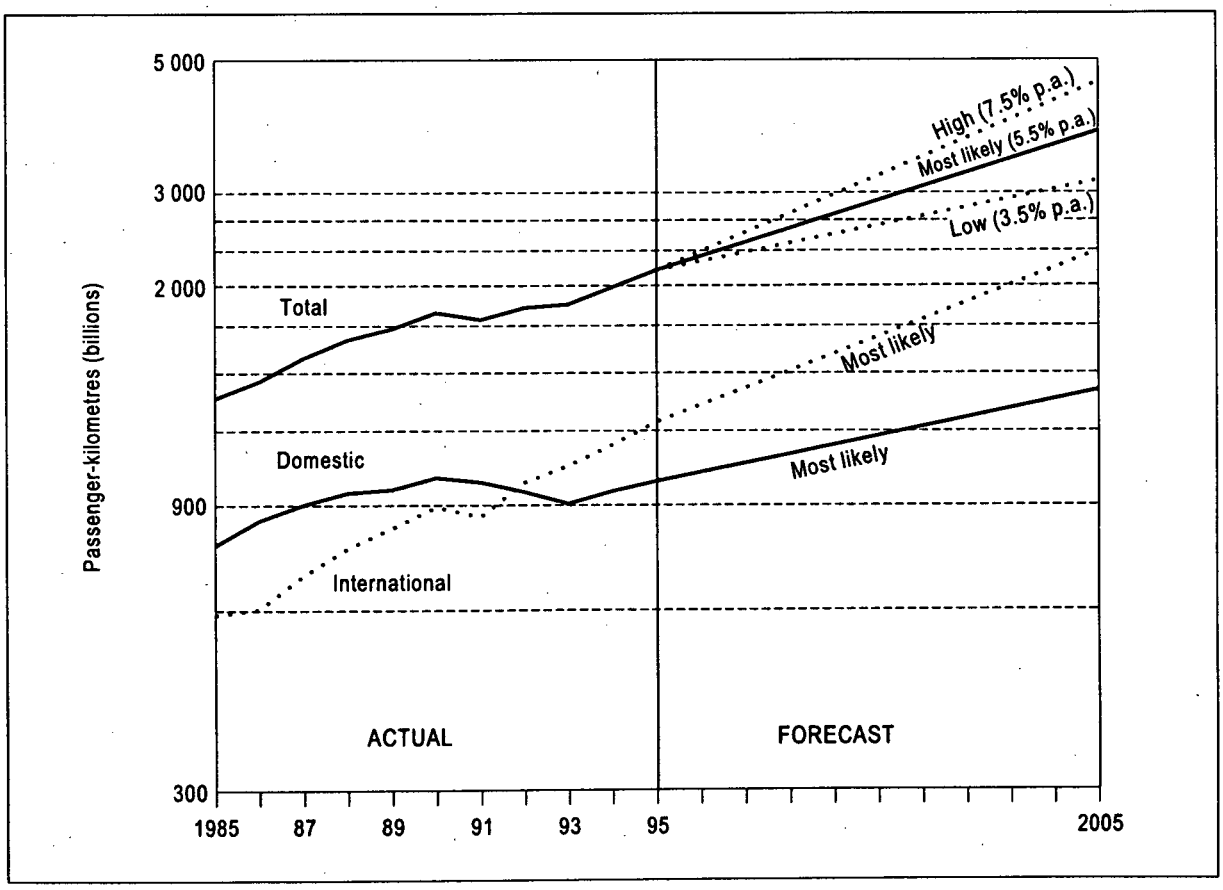


Figure 5-1. Trends in world scheduled passenger traffic
(ICAO Contracting States)

Table 5-2. Forecasts of scheduled passenger traffic by region
(region of airline registration, ICAO Contracting States)

	Passenger-kilometres (billions)			Average annual growth rate (per cent)		Regional share of world traffic (per cent)		
	Actual 1985	Actual 1995	Forecast 2005	1985-1995	1995-2005*	1985	1995	2005
Africa	36.7	51.0	77	3.3	4.0	2.7	2.3	2.0
International	28.6	42.1	65	3.9	4.5	4.8	3.4	2.7
Domestic	8.1	8.9	12	0.9	3.0	1.0	0.9	0.8
Asia/Pacific	222.3	549.7	1 260	9.5	8.5	16.3	24.7	33.1
International	150.2	372.9	870	9.5	9.0	25.4	30.1	36.3
Domestic	72.1	176.8	390	9.4	8.0	9.3	17.9	27.6
Europe	428.2	549.3	870	2.5	4.5	31.3	24.7	22.9
International	214.4	426.8	735	7.1	5.5	36.3	34.4	30.7
Domestic	213.8	122.5	135	-5.4	1.0	27.5	12.4	9.6
Middle East	42.7	67.0	115	4.6	5.5	3.1	3.0	3.0
International	35.2	57.1	100	5.0	6.0	6.0	4.6	4.2
Domestic	7.5	9.9	15	2.8	4.0	1.0	1.0	1.1
North America	569.2	902.7	1 310	4.7	4.0	41.6	40.5	34.4
International	125.3	271.7	495	8.0	6.0	21.2	21.9	20.7
Domestic	443.9	631.0	815	3.6	2.5	57.1	64.0	57.7
Latin America and Caribbean	68.3	107.9	175	4.7	5.0	5.0	4.8	4.6
International	36.5	70.3	130	6.8	6.5	6.2	5.7	5.4
Domestic	31.8	37.6	45	1.7	2.0	4.1	3.8	3.2
World	1 367.4	2 227.6	3 807	5.0	5.5	100.0	100.0	100.0
International	590.2	1 240.9	2 395	7.7	7.0	100.0	100.0	100.0
Domestic	777.2	986.7	1 412	2.4	3.5	100.0	100.0	100.0

* Rounded to the nearest 0.5 percentage point.

