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Outlook for Air Transport to the Year 2025

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FOREWORD

Introduction

1. This circular contains information on air transport trends and challenges and long-term airline passenger and freight traffic forecasts, in total and by region of airline registration, for the period through to the year 2025. In addition, it includes traffic forecasts for international route groups and global forecasts of aircraft movements, again through to the year 2025. The present circular is the sixth in a series issued biennially or triennially (the previous edition "Outlook for Air Transport to the Year 2015" was published in 2004 as Circular 304).

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. Sources of information other than ICAO, referred to in the circular, 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) and Department of Energy (DOE), the World Tourism Organization (UNWTO), the International Monetary Fund (IMF), the World Bank, BACK Aviation Solutions and aerospace manufacturers.

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 1960–2005, the aggregate economic activities of the world measured by Gross Domestic Product (GDP) increased at an average annual rate of 3.9 per cent in real terms. For the period 1985–2005, GDP and GDP per capita grew at an average annual rate of 3.7 per cent and 2.2 per cent, respectively (see Chapter 3).

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 (PKPs) increased at an average annual rate of 5.7 per cent for the 1975–2005 period. For the periods 1975–1985, 1985–1995 and 1995–2005, passenger traffic grew at an average annual rate of 7.0, 5.1 and 5.2 per cent, respectively (see Table 2-1).

3. World airline scheduled freight traffic (domestic and international) measured in terms of tonne-kilometres performed (TKPs) increased at an average annual rate of 6.9 per cent over the 1975–2005 period. For the periods 1975–1985, 1985–1995 and 1995–2005, freight traffic grew at an average annual rate of 7.5, 7.6 and 5.5 per cent, respectively (see Table 2-1).

4. The growth in passenger and freight traffic demand over the 1975–2005 period resulted in comparable growth in capacity offered, while aircraft movements measured in terms of aircraft departures grew at a much slower rate (3.1 per cent per annum, excluding airlines registered in the Commonwealth of Independent States) due primarily to increases in average aircraft size and in average distance flown per aircraft departure during this period. Historical traffic trends are described in Chapter 2.

5. During the period 1975–2005, average world passenger yield measured in real terms (expressed in U.S. cents per PKP) declined at a rate of 2.6 per cent per annum. Freight and mail yield measured in real terms (expressed in U.S. cents per TKP) decreased at a rate of 3.5 per cent per annum. During the same period, unit costs (operating cost per available tonne-kilometre (ATK)) measured in real terms declined at an average annual rate of 2.0 per cent (see Chapter 4).

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. Airline traffic forecasts are presented in Chapter 5.

7. For the forecast period 2005–2025, world economic growth (GDP) is expected to increase at an average annual rate of 3.5 per cent in real terms. Airline yields are expected to remain unchanged in real terms for the forecast horizon.

8. World scheduled traffic measured in terms of PKPs is forecast to increase at a “most likely” average annual rate of 4.6 per cent for the period 2005–2025. International traffic is expected to increase at 5.3 per cent per annum, while domestic traffic is expected to increase at an average annual rate of 3.4 per cent.

9. The airlines of the Middle East and the Asia/Pacific regions are expected to experience the highest growth in passenger traffic at 5.8 per cent per annum through to the year 2025, followed by the airlines of the

African and the Latin American/Caribbean regions with 5.1 and 4.8 per cent annual growth rates, respectively. Traffic of the airlines of the European and North American regions is expected to grow below the world average at rates of 4.3 and 3.6 per cent per annum, respectively .

10. The growth of passenger traffic on the major international route groups is expected to range from 3 to 6 per cent per annum through to the year 2025.

11. World scheduled freight traffic measured in terms of tonne-kilometres performed is forecast to increase at a "most likely" average annual rate of 6.6 per cent for the period 2005–2025. International freight traffic is expected to increase at an average annual growth rate of 6.9 per cent compared with a domestic freight traffic growth of 4.5 per cent per annum. Air freight traffic of the airlines of the Asia/Pacific region is expected to remain the fastest growing at 8.0 per cent per annum, followed by the Middle East region (7.8 per cent). Other regions are projected to experience growth rates below the world average, ranging from around 4.8 to 5.8 per cent.

12. Aircraft movements in terms of aircraft departures and aircraft kilometres flown for the period 2005–2025 are expected to increase at average annual rates of 3.6 and 4.1 per cent, respectively (see Chapter 6).

13. Tables 1-1, 1-2 and 1-3 provide summaries of traffic forecasts at the global, regional and route group level.

Table 1-1. ICAO air traffic forecasts — World (1985–2025)
(ICAO Contracting States)

Scheduled services	Actual 1985	Actual 2005	Forecast 2025	Average annual growth rate (per cent) 1985–2005	2005–2025
TOTAL					
Passenger-kilometres (billions)	1 366	3 720	9 180	5.1	4.6
Freight tonne-kilometres (millions)	39 813	142 579	510 000	6.6	6.6
Passengers carried (millions)	896	2 022	4 500	4.2	4.1
Freight tonnes carried (thousands)	13 742	37 660	145 000	5.2	5.5
Aircraft-kilometres (millions)[1]	n.a.	30 845	69 040	n.a.	4.1
Aircraft departures (thousands)[1]	n.a.	24 904	50 450	n.a.	3.6
INTERNATIONAL					
Passenger-kilometres (billions)	589	2 197	6 225	6.8	5.3
Freight tonne-kilometres (millions)	29 384	118 482	452 120	7.2	6.9
Passengers carried (millions)	194	704	1 950	6.7	5.2
Freight tonnes carried (thousands)	5 884	22 630	110 000	7.0	6.5

1. Data on operations of airlines registered in the former USSR not available for 1985.

Source: ICAO

Table 1-2. ICAO air traffic forecasts — Regions of airline registration (1985–2025)
(ICAO Contracting States)

Scheduled services by region of airline registration	Actual 1985	Actual 2005	Forecast 2025	Average annual growth rate (per cent) 1985–2005	2005–2025
TOTAL					
Passenger-kilometres (billions)					
Africa	36.7	84.8	230	4.3	5.1
Asia/Pacific	222.3	967.4	2 980	7.6	5.8
Europe	428.2	1 004.9	2 350	4.4	4.3
Latin America and Caribbean	68.3	159.2	410	4.3	4.8
Middle East	42.7	168.9	520	7.1	5.8
North America	567.4	1 334.5	2 690	4.4	3.6
Freight tonne-kilometres (millions)					
Africa	1 163	2 349	6 000	3.6	4.8
Asia/Pacific	9 605	50 105	235 000	8.6	8.0
Europe	14 422	37 875	97 000	4.9	4.8
Latin America and Caribbean	2 105	4 567	12 000	3.9	4.9
Middle East	1 880	8 880	40 000	8.1	7.8
North America	10 638	38 803	120 000	6.7	5.8
INTERNATIONAL					
Passenger-kilometres (billions)					
Africa	28.5	72.2	205	4.8	5.4
Asia/Pacific	150.3	622.5	2 100	7.4	6.3
Europe	214.4	865.9	2 160	7.2	4.7
Latin America and Caribbean	36.5	95.1	260	4.9	5.2
Middle East	35.1	152.5	480	7.6	5.9
North America	124.5	389.2	1 020	5.9	4.9
Freight tonne-kilometres (millions)					
Africa	1 070	2 256	5 870	3.8	4.9
Asia/Pacific	8 589	45 070	215 000	8.6	8.1
Europe	11 589	36 981	95 900	6.0	4.9
Latin America and Caribbean	1 487	3 777	10 600	4.8	5.3
Middle East	1 808	8 764	39 750	8.2	7.9
North America	4 841	21 634	85 000	7.8	7.1

Source: ICAO

Table 1-3. ICAO air traffic forecasts — Route groups (1985–2025)
(ICAO Contracting States)

	Passenger-kilometres performed (billion)			Average annual growth rate (per cent)	
	Actual 1985	Actual 2005	Forecast 2025	1985–2005	2005–2025
International scheduled services					
Mid-Atlantic	11.0	58.2	154	8.7	5.0
North Atlantic	139.9	434.9	1 049	5.8	4.5
South Atlantic	12.5	69.4	210	8.9	5.7
Trans-Pacific	67.4	262.5	842	7.0	6.0
Between Europe and Africa	37.6	121.8	363	6.0	5.6
Between Europe and Asia/Pacific	69.2	263.9	815	6.9	5.8
Between Europe and Middle East	25.0	73.2	235	5.5	6.0
Between Middle East and Asia/Pacific	23.0	98.4	355	7.5	6.6
Between North America and Central America/Caribbean	21.5	63.1	152	5.5	4.5
Between North America and South America	13.1	59.8	159	7.9	5.0
Intra Africa	4.6	13.4	43	5.5	6.0
Intra Asia/Pacific	70.5	295.8	949	7.4	6.0
Intra Europe	60.5	253.3	555	7.4	4.0
Intra Latin America	8.0	22.6	72	5.3	6.0
Intra Middle East	4.5	15.0	44	6.2	5.5
Intra North America	15.0	27.4	55	3.0	3.5
Other international routes	5.9	65.3	173	12.8	5.0
Total international	589.3	2 198.0	6 225	6.8	5.3
Domestic scheduled services					
Africa	8.1	12.6	36	2.2	5.4
Asia/Pacific	72.0	344.9	933	8.1	5.1
Europe	213.8	139.0	228	–2.1	2.5
Latin America	31.8	64.1	169	3.6	5.0
Middle East	7.5	16.4	40	4.0	4.6
North America	442.9	945.3	1 549	3.9	2.5
Total domestic	776.2	1 522.3	2 955	3.4	3.4
Global (international + domestic)	1 365.5	3 720.3	9 180	5.1	4.6

Note.— The historical database has been developed from several sources, including ICAO and IATA.

Chapter 2

AIR TRANSPORT TRENDS AND CHALLENGES

ECONOMIC DEVELOPMENT AND AIRLINE TRAFFIC PATTERNS

1. From a long-term historical perspective, air transport has experienced greater growth than most other industries. Since 1960, increasing demand for passenger and freight services, rapid technological development and associated investment have combined to multiply the output of the air transport industry by a factor of more than 30 in terms of TKPs. This expansion of air transport compares favourably with the broadest available measure of world output, the global GDP, which when measured in real terms has multiplied by more than 5 times over the same period.

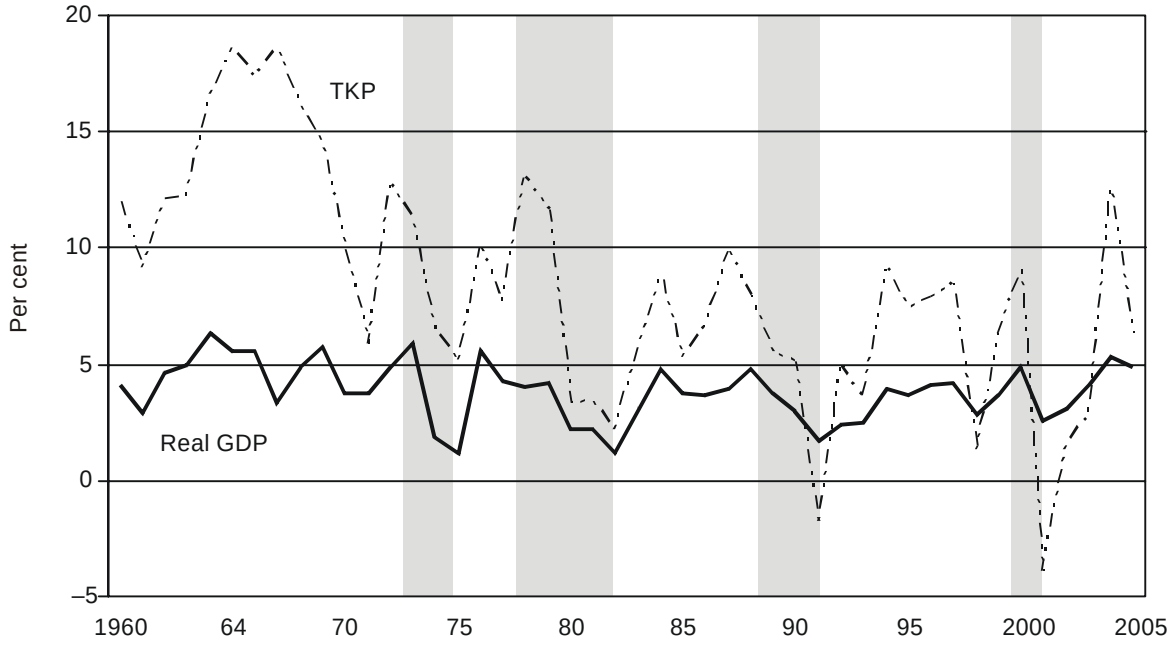
2. Economic theory and analytical studies indicate that there is a high correlation between the growth patterns of air traffic and economic trends in that the demand for air transport is primarily driven by economic development. Changes in personal income affect the level of consumer purchasing power 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 strength of the economy and traffic demand by illustrating the fluctuations in the rate of growth of each for the period 1960 to 2005. The impact of economic slowdowns and recessions on air traffic trends is clearly visible during the following years or periods: 1974–75, 1980–82, 1990–91, 1998 and 2001 (the latter coupled with the unprecedented events of 11 September).