REGIONAL PASSENGER FORECASTS

12. The "most likely" forecasts of scheduled airline passenger traffic by region of airline registration are given in Table 5-2, together with historic figures for 1985 and 1995. The airlines of the Asia/Pacific region are expected to continue to show the highest growth in passenger traffic, at 8.5 per cent per annum through to the year 2005, while the airlines of Africa and North America show the lowest growth, around 4.0 per cent per annum. Traffic of airlines of the Middle East region is expected to grow about the world average at 5.5 per cent per annum, whereas traffic of Latin American airlines is expected to increase at 5.0 per cent per annum and that of Europe at 4.5 per cent per annum.

13. As a result of the expected growth in passenger traffic, the Asia/Pacific region is expected to increase its share of world scheduled passenger traffic by about 8.4 percentage points to 33.1 per cent of total world traffic by the year 2005, with its share of total international scheduled passenger traffic increasing to approximately 36 per cent.

14. The other changes in regional shares are expected to occur in Europe and North America. The North American share is anticipated to decline by about 6.1 percentage points to 34.4 per cent by the year 2005, while the European share is expected to decline by some 2 percentage points to 22.9 per cent.

PASSENGER FORECASTS FOR INTERCONTINENTAL ROUTE GROUPS

15. The forecasts of the number of passengers carried on scheduled services in nine intercontinental route groups, accounting for almost 36 per cent of international passengers in 1995, are presented in Table 5-3. Forecast growth rates for the 1995-2005 period are somewhat lower than during the 1985-1995 period. Traffic across the North Atlantic benefited from a stimulating competitive environment during the 1980s, growing strongly despite the maturity of the market. The second half of the 1990s should see a more moderate performance in this market. The transpacific and Europe-Asia/Pacific route groups are expected to remain the fastest-growing of all those identified in Table 5-3, with average annual growth rates of 7.0 and 7.5 per cent, respectively. The growth in air travel demand in these markets is supported by competitive services and by the strong economic performance of a number of Asian countries. These markets have been the driving force in international passenger traffic growth during the last few years and this is expected to continue into the forecast horizon.

16. The Europe-Africa market is expected to recover in the 1995-2005 period, reflecting some improvement in the general economy. The performance of the Europe-Middle East market is particularly affected by political factors and economic conditions linked to trends in the world price of crude oil. This route group also continues to lose some transfer traffic because of the increasing number of direct non-stop flights between Europe and the Far East.

Table 5-3. Forecasts of international scheduled passenger traffic by international route group

	Passengers carried (thousands)			Average annual growth rate (per cent)	
	Actual 1985	Actual 1995	Forecast 2005	1985-1995	1995-2005*
North Atlantic	20 964	38 100	59 168	6.2	4.5
Mid Atlantic	1 471	2 570	4 186	5.7	5.0
South Atlantic	1 244	3 260	5 838	10.1	6.0
Transpacific	8 028	19 213	37 795	9.1	7.0
Between Europe and Asia/Pacific	5 870	20 400	42 045	13.3	7.5
Between Europe and Africa	9 280	11 000	14 783	1.7	3.0
Between Europe and Middle East	3 920	7 080	9 987	6.1	3.5
Between North America and South America	2 622	7 445	14 100	11.0	6.5
Between North America and Central America/Caribbean	15 562	24 684	38 333	4.7	4.5
Total above routes	68 961	133 752	226 237	6.8	5.5
Other routes	124 974	239 007	453 763	6.7	6.5
Total world	193 935	372 759	680 000	6.8	6.0

* Rounded to the nearest 0.5 percentage point.

Note.– The historic data base has been developed from several sources, including ICAO, IATA and aircraft manufacturers.

17. Of the remaining route groups in Table 5-3, North America-Central America/Caribbean is the largest in terms of passenger numbers. A relatively high proportion of this market is leisure travel which is responsive to the upward trend in household income levels over the long term.

GLOBAL FREIGHT FORECASTS

18. The econometric analysis, together with the assumptions mentioned earlier, resulted in a "most likely" projected growth rate of 7.0 per cent per annum for world scheduled freight tonne-kilometres for the period 1995-2005. This is slightly lower than the 7.6 per cent per annum for the 1985-1995 period. Alternative assumptions concerning the underlying factors affecting air freight suggest a band of forecast growth rates ranging from a "low" of 5.0 per cent per annum to a "high" of 9.0 per cent per annum as illustrated in Figure 5-2.