3. Between 1985 and 2005, worldwide scheduled traffic, measured in TKPs, grew at an average annual rate of 5.5 per cent, compared to a 3.7 per cent GDP growth. While the pattern of traffic growth over that period was generally a reflection of economic conditions, the impact of recent event-related developments on air travel demand (events of 11 September 2001, war in Iraq and the SARS outbreak) indicate that the air transport industry is sensitive to safety and security concerns which influence consumer confidence.

4. Other factors that have affected traffic demand include airline costs, and hence fares and rates, regulatory developments and the access to air and tourism services. Rapid growth in the 1960s coincided with the replacement of piston-engine aircraft with jet aircraft which led to reduced real fares and increased speed and comfort of travel. In addition to an adverse effect on the world economy, sharp changes in the price of oil and aviation fuel (such as in 1973–1974 and further escalation during 1979–1981) have had important effects on airline costs. Most recently airline costs have been negatively affected by increasing insurance and security costs in addition to the sharp hike in oil prices. More details are provided in paragraph 22.

TRENDS IN SCHEDULED PASSENGER, FREIGHT AND MAIL TRAFFIC

5. Over the decades, the growth experienced by the total demand for air transport has been shared to a varying extent by each of its major components — passenger, freight and mail traffic. The average growth rate for each of these components has declined since the mid-1970s as shown in Table 2-1. The gradual decline in mail traffic has been particularly severe, partly because of increasing competition from telecommunications.



Source: IMF, ICAO Reporting Form A.

Figure 2-1. Economic and airline traffic trends — World (1960–2005)
(GDP in real terms and total scheduled TKPs)

Table 2-1. Trends in total scheduled traffic — World (1975–2005)
(ICAO Contracting States)

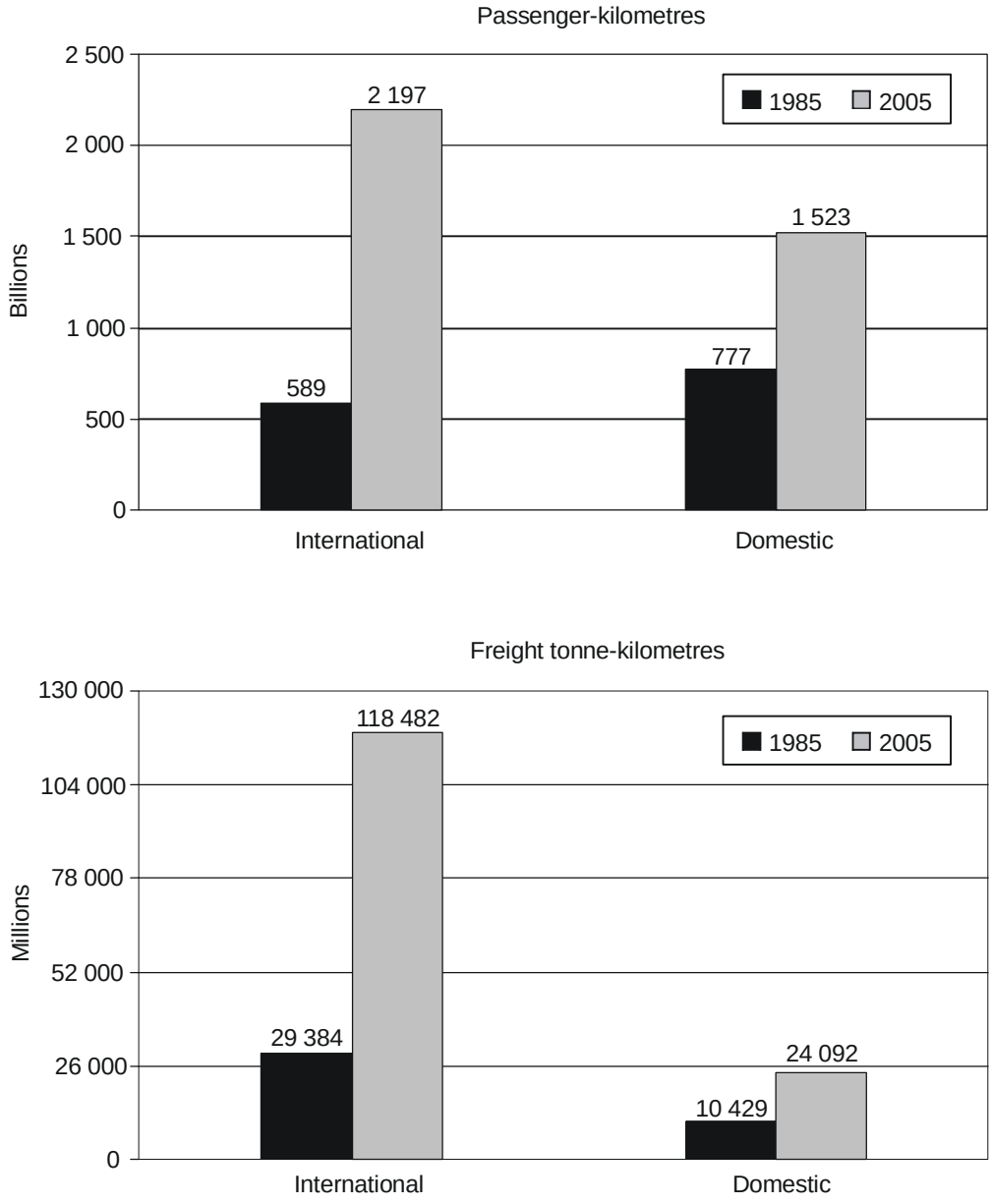
Scheduled services	Average annual growth (per cent) 1975–1985	1985–1995	1995–2005
Passenger-kilometres	7.0	5.1	5.2
Freight tonne-kilometres	7.5	7.6	5.5
Mail tonne-kilometres	4.3	2.5	–1.9
Total tonne-kilometres	7.1	5.8	5.2

Source: ICAO Reporting Form A.

6. In 2005, the world's airlines carried over 2.0 billion passengers and 37 million tonnes of freight and mail on scheduled services. During the same year, airlines performed on scheduled services 3 720 billion passenger-kilometres (equivalent to 340 billion tonne-kilometres), 143 billion freight tonne-kilometres (FTKs) and 4.7 billion mail tonne-kilometres. Over the period 1985–2005 total scheduled traffic, measured in terms of tonne-kilometres performed, grew at an average annual rate of 5.5 per cent.

International and domestic traffic

7. International traffic has tended to grow more rapidly than domestic traffic, particularly in the case of freight. Figure 2-2 shows the expansion in the international and domestic components of scheduled passenger and freight traffic over the period 1985 to 2005. Over this 20-year period both passenger and freight traffic almost quadrupled on international routes namely from 590 billion PKPs in 1985 to 2 198 billion PKPs in 2005 and from 29 384 million FTKs to 118 504 million FTKs, respectively.

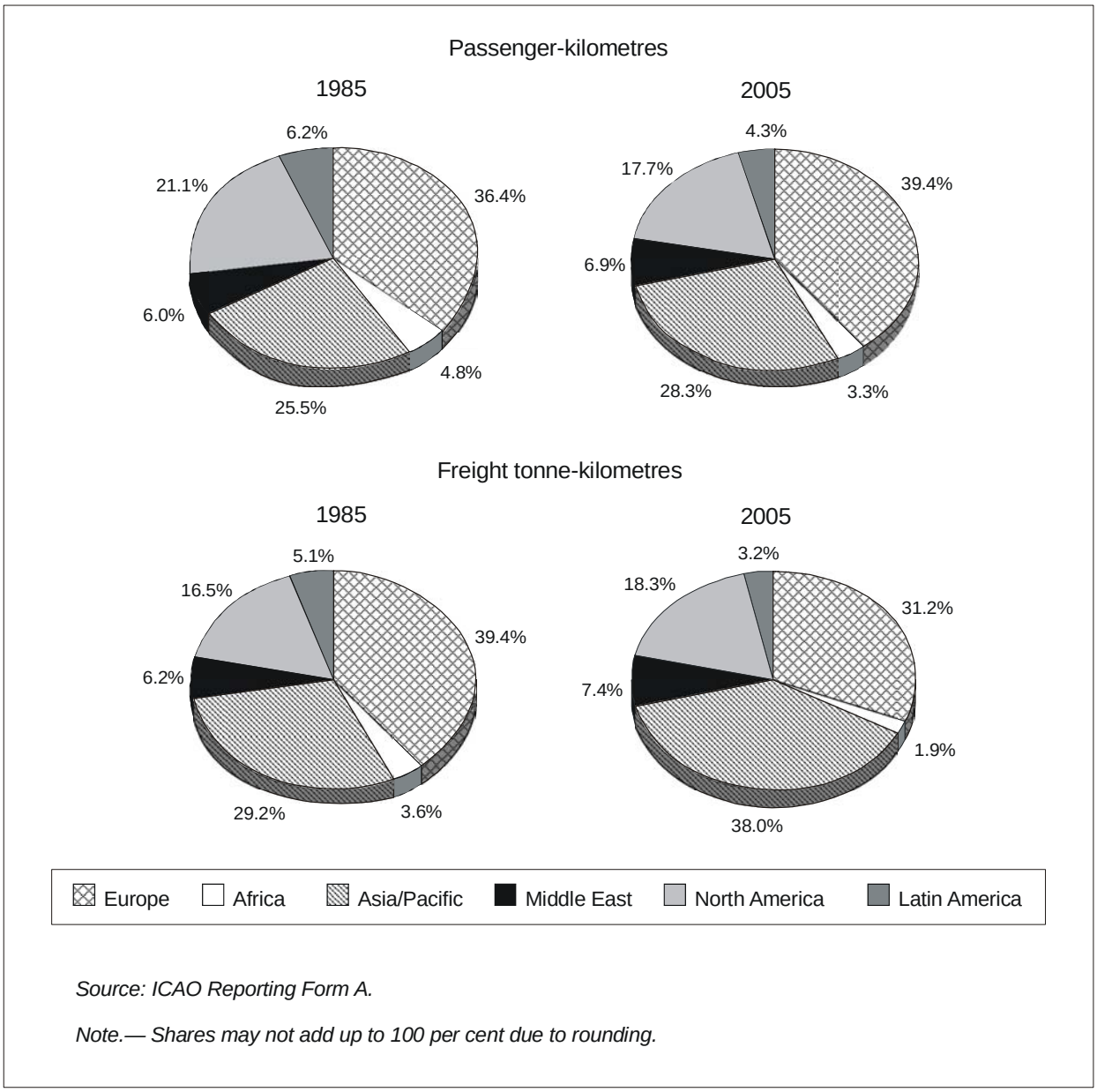


Source: ICAO Reporting Form A.

Figure 2-2. Trends in scheduled international and domestic traffic — World (1985 and 2005)

Regional distribution of scheduled international traffic

8. Figure 2-3 compares the share of international passenger and freight traffic by region of airline registration in 1985 and 2005. The scheduled international traffic regional ranking in terms of passenger-kilometres performed remained almost unchanged. Airlines registered in Europe maintained their dominance while increasing their share to about 40 per cent. Airlines registered in the Asia/Pacific region ranked second and saw their share increase to 28.3 per cent while the share of the North American airlines declined to about 18 per cent. Airlines of the Middle East region increased their share to 6.9 per cent while the shares of Latin American and Caribbean and African carriers declined to 4.3 per cent and 3.3 per cent, respectively.



Source: ICAO Reporting Form A.

Note.— Shares may not add up to 100 per cent due to rounding.

Figure 2-3. International passenger and freight traffic — Shares by region (1985 and 2005)

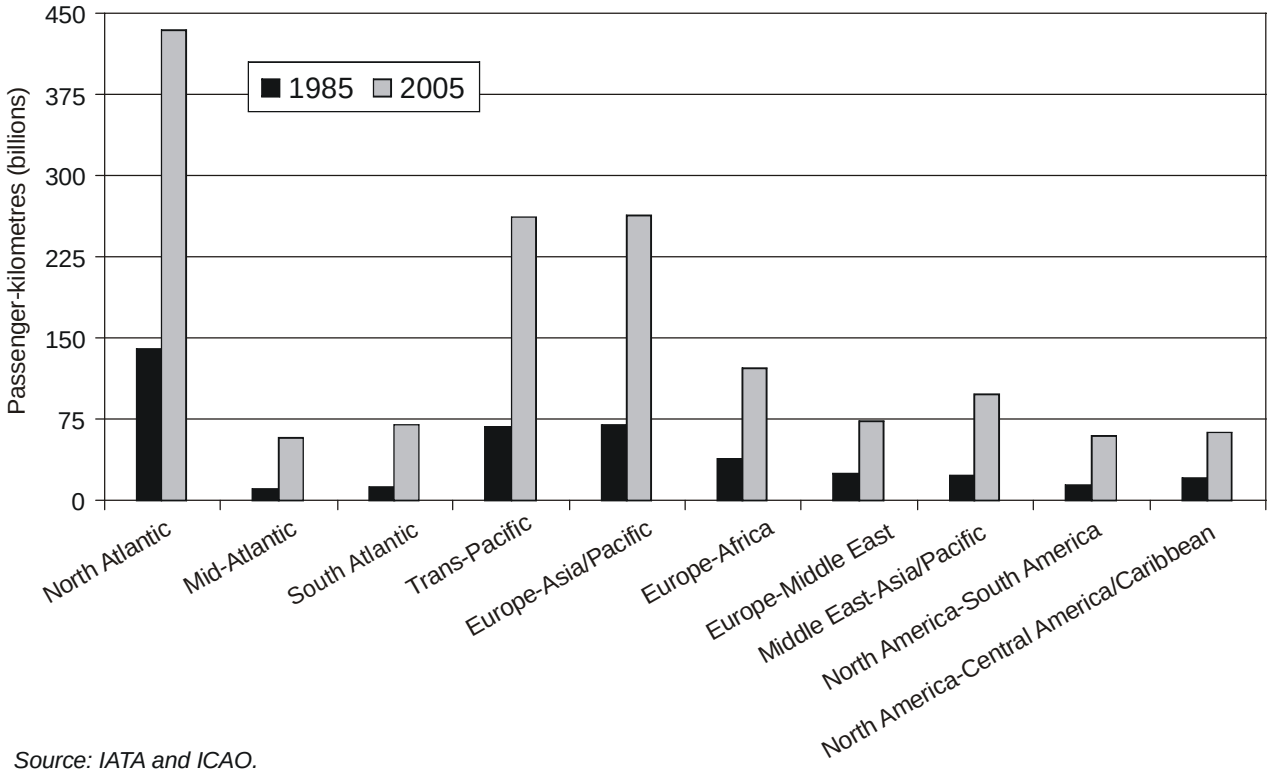
9. Airlines of the Asia/Pacific region achieved the highest share of air freight traffic of about 38.0 per cent, while the European and North American airlines saw their shares decline to 31.2 per cent and 18.3 per cent, respectively, in 2005. Airlines of the Middle East region increased their share to 7.4 per cent while the shares of Latin American and Caribbean, and African carriers declined to 3.2 per cent and 1.9 per cent respectively.

Passenger traffic on major international route groups

10. Figure 2-4 illustrates trends of scheduled passenger traffic measured in terms of passenger-kilometres performed on major international route groups between 1985 and 2005 (for data see Table 1-3). It shows the continued dominance of the top three major intercontinental route groups (North Atlantic, Europe-Asia/Pacific and Trans-Pacific). Other route groups (such as Europe-Africa, Mid-Atlantic and Europe-Middle East) have been growing faster but from a smaller base.

TRENDS IN NON-SCHEDULED PASSENGER TRAFFIC

11. 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.



Source: IATA and ICAO.

Figure 2-4. Passenger-kilometres performed on scheduled services — Major international route groups (1985 and 2005)

12. Non-scheduled air transport is primarily devoted to international passenger traffic, with freight traffic and domestic traffic being relatively small by comparison. The share of non-scheduled passenger traffic in the total international passenger traffic declined from about 15 per cent during the latter part of the 1990s to around 10 per cent in 2005. Table 2-2 provides estimates for 1985 and 2005 of non-scheduled passenger traffic carried by non-scheduled and scheduled carriers. Growth in their combined non-scheduled international traffic was approximately 4.2 per cent per annum on average in terms of PKPs during the 1985–2005 period, below the 6.8 per cent per annum growth rate for scheduled international traffic. Non-scheduled traffic is very important on intra-European routes which account for the largest part of the world charter market in terms of passengers, followed by North Atlantic routes.

AIRCRAFT MOVEMENTS

13. The growing demand for passenger and freight air services since 1960 went hand in hand with an expanded fleet capacity. Growth patterns of 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.

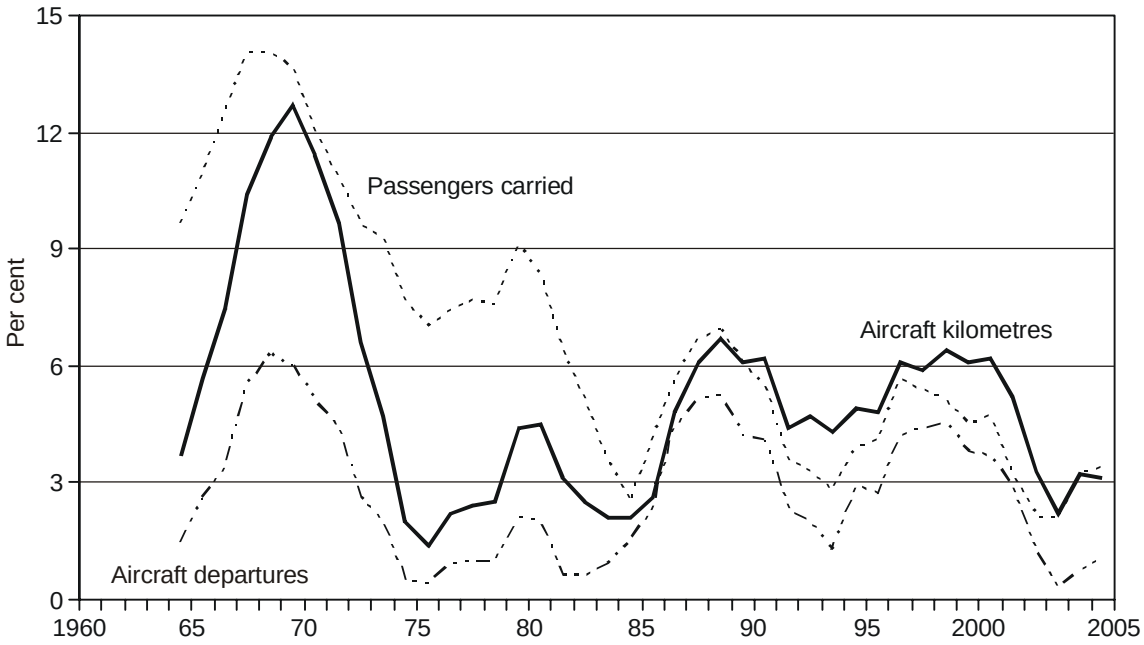
14. The large gap between the growth rates for passengers carried and aircraft departures that existed in the 1960s and 1970s is primarily a reflection of the increases in average aircraft size over this period. In the 1980s, as this trend in aircraft size levelled out, the growth rate for aircraft departures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

15. 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 (i.e. average length of non-stop flights) has been increasing. The rate of increase in average stage length was greatest when jet aircraft were replacing piston-engine aircraft.

Table 2-2. International non-scheduled passenger traffic — World (1985 and 2005)
(ICAO Contracting States)

	Passenger-kilometres performed		Average annual growth (per cent)
	1985 (billions)	2005 (billions)	
Non-scheduled carriers	68.7	47.8	–1.8
Scheduled carriers	46.1	215.2	8.0
Total	114.8	263.0	4.2

Source: ICAO Reporting Form A.



Source: ICAO Reporting Form A.

Note.— 5-year moving average of annual growth. Excluding operations of airlines registered in the Commonwealth of Independent States (CIS).

Figure 2-5. Growth in passengers and aircraft movements — World (1960–2005)
(Total scheduled operations)

FLEET COMPOSITION AND PRODUCTIVITY

16. At the end of 2005, the scheduled and non-scheduled carriers of ICAO Contracting States had a combined fleet of about 22 130 aircraft of over 9 tonnes (t) maximum take-off mass (MTOM) for their international and domestic operations. This is more than double the 1985 fleet. The number of jet aircraft at the end of 2005 was some 18 240, which is also more than two and a half times the corresponding 1985 fleet. Jet aircraft obviously account for an even larger proportion of carriers' fleet capacity than indicated by the relative number of aircraft. Figure 2-6 contrasts the steep 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-engine aircraft.

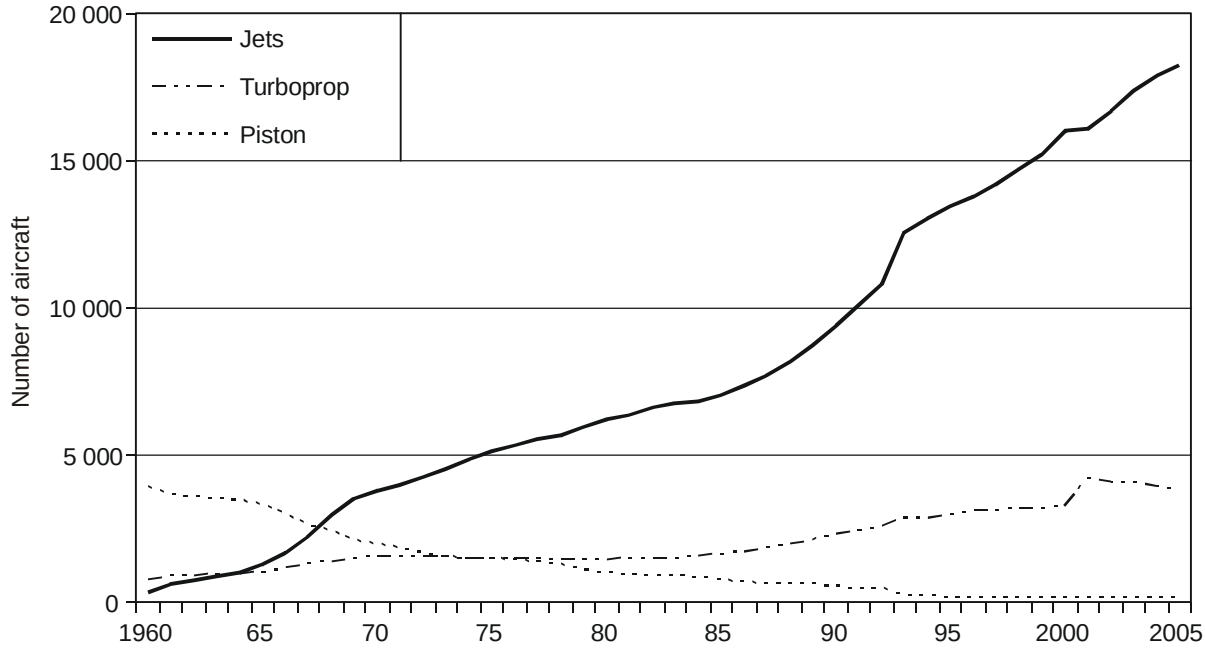
17. The progressive absorption of advanced aerospace technology into airline fleets has been a major source of productivity improvement for the airline industry, as measured by the quantity of output per unit of input. A single reliable measure of productivity requires comprehensive measures of output and input. For the airline industry, TKP, including both passenger and freight traffic, is a measure of aggregate 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 for the aggregated operations of international scheduled airlines are shown in Table 2-3. 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 that 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 by far the largest impact over the past four decades. The three components of aircraft productivity have been combined into a single measure of aircraft productivity whose trend is included among those illustrated in Figure 2-7. There have been some fluctuations in performance related to business cycle conditions. Over the whole 45-year period, aircraft productivity has advanced at an average annual rate of about 3.2 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 2-7. The introduction of labour-saving technology and systems has resulted in an impressive 6.0 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 over 28 tonnes in 2005. However, average aircraft capacity has not changed much since 1985.