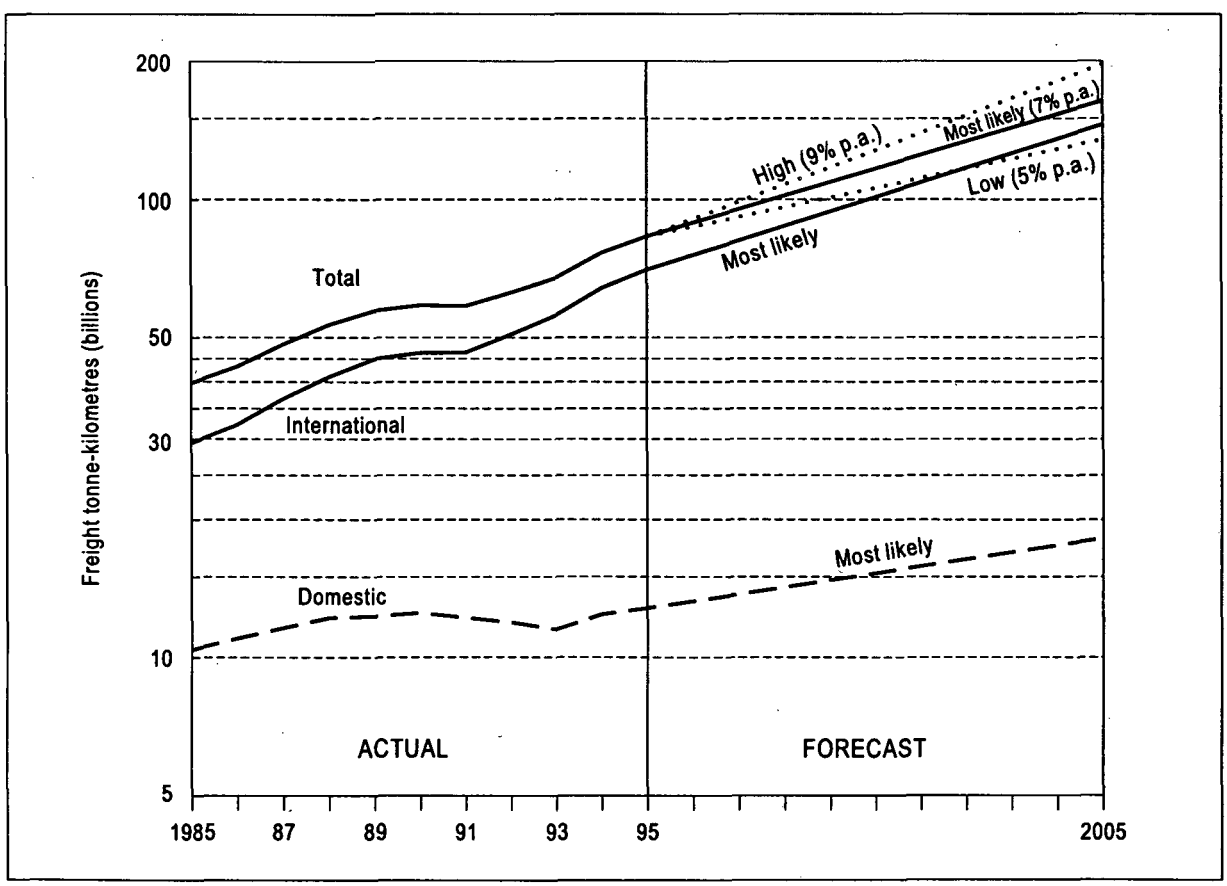


Figure 5-2. Trends in world scheduled freight traffic
(ICAO Contracting States)

19. Table 5-4 presents the ICAO forecasts of scheduled freight traffic (including international and domestic components) in terms of both tonne-kilometres performed and tonnes carried. International freight traffic is expected to grow more rapidly than domestic freight traffic, due partly to the relatively fast growth of international commerce. Domestic freight is dominated by the more mature market of the United States and this is another reason for the moderate growth of total domestic traffic. Freight tonnes carried are expected to grow more slowly than freight tonne-kilometres because of a continuing increase in the average length of haul.

REGIONAL FREIGHT FORECASTS

20. The "most likely" forecasts of scheduled freight traffic by region of airline registration are presented in Table 5-5. The regional pattern of growth is rather similar to that for passenger traffic. Asia/Pacific is expected to remain the fastest-growing region, although its forecast rate is somewhat slower than the growth rate for the 1985-1995 period.

21. By the year 2005, the Asia/Pacific region is expected to increase its share of air freight traffic by 9.2 percentage points to over 43 per cent of total world freight, a share well above that of any other region.

SUMMARY OF AIR TRAFFIC FORECASTS BY OTHER ORGANIZATIONS

22. Some recent long-term forecasts of growth in world scheduled traffic by major airframe and engine manufacturers are given in Table 5-6. These forecast growth rates are in the range of 4.5 to 6.5 per cent per annum for passenger-kilometres.

23. Separate forecasts for the number of passengers and freight tonnes carried on international routes by member airlines are regularly prepared by the International Air Transport Association (IATA). The most recent forecast, covering the 1996-2000 period, indicates an average growth of 7.1 per cent per annum for international passengers.