20. An overall index of airline productivity has been derived by combining the indices for aircraft, labour and fuel productivity into a single average measure (presented in paragraph 23). The average growth in this measure was about 5.6 per cent per annum between 1960 and 2005.



Source: ICAO, BACK Aviation Associates.

Note.— As from 2001, turboprop aircraft manufactured in China and the Russian Federation are included.

Figure 2-6. Composition of commercial aircraft fleet — World (1960–2005)
(Aircraft of 9 tonnes MTOM and over)

Table 2-3. Productivity of international scheduled airlines — World (1965–2005)
(ICAO Contracting States)

Productivity measure	Average levels 1965	1975	1985	1995	2005
Aircraft productivity					
Aircraft load factor (per cent)	52	50	58	60	63
Aircraft speed (km/h)	469	600	635	647	674
Aircraft utilization (hours per aircraft per year)	1 678	2 064	2 179	2 790	3 556
Labour productivity					
TKP per employee (thousands)	43	82	144	261	397
Fuel productivity					
TKP per litre of fuel (index)	100	123	187	217	277

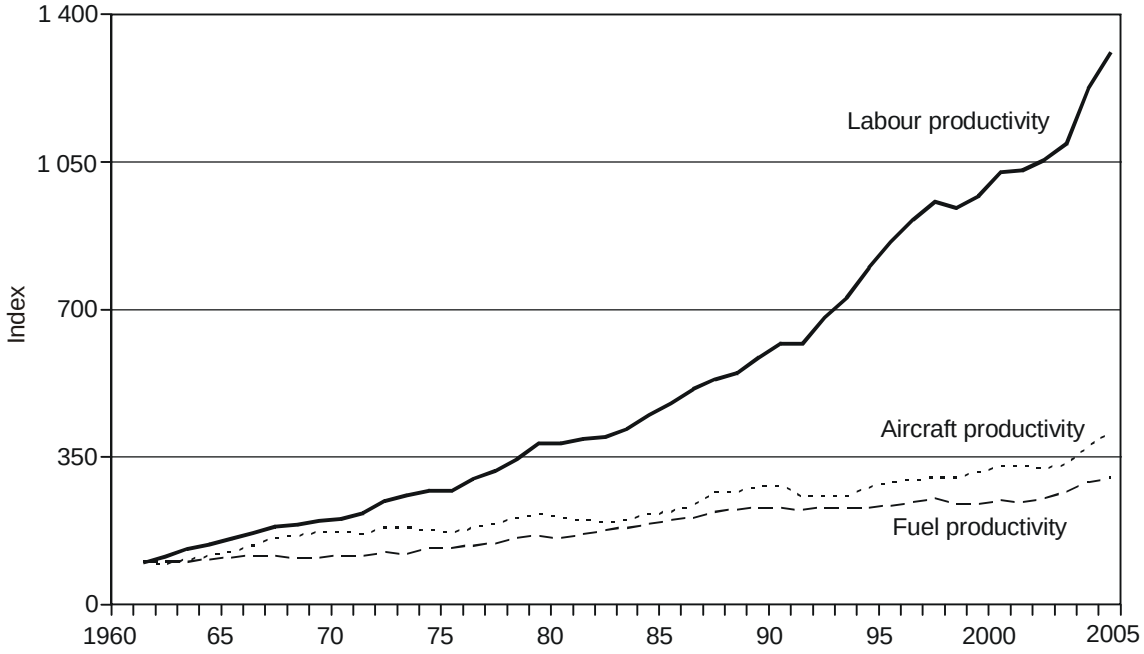
Note.— Excluding operations of airlines registered in the CIS.
Source: ICAO

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.

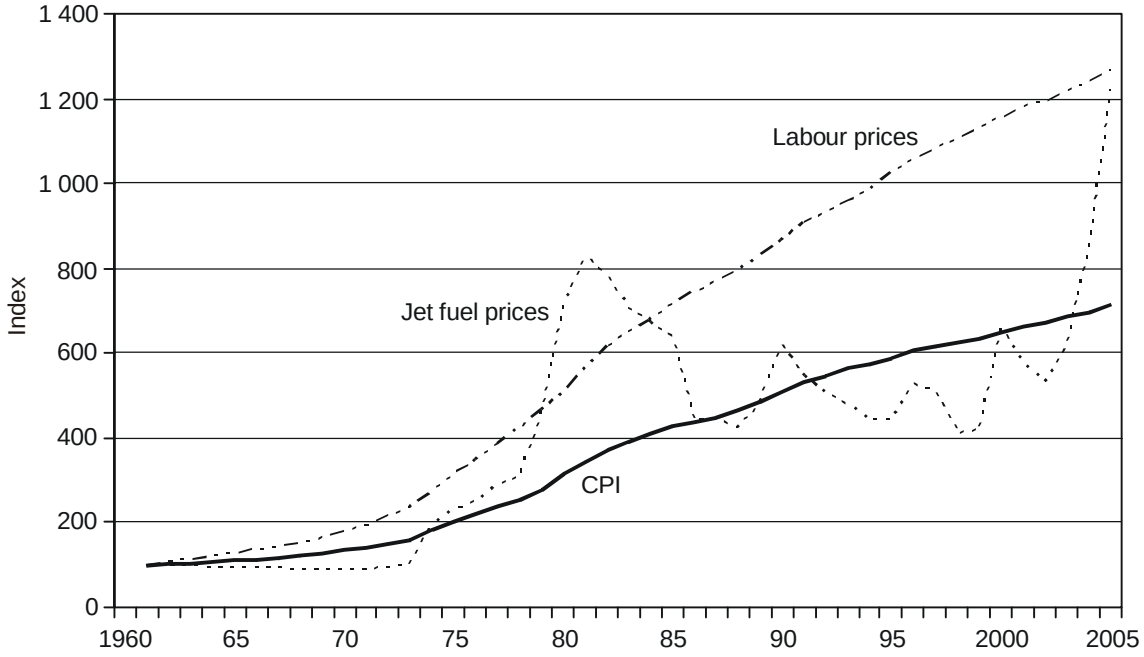
22. Changes in the real prices paid for inputs (e.g. labour and fuel) purchased by the airlines are also reflected in the cost per unit of output, and hence in real fares and rates and in financial performance. The price trends of two of the most important inputs, labour and jet fuel, are indicated in Figure 2-8, 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 2-7. Fuel is another key item on the expense side of the accounts. The impact on expenses of the very large fuel price increases in 1973–74 and 1979–80 was partly reversed by the price declines in 1985. Further hikes in jet fuel prices occurred in 1990, 1996 and 2000 when the average annual price in U.S. dollars reached 85 cents per gallon. Due to a contraction in demand, the jet fuel price softened to 69 cents on average in 2002 but has since increased substantially to reach an average of 171 cents in 2005 increasing the pressure on airline operating costs. As a result, the share of fuel and oil costs in total operating costs of scheduled airlines climbed to 22 per cent in 2005 compared to only 10 to 15 per cent during the 1990s.

23. The trends in productivity, input prices, yields (i.e. fares and rates), and financial performance are summarized in Figure 2-9. A log scale is used so that the slopes of the trend lines represent percentage changes. The productivity measure is the overall index referred to above. An overall 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.



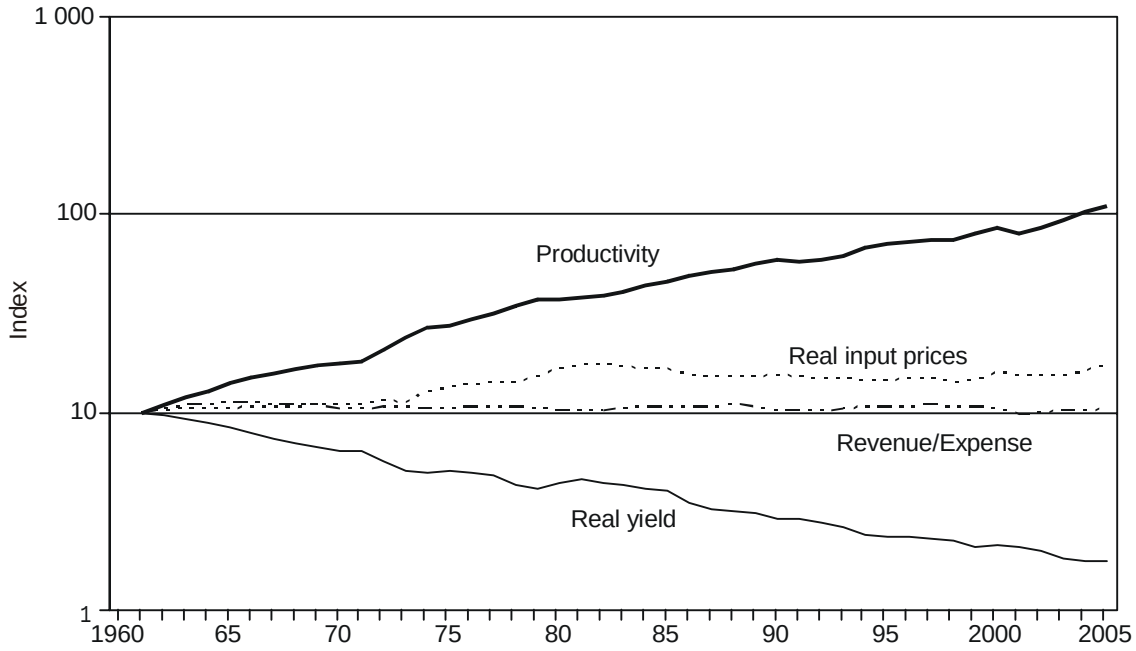
Source: ICAO, BACK Aviation Associates, IMF, OECD.

Figure 2-7. Trends in airline productivity — World (1960–2005)



Source: IMF, OECD, US Department of Energy.

Figure 2-8. Input price trends — World (1960–2005)



Source: IMF, ICAO Reporting Forms A and EF.

Figure 2-9. Trends in airline industry performance — World (1960–2005)

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. A slight increase in these prices can also be observed in recent years which can be mainly attributed to fuel price hikes.

25. Although there have been substantial changes in the operating results of the airline industry in the short and medium terms (see Chapter 4), there has been neither an improving nor declining trend in financial performance over the long term. A significant sustained 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 substantial 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 0.08 in 1980, 0.03 in 1990 and has ranged between 0.05 and 0.01 since then. The year 2005 saw 0.02 passenger fatalities per 100 million passenger-kilometres flown.

27. There have also been significant enhancements in the quality of service provided to airline customers. There are many dimensions to 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 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 (km/h) in 1960 to 630 km/h in 1980 and 674 km/h in 2005 (an increase of about 90 per cent over 1960). There has been little change in block speed since 1980. The average stage length has more than doubled from 470 kilometres in 1960 to 1 239 kilometres in 2005. 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 passenger total journey time especially for multi-leg trips.

28. With the growth in air transport demand in response to factors such as overall 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 stimulation of demand in the long run, although there have also been short-term demand contractions due to so-called fear and hassle and other non-economic factors. While it is not possible to isolate cause and effect, the fact that aircraft departures have increased by around 270 per cent between 1960 and 2005 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. However, the subsequent resumption of traffic growth in the late 1990s put pressure again on facilities. This came to a halt in the early 2000s, with the combination of terrorist events and the general economic slowdown, which resulted in a delay of about five years in airport traffic growth. Air traffic growth has now resumed in most regions of the world and air traffic congestion has re-emerged, increasing the pressure on capacity which is acute 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. Barriers to building new airport infrastructure may be of a regulatory, political or environmental nature in addition to lack of funding and barriers to foreign investment.

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. Implementation of the global air traffic management operational concept under the leadership of ICAO is expected to lead to significant improvements in the management of air traffic in all phases of flight.

31. There are also various technical procedures, such as revisions to separation criteria, that 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 measures are essentially supply-side oriented and 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.

34. The increasing use of secondary airports in major urban areas and of regional airports is providing relief, as well as a degree of competition, to major airports by diverting traffic from high-density flows but, at the same time, is adding aircraft movements, usually performed by smaller aircraft, to air traffic management systems.

ENVIRONMENTAL PROTECTION

35. 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.

36. 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 worldwide policy enabling States to introduce operating restrictions on the older, noisier ("Chapter 2") aircraft covered by these Standards. The phase-out of Chapter 2 aircraft has now been completed at most airports where aircraft noise is a problem and governments have been turning their attention to concerns that the rapid growth of air transport could increase noise levels once again. With a view to addressing these concerns, ICAO endorsed the concept of a "balanced approach" to aircraft noise management. This consists of identifying the noise problem at an airport and then analysing the various measures available to reduce noise through the exploration of four principal elements, namely reduction at source (quieter aircraft), land-use planning and management, noise abatement operational procedures, and operating restrictions, with the goal of addressing the noise problem in the most cost-effective manner. In 2006, a new, more stringent ICAO Standard ("Chapter 4") became applicable.

37. As regards aircraft engine emissions, initially the main concern 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. The principal issue is aviation's contribution to climate change. In 1999, the Intergovernmental Panel on Climate Change (IPCC) prepared a *Special Report on Aviation and the Global Atmosphere*[1] which estimated that aircraft contribute about 3.5 per cent of the total radiative forcing[2] by all human activities. The emissions from aircraft of relevance for climate change include carbon dioxide (CO_2), water vapour, nitrogen oxides (NO_x), sulphur oxides and soot.

38. The Kyoto Protocol to the UN Framework Convention on Climate Change (UNFCCC), which was adopted in 1997 and entered into force on 16 February 2005, requires industrialized countries to reduce their collective emissions of certain greenhouse gases, the one most relevant to aviation being CO_2. The Kyoto Protocol also calls for industrialized countries, working through ICAO, to limit or reduce emissions from international aviation.

39. Future concerns about aviation's role in both climate change and local air quality are largely due to the projected continued growth. Because of improvements in fuel productivity, growth rates for emissions are less than those for traffic growth. While fuel productivity improvement is expected to continue, there are no easy technical "fixes" for aviation and total emissions will continue to increase.

FINANCIAL RESOURCES

40. 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 began to build up again in the latter part of the 1990s. As illustrated in Figure 2-10, aircraft orders tended to peak when the air transport industry was profitable while peak deliveries coincided with financial deficits and low traffic growth leading to over-capacity and further losses. There are signs however of a change in behavior and airlines made record aircraft orders in 2005 despite their net financial losses. The expected future funding requirement over the

1. This Report has a *Summary for Policymakers* which is available in six UN languages (Arabic, Chinese, English, French, Russian and Spanish) and is accessible at IPCC's Web site (www.ipcc.ch). The report itself (over 300 pages) is published in English only and can be purchased from Cambridge University Press (www.cup.cam.ac.UK).
2. Radiative forcing is a measure of the importance of a potential climate change mechanism.

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. In general, it is expected that sufficient funding will be made available for the purchase or lease of aircraft and that the matching of supply to demand will improve over the forecast horizon.

ECONOMIC REGULATION

41. For the past decade, there have been significant developments in the air transport regulatory scene at the national, bilateral, regional and multilateral levels. Much progress has been made in the liberalization of international air transport.

42. At the national level, there has been a shift in the regulatory approach, from detailed regulation of airline operations to relying more on market forces. Several States have amended their air transport policies in light of the global trend toward increased liberalization. Some of these policies seek to liberalize air transport services, in whole or in part, on a unilateral basis without requiring comparable rights from bilateral partners in return. Others aim at liberalizing domestic air transport markets and also at permitting more carriers to fly international routes.

43. At the bilateral level, over 70 per cent of bilateral air services agreements which were recently concluded or amended contained some form of liberalized arrangements such as unrestricted traffic rights (covering Third, Fourth and in some cases Fifth Freedom rights), multiple designation with or without route limitations, free determination of capacity, a liberal double disapproval or country-of-origin tariff regime, and broadened criteria for air carrier ownership and control. One notable development is the considerable increase in the number of "open skies" agreements, which provide for full market access without restrictions on designations, route rights, capacity, frequencies, codesharing and tariffs. Since the mid-1990s, over 120 such open skies agreements were concluded between some 90 States. These agreements involve not only developed countries but also an increasing number of developing countries (involved in about 65 per cent of the agreements).

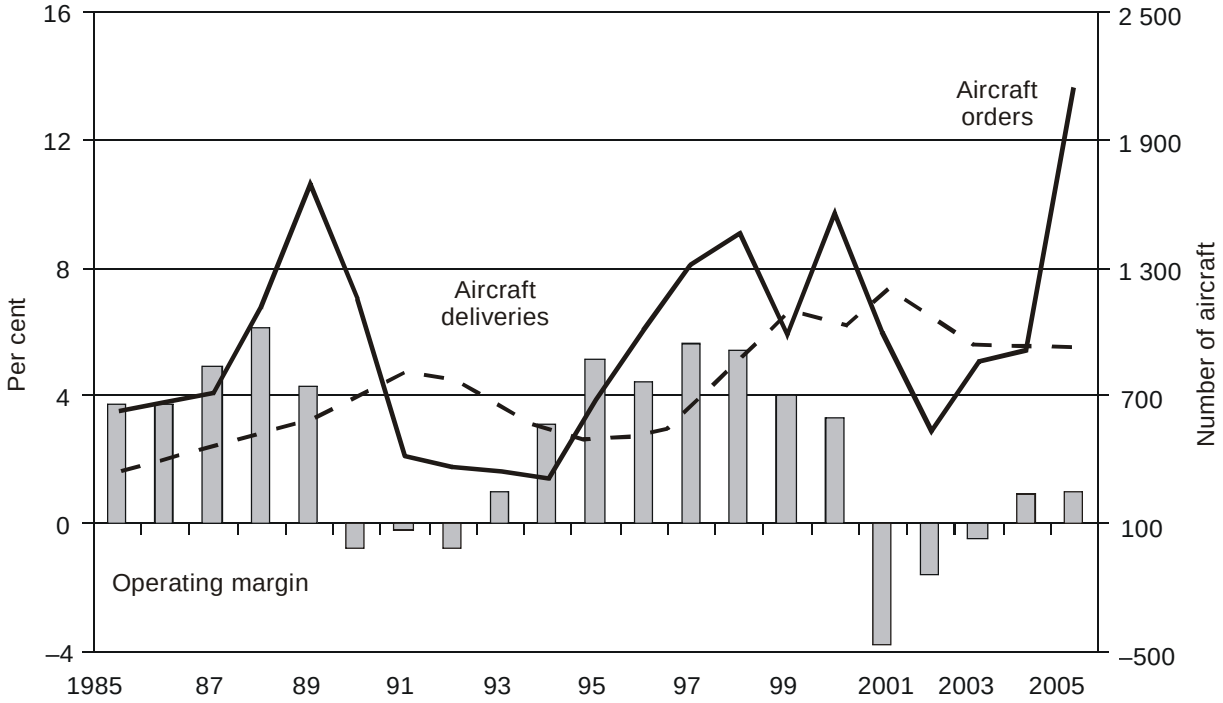


Figure 2-10. Aircraft orders, deliveries and operating margin — World (1985–2005)

44. At the regional level, no less than 11 groups of States have created liberalization regimes on a regional basis or among a group of like-minded States; a few examples being the European Union (EU), the Andean Pact, the Yamoussoukro II Ministerial decision, and the Multilateral Agreement on the Liberalization of International Air Transportation (MALIAT) known as the "Kona" open skies agreement. There are also several other potential arrangements under development throughout the world. These regional and/or plurilateral liberalization arrangements have the basic objective of providing greater market access and improving services among the member States concerned. Small groups of States of comparable size and development may find it easier to agree on market access than larger, diverse groups of States. The small groups would also provide a more manageable environment to test liberalized air transport policies.

45. Along with intra-regional liberalization, interaction between regions has also been on the rise. More significantly, there has been an increase in air service negotiations involving a regional grouping on the one hand, and a State or a group of States on the other. In this respect, EU has been the most active, where the European Commission now is engaged in such negotiations under specific mandates on behalf of all EU member States. This approach has led to the conclusion or negotiation of several liberalized arrangements (e.g. between the EU and the United States, the EU and Morocco, and between the Association of Southeast Asian Nations (ASEAN) and China). Such negotiations have introduced a new dimension to aviation relations between States.

46. Because of such a continuing trend of liberalization in air transport regulation, in 2005, about 20 per cent of the country-pairs with non-stop passenger air services and almost half of the seat capacity offered occurred between States which have embraced liberalization either by bilateral "open skies" air services agreements or by regional liberalized agreements and arrangements (compared with less than 4 per cent and about 20 per cent respectively in 1995).

47. At the multilateral level, the World Trade Organization (WTO) came into being in January 1995 when the General Agreement on Trade in Services (GATS) entered into force. The GATS Annex on Air Transport Services applies trade rules and principles such as most-favoured nation (MFN) treatment and national treatment to three specific so-called "soft" rights, namely, aircraft repair and maintenance, selling and marketing of air transport, and computer reservation system (CRS) services. It excludes from the application of the GATS "services directly related to the exercise of traffic rights". Pursuant to an earlier ministerial decision, WTO launched in 2000 the first review of the operation of this Annex with a view to considering possible extension of its coverage in the air transport sector. In 2003, however, the first review was concluded with the result that the Annex remains unchanged. In 2005, WTO launched its second round of review of the Annex on Air Transport Services.

48. Other more general regulatory measures also affect air transport. Such measures include competition law, 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 particularly where prevention of the spread of Acquired Immune Deficiency Syndrome (AIDS) and Severe Acute Respiratory Syndrome (SARS) and other contagious diseases is sought, and national narcotics control efforts.

INDUSTRY STRUCTURE

49. Traditionally, changes in airline industry structure arise from the need to meet growing demand for air transport services in increasingly competitive but less regulated markets and a more globalized economic environment.

50. Mega-carriers in the United States and elsewhere operate out of their home base airports applying 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 by each flight. This operational approach arose from a perceived need to operate several hubs and to achieve critical mass (i.e. a volume sufficient to exploit economies of scope and density, and the ability to influence market conditions). However, the hub-and-spoke concept has recently come under scrutiny as

one of the measures taken by airlines to reduce airport services costs by utilizing staff, gates and aircraft more productively and to effectively compete with low cost carriers'(LCCs) point-to-point non-stop operations.

51. Airlines are making increased use of computer-based measures to improve productivity and optimize revenues, including the use of automated systems for yield (or revenue) management and for marketing, sales and communication. The development of sophisticated yield management systems has enabled airlines to adjust the mix of high- and low-fare passengers on each flight in order to maximize revenues as well as to allocate seats efficiently. Yield management has enabled established higher-cost airlines in certain instances to compete selectively with new LCCs that are often reliant upon low fares to achieve market penetration.