Table 5-4. Summary of ICAO scheduled freight traffic forecast to the year 2005 (ICAO Contracting States)

	Actual 1985	Actual 1995	Forecast 2005	Average annual growth rate (per cent) 1985-1995	1995-2005*
			Freight tonne-kilometres (millions)		
Scheduled services	39 837	83 082	163 950	7.6	7.0
International	29 384	70 273	145 720	9.1	7.5
Domestic	10 453	12 809	18 230	2.1	3.5
			Freight tonnes carried (thousands)		
Scheduled services	13 742	21 488	34 600	4.6	5.0
International	5 884	12 982	24 400	8.2	6.5
Domestic	7 858	8 506	10 200	0.8	2.0

* Rounded to the nearest 0.5 percentage point.

Table 5-5. Forecasts of scheduled freight traffic by region (region of airline registration, ICAO Contracting States)

	Freight tonne-kilometres (millions) Actual 1985	Actual 1995	Forecast 2005	Average annual growth rate (per cent) 1985-1995	1995-2005*	Regional share of world traffic (per cent) 1985	1995	2005
Africa	1 163	1 418	2 050	2.0	4.0	2.9	1.7	1.3
International	1 070	1 320	1 920	2.1	4.0	3.6	1.9	1.3
Domestic	93	98	130	0.5	3.0	0.9	0.8	0.7
Asia/Pacific	9 605	28 346	71 000	11.4	9.5	24.1	34.1	43.3
International	8 589	26 243	66 900	11.8	10.0	29.2	37.3	45.9
Domestic	1 016	2 103	4 100	7.5	7.0	9.8	16.4	22.5
Europe	14 422	24 607	40 900	5.5	5.0	36.2	29.6	24.9
International	11 589	23 815	40 000	7.5	5.5	39.4	33.9	27.4
Domestic	2 833	792	900	−12.0	1.5	27.2	6.2	4.9
Middle East	1 880	3 775	6 800	7.2	6.0	4.7	4.5	4.1
International	1 807	3 694	6 700	7.4	6.0	6.1	5.3	4.6
Domestic	73	81	100	1.0	2.0	0.7	0.6	0.5
North America	10 622	21 253	36 200	7.2	5.5	26.7	25.6	22.1
International	4 842	12 162	24 000	9.6	7.0	16.5	17.3	16.5
Domestic	5 780	9 091	12 200	4.6	3.0	55.5	71.0	66.9
Latin America and Caribbean	2 105	3 683	7 000	5.8	6.5	5.3	4.4	4.3
International	1 487	3 039	6 200	7.4	7.5	5.1	4.3	4.3
Domestic	618	644	800	0.4	2.0	5.9	5.0	4.4
World	39 797	83 082	163 950	7.6	7.0	100.0	100.0	100.0
International	29 384	70 273	145 720	9.1	7.5	100.0	100.0	100.0
Domestic	10 413	12 809	18 230	2.1	3.5	100.0	100.0	100.0

* Rounded to the nearest 0.5 percentage point.

Table 5-6. Available forecasts of world scheduled traffic growth by manufacturers (average annual growth rates)

Source of forecast	Forecast period	Passenger-kilometres (per cent)	Freight tonne-kilometres (per cent)
Aerospatiale	1994-2014	5.0	—
Airbus Industrie	1994-2004	5.4	—
	2004-2014	4.8	—
Boeing			
Domestic	1995-2015	4.8	—
International	1995-2015	5.3	—
Total	1995-2015	5.1	—
British Aerospace	1995-2014	4.8	—
Rolls-Royce	1995-2014	4.9	—
McDonnell Douglas	1995-2015	6.3	7.6

Sources:

- *Aerospatiale, "1994-2014 Market Forecast", November 1995;*
- *Airbus Industrie, "Global Market Forecast", 1995;*
- *Boeing Commercial Airplane Company, "Current Market Outlook", 1996;*
- *British Aerospace, "World Civil Jet Market Forecast 1995-2014", 1996;*
- *Rolls-Royce, "Market Outlook 1995", 1996;*
- *McDonnell Douglas Corporation, "World Economic and Traffic Outlook", November 1996.*

Chapter 6
FORECASTS OF AIRCRAFT MOVEMENTS TO THE YEAR 2005

FACTORS AFFECTING AIRCRAFT MOVEMENTS

1. The planning of aviation facilities and the development of aviation policies require assessment of future trends in aircraft movements as well as of passenger and freight traffic flows. This is becoming increasingly important because of concerns over airport and airspace congestion in some regions. Aircraft movements have grown quite rapidly for most of the past decade, increasing the pressure on airport and air traffic control facilities.

2. The primary factor affecting the number of aircraft movements is the demand for passenger travel. The passenger traffic forecasts presented in the previous chapter are, therefore, key inputs to the aircraft movement forecasts.

3. When passenger demand increases, air carriers can respond by scheduling extra flights, by using larger aircraft, or by managing higher load factors. During the 1970s, air carriers accommodated most of the growth in demand by introducing larger aircraft. As a result of both increasing aircraft size and improving load factors, the growth in aircraft movements was quite small in the 1970s despite rapid growth in passenger traffic. From the early 1980s, the trend in average aircraft size has levelled out and the growth rate in aircraft movements has approached the growth rate for passenger traffic. Past trends in average aircraft size and average load factor for total world scheduled services (excluding the Commonwealth of Independent States) are illustrated in Figure 6-1.