Product distribution

52. An important development in the airline distribution and sales area which combines computers and personal communication systems is direct sales to consumers, including via the Internet. Traditional travel agents still issue the majority of airline tickets, but online sales through airline websites and online travel agencies have increased significantly. This development has created new opportunities as well as challenges for airlines and CRS vendors. Many airlines have started or expanded online sales as a way of cutting distribution costs. Some have joined forces to create travel websites in order to maximize the benefits of electronic commerce. The four global CRS vendors, *Amadeus*, *Galileo*, *Sabre* and *Worldspan*, have increasingly seen themselves as global distribution systems (GDSs) and have pursued e-commerce businesses aggressively and acquired major online travel agencies. There is also the emergence of some so-called GDS New Entrants (GNEs), which provide a cheaper alternative to CRSs and have the potential to significantly reduce distribution costs for major airlines.

53. Another important development in this area is electronic ticketing, initially offered for domestic flights in the United States but now becoming widely available for international flights in all regions. IATA declared in 2004 that the elimination of paper tickets and full implementation of e-ticketing worldwide would be achieved by the end of 2007. In an era of increased competition, these developments offer considerable cost savings for airlines, as well as diversification of their distribution outlets.

Alliances and airline cooperation

54. The formation of alliances as well as joint marketing arrangements among airlines is a relatively recent but rapidly evolving phenomenon implemented to achieve and improve market access (albeit indirectly) and synergies (for example, reducing the costs through network related economies of scope and scale). Currently, over 600 such voluntary strategic alliance agreements exist worldwide, containing a variety of elements such as codesharing, blocked space, cooperation in marketing, pricing, inventory control and frequent flyer programmes (FFPs), coordination in scheduling, sharing of offices and airport facilities, joint ventures and franchising. Among the transnational groupings, there are three competing "global alliances", namely *Star Alliance*, *Oneworld* and *SkyTeam*. Each group is composed of some major airline members having different geographical coverage with fairly extensive networks. Through the alliances, these carriers have combined their route networks, which extend to most parts of the world, and together they account for over 50 per cent of worldwide scheduled passenger traffic.

55. These developments have caused concerns to small- and medium-size airlines for their survival and have prompted efforts by these airlines to specialize in serving particular segments of the market, to compete as low-cost, point-to-point airlines or to enter various alliances of their own.

Airline business models

56. In recent years, successful LCCs have been challenging the full-service network airlines. The common features of the LCC business model are, with some variations: point-to-point network focusing on short-haul

routes, high frequencies, simple low-fare structures, high-density single class with no seat assignment, simple in-flight services, staffing flexibility and minimal overheads, and intensive use of electronic commerce for marketing and distribution (including online booking via the Internet and electronic ticketing). To sustain low-cost structures, these airlines usually operate a single aircraft type with high daily aircraft utilization. They also use less-congested secondary airports to ensure quick turnarounds and punctuality and to reduce airport-related costs. Low operating costs enable LCCs to allocate all their seats to low fares. The growth of LCCs has prompted some larger airlines to create subsidiaries or separate units to compete with them.

57. In the area of air cargo, the highly sophisticated airline/parcel express delivery companies, which grew substantially in the past decade, continue to expand this specialized service. 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. This concept has also been adopted by a number of postal administrations.

Privatization, national consolidation and transnational ownership

58. Privatization of State-owned airlines has been one of the preeminent transformations in international air transport, where airlines in all but a handful of States had been State-owned until recently. The motives for privatization have been highly diverse, ranging from purely economic considerations, or attempts to improve operating efficiency and competitiveness, to a more pragmatic desire to reduce the heavy financial burden for States for financing capital investment in new equipment. Whatever the reasons, the privatization of airlines has accompanied a more commercially-oriented outlook within an increasingly competitive environment. Since 1985, about 135 States have announced privatization plans or expressed their intentions of privatization for over 205 State-owned airlines. During this period, about 125 of these targeted carriers have achieved privatization goals.

59. Airlines in many parts of the world have continued the pursuit of the perceived advantages of enhanced market strength through mergers, acquisitions or operational integration under a single holding company. The common thread of this trend is the continuing development of growth strategies designed to hold and expand existing market share, gain access to new markets, achieve unit cost reduction, shield themselves against competition, and increase the scale of operations in order to attain a critical market position. The notable recent cases were the creation of a cross-border European airline group between Air France and KLM under a single holding company in 2004, a phased acquisition of Swiss by Lufthansa, through AirTrust, in 2005 and a full acquisition of Avianca by Brazilian owned Synergy Group in 2005. Mergers or acquisitions are easier to achieve within the same country, although some Governments have expressed concerns regarding industry consolidation and have scrutinized it closely.

60. The opportunity for equity investment in foreign carriers has increased as many States adopted new policies or amended existing rules on foreign investment or control in national airlines and relaxed air carrier ownership and control conditions in air services agreements. However, most attempts to initiate transactions involving a foreign majority ownership, including cross-border mergers or acquisitions, were abandoned owing to aeropolitical, economic and regulatory complexities. Even in the implemented cases, the control and management of foreign carriers were not financially risk-free. Because of these difficulties in successful implementation, most foreign investments in the airline industry have been on a limited scale, instead of taking a majority stake or pursuing a full-scale merger, and often as part of a strategy to forge or strengthen alliances and expand market access. Nevertheless, foreign investments have sometimes been short-lived.

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 period 1960–2005, the aggregate world economy measured in terms of GDP increased at an average annual rate of 3.9 per cent in real terms.

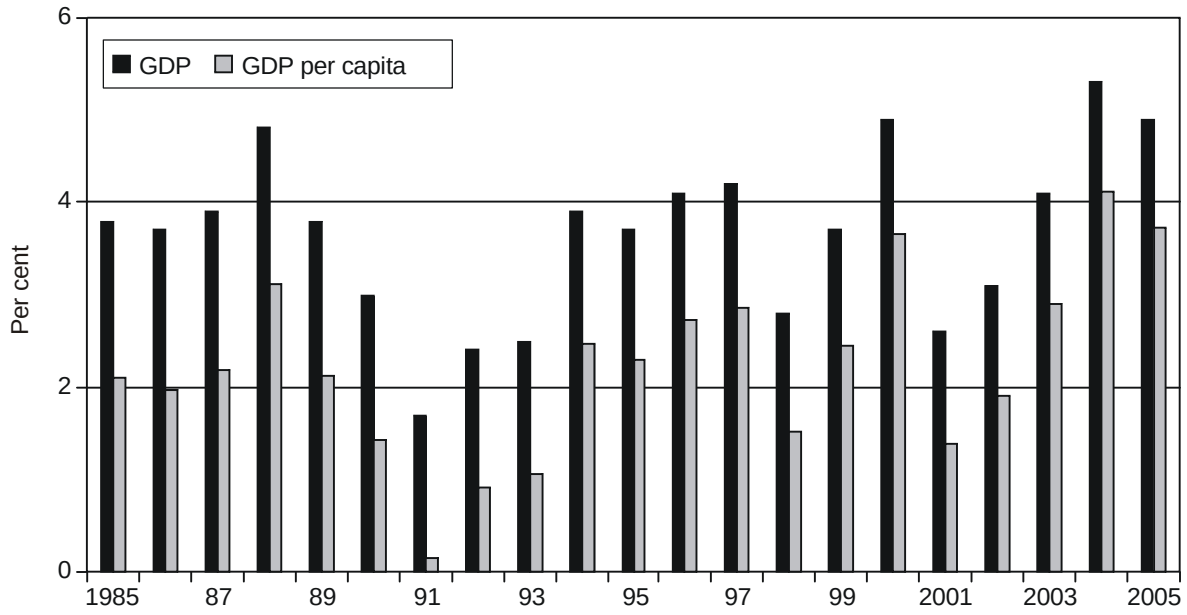
2. Following the slowdown of 1980–1982, the world economy experienced its longest period of sustained progress (1983–1990) since the Second World War, achieving an average annual growth rate of 4.0 per cent before a slowdown in 1991, due primarily to fuel price increases in the wake of the Gulf crisis.

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 ability 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 3.8 per cent in 1989 to 3.0 per cent in 1990. In 1991, some major economies entered into a recession or experienced a slowdown; as a result, the world economy increased only by 1.7 per cent in 1991, the most difficult year globally since 1982. The world economy improved in 1992 and 1993, and over the period 1990–1995 it grew at an average annual rate of 2.5 per cent. Having experienced high growth rates in 1996 and 1997 (4.1 and 4.2 per cent, respectively), the world economy slowed down in 1998, led by a downturn in the Asia/Pacific region, and increased only by 2.8 per cent. It regained strength, however, in 1999 with GDP growth of 3.7 per cent, based mainly on economic recovery in the Asia/Pacific region and continued strong growth in the United States economy, and continued to grow in 2000 at 4.9 per cent. Another slowdown occurred during 2001 across almost all major regions resulting from a marked decline in trade growth, significantly lower commodity prices, and deteriorating financing conditions in emerging markets. The events of 11 September 2001 amplified the impact of an already weakening global economy, particularly on consumer and business confidence in the United States; as a result, GDP growth dropped to 2.6 per cent. With trade, industrial production and private consumption improving across all regions, the world economy recovered its strength and grew at a rate of 3.1 per cent and 4.1 per cent in 2002 and 2003, respectively. The growth momentum continued in 2004 and 2005, with increases of 5.3 and 4.9 per cent respectively, helped in part by a robust service sector performance despite the sustained increase in oil prices.

5. World population between 1985 and 2005 increased at an average annual rate of 1.5 per cent. Hence, the world's GDP per capita increased during the same period at an average annual rate of 2.2 per cent, lower than the growth of GDP itself. For the period 1995–2005, GDP and GDP per capita grew at an average annual rate of 4.0 per cent and 2.7 per cent, respectively.

6. Figure 3-1 portrays the historical growth trends of GDP and GDP per capita in real terms from 1985–2005 and shows that since the end of the economic slowdown of the early nineties, GDP per capita has been growing.



Source: ICAO estimates based on data from IMF, World Bank and other sources.

Figure 3-1. Growth of real GDP and GDP per capita — World (1985–2005)

OUTLOOK

7. Despite some concerns about the short-term prospects for some regions and expectations that oil prices will likely remain at their current levels, there appears to be consensus among economic forecasters that the global economy will continue to expand over the medium and long terms. The world GDP growth in 2006 is estimated at 5.1 per cent in real terms and it is anticipated to continue in 2007 and 2008 at the rates of 4.9 and 4.8 per cent, respectively.

8. Over the long-term horizon to 2025, the world economy is projected to grow at an average annual rate of 3.5 per cent in real terms (see Chapter 5). This projected growth rate is slightly lower than the actual rate for the past 20 years. The economies of the Asia/Pacific region are expected to grow at an average of 4 per cent per annum. Excluding Japan, the region is anticipated to register the highest growth of 5.7 per cent per annum mainly driven by the economies of China and India whose share in the world economy is expected to double by 2025 due to an expanding middle class and the growth in export-oriented industries and services. The economies of the African and the Latin America and Caribbean regions are expected to grow at about 5 per cent and 4 per cent per annum, respectively, benefiting from the implementation of reforms aiming at achieving improved fiscal balances, establishing a more effective institutional framework and an increased integration with the world economy through trade and investment. The economies of the Middle East region are expected to grow at about 4.2 per cent per annum, helped by oil exports, economic reforms and diversification. The more mature economies of the North American and European regions are expected to grow at about 3 per cent and 2.5 per cent per annum respectively.

Chapter 4

AIRLINE FINANCIAL TRENDS

OPERATING REVENUES, EXPENSES AND RESULTS

Global trends

1. This chapter outlines general trends in airline financial data (in current terms unless indicated otherwise) from the historical perspective and, in broad terms, the outlook to the year 2025. Five-year-interval financial data for the period 1965–2005, categorized by major components of operating revenues and expenses, are given in Table 4-1. The trends in annual operating revenues and expenses for the period 1985 to 2005 are illustrated in Figure 4-1. The treatment is global in nature, dealing with totals and averages for the airlines at the global level, and for this reason does not show the wide differences that exist between regions or 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. The long-term historical trend of the financial performance of scheduled airlines indicates neither an improvement nor a decline. Fluctuations in the operating results over the past twenty years appear to be cyclical. 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 a steep increase in fuel prices caused by the Gulf crisis, along with a 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. Between 1994 and 2000, the airline industry continued to show positive operating results with profit margins ranging between 3.1 and 5.6 per cent of operating revenues. In 2001, shrinking operating revenues, due to declining traffic combined with increasing fuel, security and insurance costs, led to an unprecedented operational loss of $11.8 billion and a net loss of $13 billion. Airlines continued to suffer operational losses in 2002 and 2003 due to the buildup to the war in Iraq and its aftermath and to the outbreak of the SARS epidemic. An impressive traffic recovery in 2004 and 2005 accompanied with a measured capacity response led to positive operating results in those years while net results remained negative (see Table 4-1).