4. Gradual improvements in average load factors have resulted from marketing initiatives and yield management programmes, but there is evidence that the rate of improvement in load factors is slowing down. This is expected as the industry gradually approaches upper limits for load factors, which are partially determined by periodic and random variations in demand. Nevertheless, it is expected that the world average scheduled passenger load factor, which increased from 63 per cent in 1985 to 67 per cent in 1995, will rise to about 70 per cent by 2005.

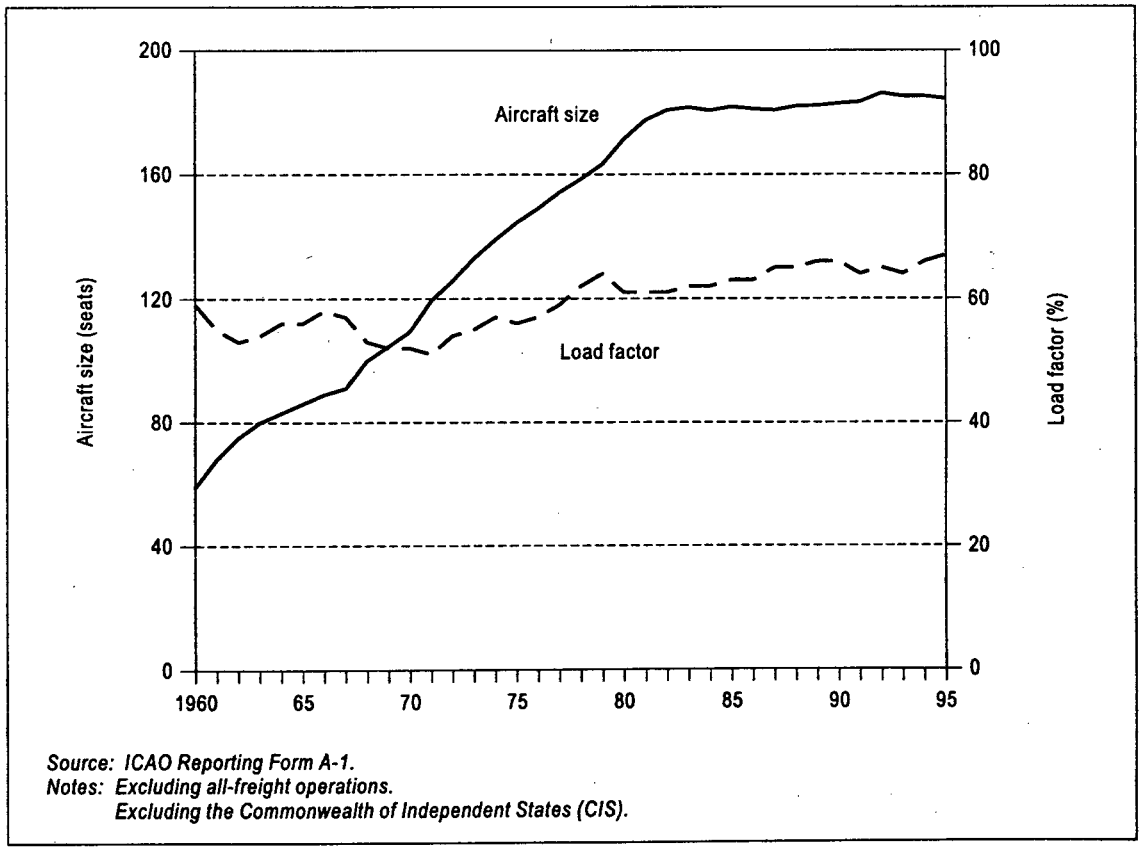
5. The services provided by carriers to meet demand result from a large number of decisions concerning network structure, aircraft type and service frequency. These decisions depend on factors such as the availability of traffic rights, the characteristics of alternative aircraft, and consumer preferences and trade-offs between price and service quality. Despite the complexity of this process, it is possible to discern several key factors which are in part responsible for the observed change in the trend in average aircraft size and hence the relationship between traffic demand and aircraft movements.

6. The first of these factors is the trend towards liberalization or deregulation in some important markets. Deregulation in the United States domestic airline markets began in 1978, and the evolution of competitive strategies and market structures has continued since then. Adequate frequency and convenient

interline and on-line connections, as well as low price, became important competitive tools. A more liberal regulatory environment also began to emerge gradually in other domestic markets and in international markets. The consequent increased priority given to frequency and direct service has tended to increase the number of aircraft movements required to satisfy a given level of demand.

7. The second factor is the arrival of new, mid-sized, high-technology aircraft. The 1970s saw B-747, DC-10 and L-1011 aircraft absorbed into airline fleets. These aircraft had favourable range and unit cost characteristics and were at the top end of the size spectrum. In contrast, the new aircraft of the 1980s, such as the B-757, B-767, MD-80 and A-310, were in the mid-size bracket. The economics of fleet replacement and expansion, therefore, encouraged a much smaller change in the average aircraft size during the 1980s than during the 1970s.

8. The North Atlantic is an example of a route group where in recent years regulatory developments and the characteristics of new aircraft types have encouraged the deployment of smaller aircraft. For example, extended range B-767 aircraft were able to service some secondary markets with direct trans-Atlantic service after 1984. This resulted in a proliferation of direct transatlantic services between North America and Europe. The transpacific market also experienced an increase in the number of city-pairs with direct services, but the penetration of B-767 services was more limited than on the North Atlantic, with a correspondingly reduced impact on the trend.



Source: ICAO Reporting Form A-1.
Notes: Excluding all-freight operations.
Excluding the Commonwealth of Independent States (CIS).

Figure 6-1. Average aircraft size and load factor
(passenger aircraft on scheduled services)

9. The regulatory and technological factors described above are likely to continue. However, the more liberal regulatory environment and competitive forces are encouraging consolidation and alliances among airlines which might eventually reduce or reverse the pressures to increase flight frequency at the expense of aircraft size. The buildup of airport and airspace congestion over the next decade is another factor which would favour larger aircraft. Furthermore, the new technology aircraft penetrating the fleets in the next decade include the B-777, A-330 and A-340, which are larger than the new aircraft of the 1980s. For these reasons, it is assumed that the world average aircraft size will begin to increase again and could reach almost 200 seats by 2005 compared with 184 seats in 1995.

MEASURES OF AIRCRAFT MOVEMENTS

10. Aircraft movements can be measured in terms of the number of aircraft-kilometres (or aircraft hours) flown in the airspace or the number of aircraft departures from airports. While each measure is relevant for determining the demand for air traffic control facilities, aircraft departures is the key parameter for airport planning.

11. The link between the two measures is the average aircraft stage length. The trend in the average stage length is illustrated in Figure 6-2. In the 1960s, average stage length for scheduled services increased by more than 4 per cent per annum, and thus aircraft kilometres grew 4 to 5 per cent per annum faster than aircraft departures. In the past 20 years, the growth in average stage length has been around 1 or 2 per cent per annum. The increase in stage length reflects the changing pattern of demand, with growth in passenger and freight traffic being greater for long-haul routes than for short-haul routes. Another factor has been increases in the length-of-haul capabilities of new aircraft types progressively introduced into fleets. This was especially important in the 1960s with the introduction of jet aircraft. Over the forecast period (1995 to 2005), the average stage length is assumed to grow at about 2 per cent per annum.

FORECASTING METHODOLOGY

12. The forecasting process began with the forecasts of passenger traffic and incorporated assumptions for future load factors and aircraft size, which were together translated into forecasts of aircraft movements. The specification of the model used in this process is given in Appendix 2.

13. The forecast in terms of global aircraft-kilometres was based on passenger-kilometre forecasts and assumptions from average passenger load factors and aircraft size (measured by number of seats). Since all-freight aircraft services account for less than 4 per cent of total services, their impact on the overall trend is very small. The forecast of global aircraft departures is derived from the forecast of aircraft-kilometres and expectations for the future trend in average aircraft stage length. The main assumptions for growth in world scheduled passenger traffic and trends in load factors, aircraft size and aircraft stage length over the period 1995-2005 are given below:

a) a growth in passenger-kilometres of 5.5 per cent per annum;

b) an increase in average load factor from 67 to 70 per cent;

c) a growth in average passenger aircraft size (in terms of seats) of 0.8 per cent per annum;

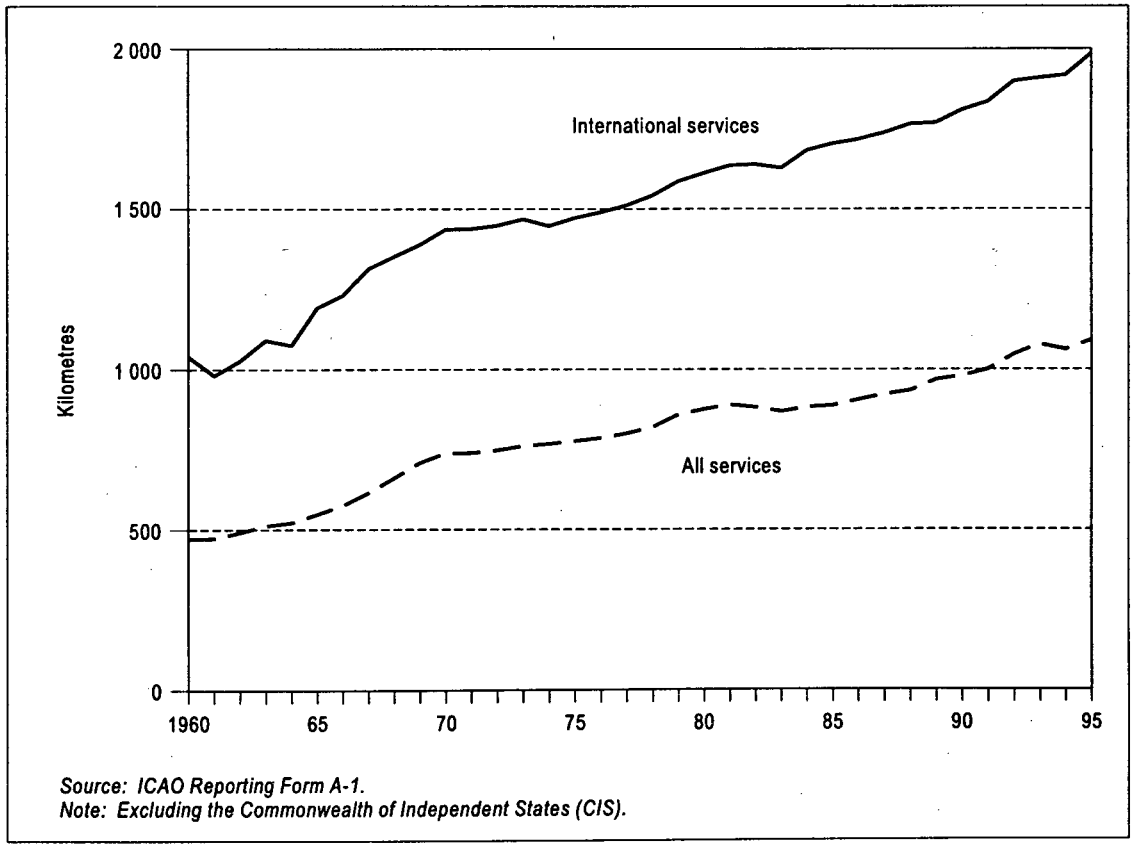
d) a growth in average aircraft stage length of 2.0 per cent per annum.