3. As shown in Table 4-2, from 1985 to 2005 the total operating revenues of the world's scheduled airlines from scheduled and non-scheduled services (including incidental revenues) increased at an average annual rate of 6.7 per cent, from $112 200 million to $413 300 million. During the same period, the corresponding total operating expenses increased at an average annual rate of 6.9 per cent, from $108 100 million to $409 000 million. During this period, the growth in world airline operating revenues was associated with an average annual growth in total traffic of 6.2 per cent in terms of TKPs (excluding domestic operations in the Russian Federation in 1985) and an increase in airline yields (average operating revenue per tonne-kilometre performed) of 0.5 per cent per annum from 72 cents in 1985 to 80.2 cents in 2005. The unit cost per available tonne-kilometre (ATK) increased by 1.1 per cent per annum from 40.3 cents in 1985 to 49.7 cents in 2005. Figure 4-2 presents the trends in the financial performance indicators of the global airline industry in terms of unit revenues and costs as well as operating and net results over the 1985–2005 period.

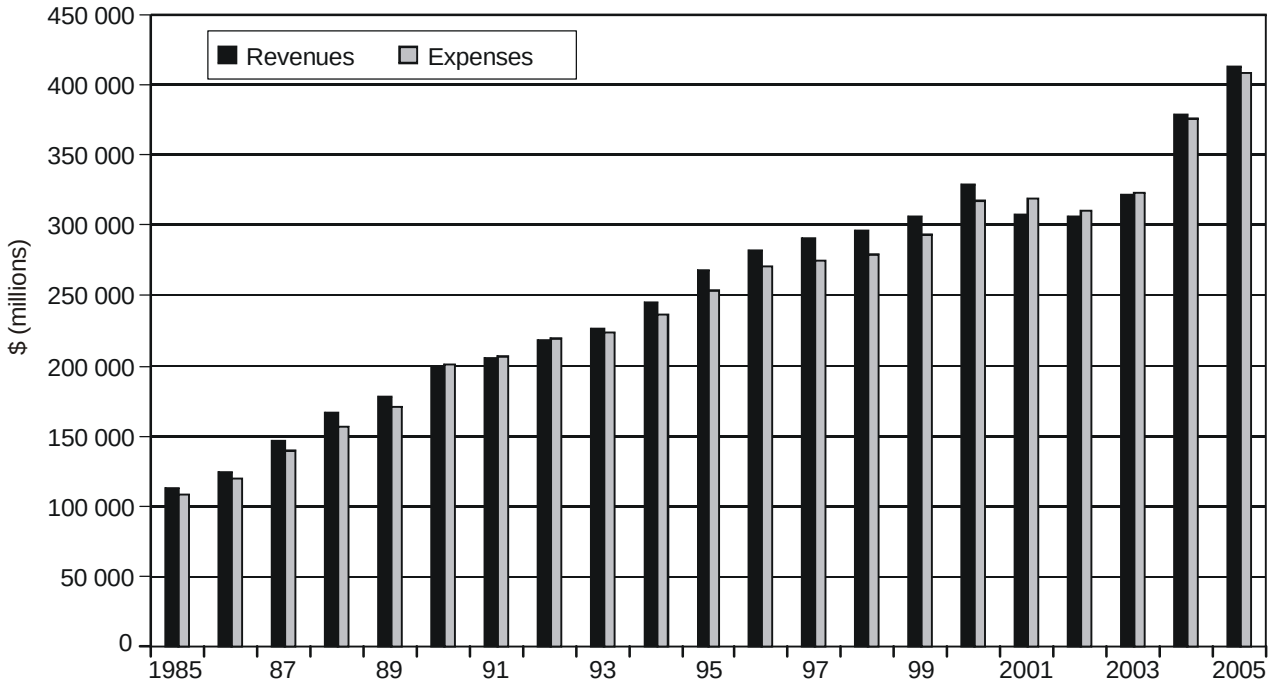
Table 4-1. Operating revenues and expenses -- World (1965-2005)

(Total services of scheduled airlines of ICAO Contracting States[1])

	1965	1970	1975	1980	1985	1990	1995	2000	2001	2002	2003	2004	2005[2]
						(millions of dollars)							
OPERATING REVENUES													
Scheduled services (total)	7 881	16 466	35 166	80 003	102 000	173 970	233 660	284 920	267 550	265 910	279 320	328 420	360 190
Passenger	6 748	14 097	30 174	69 290	87 000	153 330	205 000	248 940	232 410	231 030	242 320	285 970	315 970
Freight	755	1 745	4 196	9 293	13 300	18 410	25 980	33 840	32 990	32 740	34 750	40 180	42 150
Mail	378	624	796	1 420	1 700	2 230	2 680	2 140	2 150	2 140	2 250	2 270	2 070
Non-scheduled operations	358	805	1 612	3 260	3 500	7 090	10 680	11 710	10 470	9 790	9 980	11 740	10 340
Incidental	195	546	1 513	4 413	6 700	18 440	22 660	31 870	29 480	30 300	32 500	38 600	42 770
Total operating revenues	8 434	17 817	38 309	87 676	112 200	199 500	267 000	328 500	307 500	306 000	321 800	378 760	413 300
OPERATING EXPENSES													
Flight operations (total)	1 971	4 651	12 215	33 768	34 930	56 320	66 550	98 790	97 020	95 700	102 840	125 800	154 190
Flight crew salaries and expenses	705	1 796	3 292	6 424	7 250	13 780	19 450	26 380	27 840	27 960	29 760	31 920	31 900
Aircraft fuel and oil	944	1 944	7 305	24 524	23 780	30 300	28 970	45 900	42 950	40 400	43 950	61 210	89 570
Other (insurance, rental, training, etc.)	322	911	1 618	2 820	3 900	12 240	18 130	26 510	26 230	27 340	29 130	32 670	32 720
Maintenance and overhaul	1 331	2 476	4 688	9 079	11 070	22 900	26 810	33 710	36 120	35 130	34 910	39 430	41 720
Depreciation and amortization	845	1 899	3 065	5 457	7 770	13 850	18 400	20 780	22 670	22 190	21 330	23 660	24 950
User charges and station expenses (total)	1 199	2 908	6 351	13 364	17 340	32 460	46 140	54 720	54 000	52 860	54 950	61 970	66 260
Landing and associated airport charges	212	530	1 424	3 069	3 540	7 730	11 440	13 490	12 660	12 440	12 930	14 650	15 540
Other	987	2 378	4 927	10 295	13 800	24 730	34 700	41 230	41 340	40 420	42 020	47 320	50 720
Passenger services	647	1 714	3 514	7 963	10 310	20 710	28 070	31 780	32 670	31 710	32 330	36 420	38 040
Ticketing, sales and promotion	1 183	2 643	5 491	12 634	18 470	32 860	39 590	40 450	35 650	33 260	32 330	36 430	37 220
General, administrative and other operating expenses	450	1 076	2 255	6 055	8 210	21 900	27 940	37 570	41 170	40 050	44 610	51 790	46 620
Total operating expenses	7 626	17 367	37 579	88 310	108 100	201 000	253 500	317 800	319 300	310 900	323 300	375 500	409 000
Operating result [profit or loss (–)]	808	450	730	–634	4 100	–1 500	13 500	10 700	–11 800	–4 900	–1 500	3 260	4 300
Operating result as a percentage of operating revenues	9.6	2.5	1.9	–0.7	3.7	0.7	5.1	3.3	–3.8	–1.6	-0.5	0.9	1.0
Net result	488	–27	–67	–919	2 100	–4 500	4 500	3 700	–13 000	–11 300	–7 560	–5 670	–4 100
Net result as a percentage of operating revenues	5.8	–0.2	–0.2	–1.0	1.9	–2.3	1.7	1.1	–4.2	–3.7	–2.3	–1.5	–1.0

1. Excludes domestic operations of airlines registered in the USSR prior to 1992 and the Russian Federation from 1992–1997.
2. Preliminary data.

Source: ICAO



Source: ICAO Reporting Form EF.

Note.— Excluding domestic operations of airlines registered in the Russian Federation prior to 1996.

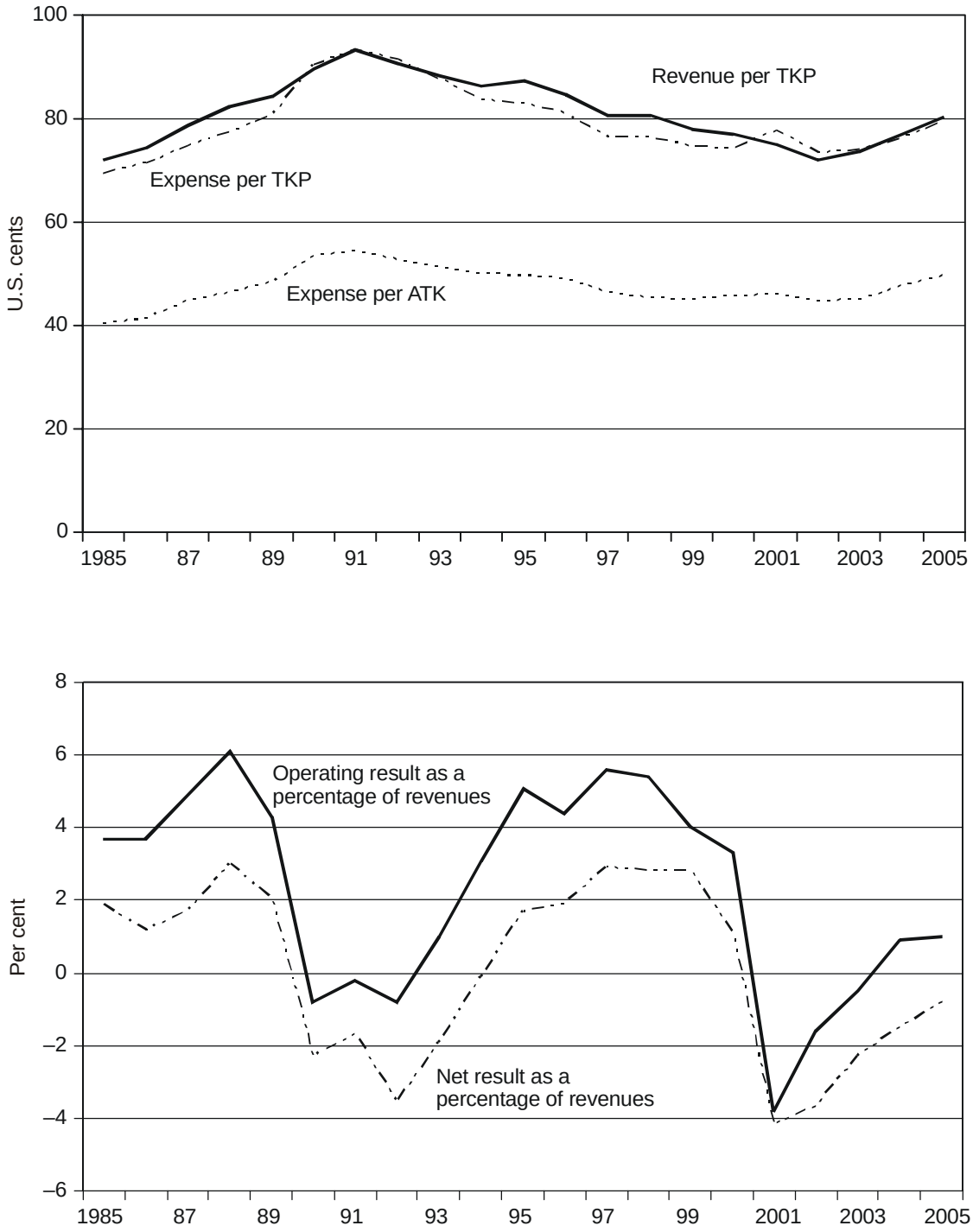
Figure 4-1. Scheduled airline operating revenues and expenses — World (1985–2005)

Table 4-2. Total and unit operating revenues and expenses — World (1985 and 2005)
(Total services of scheduled airlines of ICAO Contracting States)

	Operating revenues ($ millions)	Operating expenses ($ millions)	Total traffic (TKP millions)	Unit revenue (cents/TKP)	Total capacity (ATK millions)	Unit cost (cents/ATK)
1985[1]	112 200	108 100	155 940	72.0	268 260	40.3
2005	413 300	409 000	515 540	80.2	823 250	49.7
Average annual growth 2005/1985 (per cent)	6.7	6.9	6.2	0.5	5.8	1.1

1. Excluding domestic operations of airlines registered in the former USSR.

Source: ICAO Reporting Forms A and EF.