(Because of data constraints, all assumptions and forecasts exclude the Commonwealth of Independent States.)

FORECASTS OF WORLD SCHEDULED AIRCRAFT MOVEMENTS

14. The above analyses led to the forecast of average world annual growth rates of nearly 4.5 per cent for aircraft-kilometres and 2.5 per cent for aircraft departures over the period 1995 to 2005.

15. The growth rate for aircraft kilometres is below the growth rate for passenger-kilometres by one percentage point per annum because of the increases in load factor and aircraft size. Growth in aircraft departures is below the growth in aircraft-kilometres by 2 per cent per annum, which is equal to the growth in stage length.



Source: ICAO Reporting Form A-1.
Note: Excluding the Commonwealth of Independent States (CIS).

Figure 6-2. Average aircraft stage length
(scheduled services)

16. In Table 6-1, the forecasts for aircraft movements are compared with actual past movemen The rates of growth reported in the table are *average* measures over the relevant 10-year periods; the ra over shorter periods may vary. Despite lower traffic growth, the growth in aircraft movements betwe 1985 and 1995 was relatively buoyant when compared with the growth between 1975 and 1985. This w a consequence of slower growth in average aircraft size and load factor.

17. In Chapter 2 it was noted that traffic growth in the 1980s placed increasing demands on t aviation infrastructure. Although there was an easing of demand pressures in the early 1990s, the foreca imply an increase of about 55 per cent in aircraft-kilometres and 28 per cent in aircraft departures betwe 1995 and 2005. In absolute terms, the increase in aircraft kilometres between 1995 and 2005 is expect to be only a little smaller than the increase that occurred between 1985 and 1995. The absolute increa in aircraft departures is forecast to be about 4.6 million between 1995 and 2005 compared with 4.8 milli between 1985 and 1995. Over-all increases of this magnitude could result in serious congestion of certa already hard-pressed airport and airspace facilities. It is important to recognize that in arriving at the forecasts, no allowance has been made for the effect that potential supply constraints might have on traf volumes. In other words, if the supply of air traffic control and airport services does not keep pace wi demand in the same way that it has in the past, then actual traffic flows may be suppressed below t levels of demand forecast here.

Table 6-1. ICAO scheduled aircraft movements[1] forecast to the year 2005

	Actual 1975	Actual 1985	Actual 1995	Forecast 2005	Average annual growth rate (per cent) 1975-1985	1985-1995	1995-2005
Aircraft-kilometres (millions)	7 516	10 598	18 279	28 400	3.5	5.6	4.5
Aircraft departures (thousands)	9 683	11 953	16 754	21 400	2.1	3.4	2.5

1. Includes all-freight movements; excludes operations of aircraft registered in Member States of the Commonwealth of Independent States (CIS).

Appendix 1

ECONOMETRIC MODELS OF DEMAND FOR WORLD SCHEDULED AIR TRAFFIC

The basic models form assumed was:

$$y = a\ x_1^{b_1} \cdot x_2^{b_2}$$

For the model of passenger traffic:

y = passenger-kilometres performed (PKP)

x_1 = gross domestic product in real terms (GDP)

x_2 = passenger revenue per passenger-kilometre in real terms (PYIELD)

For the model of freight traffic:

y = freight tonne-kilometres (FTK)

x_1 = world exports in real terms (EXP)

x_2 = freight revenue per freight tonne-kilometre in real terms (FYIELD)

The a, b_1 and b_2 are constant coefficients whose values were obtained by statistical estimation, using econometric analysis. The b_1 and b_2 are equal to the elasticities of demand with respect to the corresponding x_1 and x_2.

Annual data were used in the estimations, covering a period of 35 years, but excluding the Commonwealth of Independent States and China. ICAO and the International Monetary Fund (IMF) were the sources of the airline and general economic data, respectively, used in the models.

Estimated passenger model:

$$ln\ \text{PKP} = 1.05 + \underset{(31.9)}{2.12}\ ln\ \text{GDP} - \underset{(7.9)}{0.61}\ ln\ \text{PYIELD} \qquad R^2 = 0.999$$

Estimated freight model:

$$ln\ \text{FTK} = -0.41 + \underset{(20.3)}{1.58}\ ln\ \text{EXP} - \underset{(5.1)}{0.37}\ ln\ \text{FYIELD} \qquad R^2 = 0.996$$

The figures in brackets are the "t" statistics of the corresponding coefficient estimates.

Appendix 2

MODEL FOR AIRCRAFT MOVEMENT FORECASTS

1. The relationship between aircraft-kilometres, load factors and aircraft size (seats per aircraft) was developed for passenger aircraft as follows:

$$\text{Aircraft kilometres} = \frac{\text{passenger-km}}{(\text{passenger-km/seat-km}) \cdot (\text{seat-km/aircraft-km})}$$

$$= \frac{\text{passenger-km}}{\text{load factor} \cdot \text{aircraft size}} \qquad (1)$$

The forecast for aircraft-kilometres for scheduled passenger aircraft in the year 2005 was generated by substituting into this expression the assumptions for passenger-kilometres, average load factor and average aircraft size in the year 2005 (excluding the Commonwealth of Independent States for which some of the base data were not available). The first of these assumptions follows directly from the traffic forecast presented in Chapter 5.

2. The average rate of increase in aircraft-kilometres from 1995 to 2005 implied by this forecast was then used to calculate the forecast number of aircraft-kilometres for all scheduled services, including all-freight as well as combined passenger and freight services (but excluding the Commonwealth of Independent States).

3. The relationship between aircraft departures, aircraft-kilometres and aircraft stage length for passenger and all-freight aircraft combined is derived as follows:

$$\text{Aircraft departures} = \frac{\text{aircraft-km}}{\text{aircraft-km/aircraft departures}}$$

$$= \frac{\text{aircraft-km}}{\text{stage length}} \qquad (2)$$

The forecast for aircraft departures in the year 2005 was generated by substituting into this expression the forecast for aircraft-kilometres and the assumption for average stage length in the year 2005.

4. Equations (1) and (2) can be expressed, approximately, in terms of the average annual rates of change of the variables over a specified period (e.g. 1995 to 2005).

Equation (1) becomes:

$$\% \text{ (ac-km)} \approx \% \text{ (passenger-km)} - \% \text{ (load factor)} - \% \text{ (ac size)}$$

Equation (2) becomes:

$$\% \text{ (ac departures)} \approx \% \text{ (ac-km)} - \% \text{ (stage length)}$$

where ac stands for "aircraft" and % stands for "average annual percentage increase".

5. The actual historic values and forecast values, as well as the corresponding average annual rates of change for all of the variables in equations (1) and (2), are given in Table A2-1.

Table A2-1. Contributions to the growth in world aircraft movements

					Average annual growth rate (per cent)		
	Actual 1975	Actual 1985	Actual 1995	Forecast 2005	1975-1985	1985-1995	1995-2005
Passenger-kilometres (billions)	575	1 180	2 160	3 690	7.5	6.2	5.5
Passenger load factor (%)	56	63	67	70	1.2	0.6	0.4
Passenger aircraft size (seats)	145	183	184	200	2.4	0.1	0.8
Aircraft stage length (km)	776	887	1 091	1 330	1.3	2.1	2.0
Aircraft-kilometres (millions)	7 516	10 598	18 279	28 400	3.5	5.6	4.5
Aircraft departures (thousands)	9 683	11 953	16 754	21 400	2.1	3.4	2.5

— END —

ICAO PUBLICATIONS
IN THE AIR TRANSPORT FIELD

The following summary gives the status and also describes in general terms the contents of the various series of publications in the air transport field issued by the International Civil Aviation Organization:

International Standards and Recommended Practices on Facilitation *(designated as Annex 9 to the Convention)* which are adopted by the Council in accordance with Articles 37, 54 and 90 of the Convention on International Civil Aviation. The uniform observance of the specifications contained in the International Standards on Facilitation is recognized as practicable and as necessary to facilitate and improve some aspect of international air navigation, while the observance of any specification contained in the Recommended Practices is recognized as generally practicable and as highly desirable to facilitate and improve some aspect of international air navigation. Any differences between the national regulations and practices of a State and those established by an International Standard must be notified to the Council in accordance with Article 38 of the Convention. The Council has also invited Contracting States to notify differences from the provisions of the Recommended Practices;

Council Statements on policy relating to air transport questions, such as charges for airports and air navigation services, taxation and aims in the field of facilitation;

Digests of Statistics which are issued on a regular basis, presenting the statistical information received from Contracting States on their civil aviation activities;

Circulars providing specialized information of interest to Contracting States. They include regional studies on the development of international air passenger, freight and mail traffic and specialized studies of a world-wide nature;

Manuals providing information or guidance to Contracting States on such questions as airport and air navigation facility tariffs, air traffic forecasting techniques and air transport statistics.

Also of interest to Contracting States are reports of meetings in the air transport field, such as sessions of the Facilitation Division and the Statistics Division and conferences on the economics of airports and air navigation facilities. Supplements to these reports are issued, indicating the action taken by the Council on the meeting recommendations, many of which are addressed to Contracting States.

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