Source: ICAO Reporting Form EF.

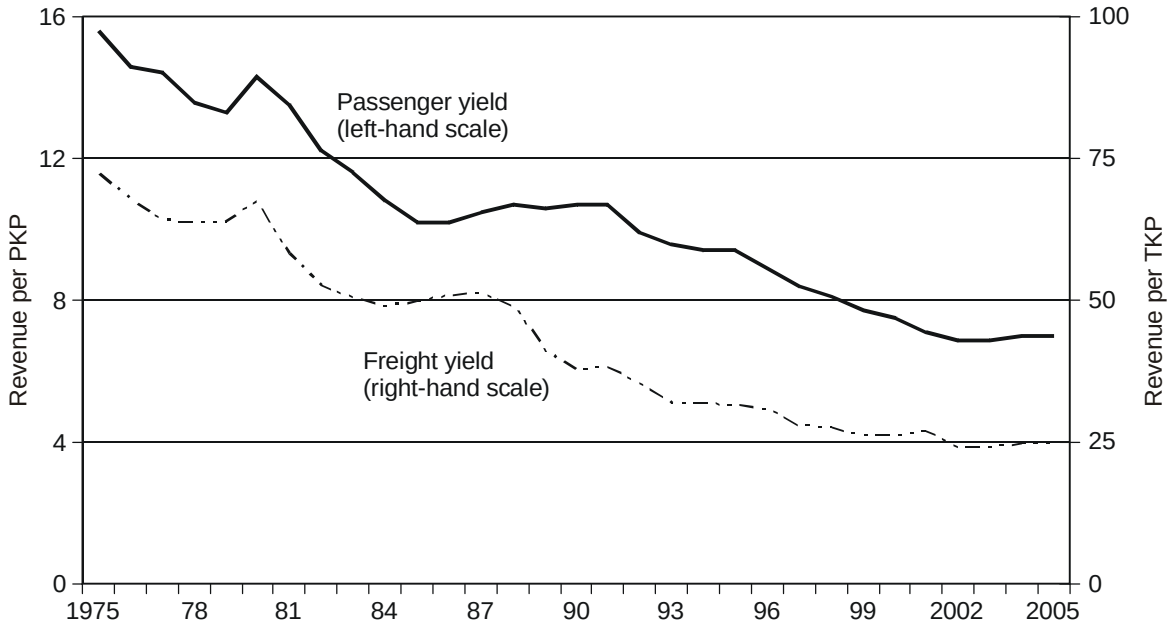
Note.— Excluding domestic operations of airlines registered in the Russian Federation prior to 1996.

Figure 4-2. Financial performance indicators of scheduled airlines — World (1985–2005)

Yields and unit costs

4. 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, that occurred between 1975 and 2005 are reflected in real declines in passenger revenue per passenger-kilometre and freight revenue per freight tonne-kilometre. These declines in yield contributed substantially to traffic growth. Marketing of air transport was aided by the fact that airfares represented a steadily improving bargain in comparison with many other services. Figure 4-3 illustrates the annual change in average passenger yield over the 1975–2005 period as well as the annual change in freight yield. Average world passenger yield measured in real terms decreased at a rate of 2.6 per cent per annum, while freight and mail yield decreased at a rate of 3.5 per cent per annum over that period. These declines in yield were the result of technological advances, longer average trip lengths, greater competition and certain economies of scale.

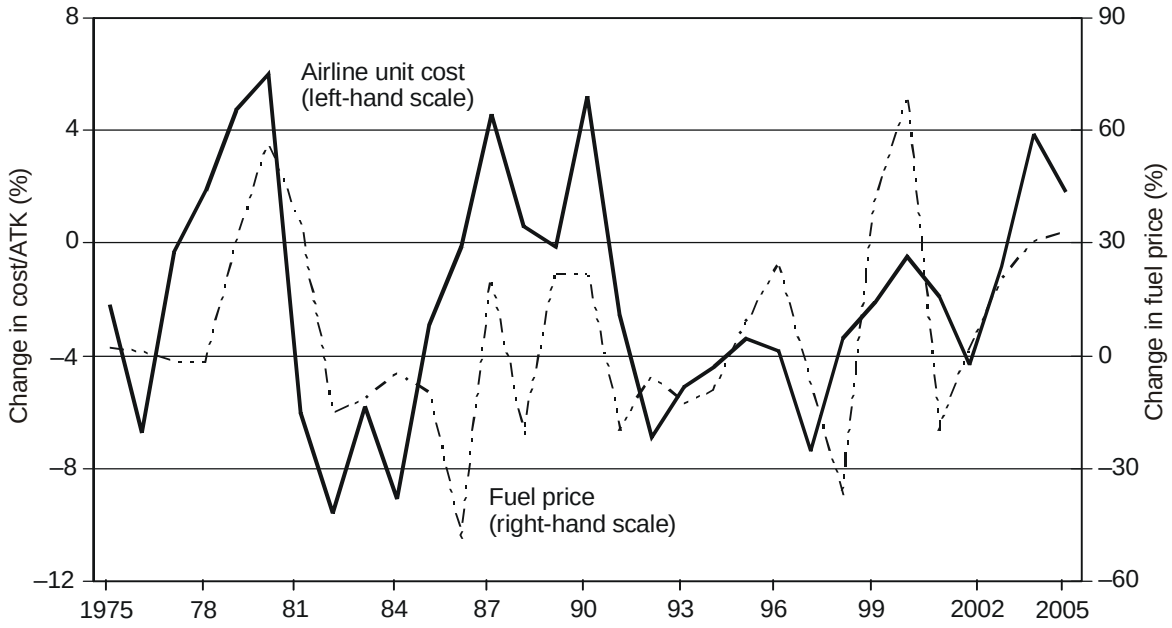
5. Measured in real terms, the operating costs per available tonne-kilometre (ATK) of world scheduled airlines declined on average by 2.0 per cent per annum over the 1975–2005 period, with year-to-year fluctuations illustrated in Figure 4-4.



Source: ICAO Reporting Form EF.

Note.— Excluding domestic operations of airlines registered in the USSR prior to 1992 and the Russian Federation from 1992 to 1996.

Figure 4-3. Passenger and freight yields of scheduled airlines — World (1975–2005)
(U.S. cents in real terms)



Source: ICAO Reporting Forms A and EF, US Department of Energy.

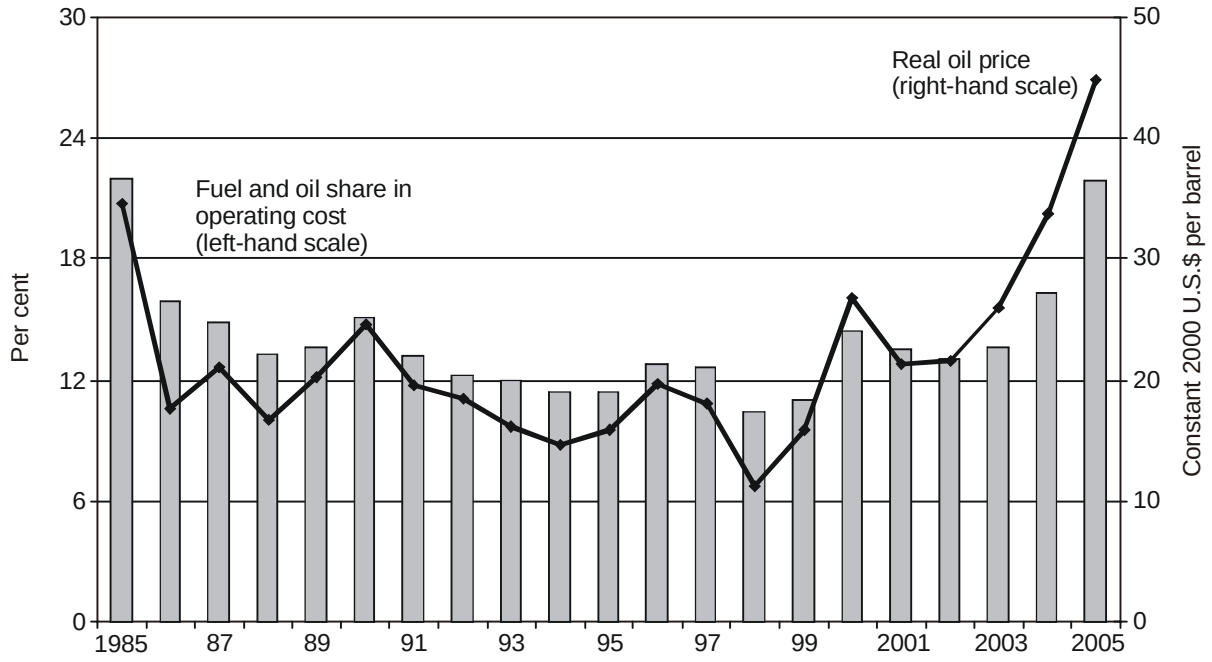
Note.— Excluding domestic operations of airlines registered in the Russian Federation prior to 1996.

Figure 4-4. Changes in unit operating costs of scheduled airlines and fuel prices — World (1975–2005)
(U.S. cents per ATK in real terms)

6. 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 the total costs of scheduled airlines. Unit costs declined during the period 1982–1985 partly as a result of declining fuel prices. The share of aircraft fuel and oil costs in total operating costs varies in tandem with fuel prices as illustrated in Figure 4-5, Following the sharp increases in oil prices in the years 2004 and 2005, the share of fuel and oil costs regained its 1985 level after remaining confined within the 10 to 15 per cent range over the period in between In the absence of hedging, short-term variations in fuel prices would have an immediate impact on unit costs forcing the airlines to look for alternative cost reduction measures or pass the costs to the passenger through higher fares. In the long term, fuel prices are expected to remain within the range of 40 to 60 dollars per barrel and their pressure on costs is expected to remain at its current level. In addition to aircraft fuel costs, other factors that have an important impact on unit costs include aircraft utilization and capacity.

Operating revenues and expenses by category and region

7. When comparing 1985 and 2005, as presented in Table 4-3, the share of revenues from scheduled services declined more than 3 percentage points and accounted for nearly 87 per cent of total operating revenues in 2005, while that of incidental revenues (which cover sales of services and maintenance, leasing of aircraft to other airlines and other non-core transport-related activities) jumped to 10 per cent. But this distribution has broadly been about the same since the early 1990s.



Source: ICAO Reporting Forms A and EF, US Department of Energy.

Note.— Excluding domestic operations of airlines registered in the Russian Federation prior to 1996.

Figure 4-5. Share of fuel and oil in operating expenses of scheduled airlines — World (1985–2005)

8. Considering the two major categories of airline operating expenses, direct expenses accounted for about 54 per cent of the total in 2005 while indirect expenses made up the remaining 46 per cent, compared to 49.7 and 50.3 per cent, respectively, in 1985. The major part of the direct expenses, i.e. total flight operations expenses, increased by over 5 percentage points between 1985 and 2005, mainly because of significant increases in "other" expenses which include rental of flight equipment expenses, reflecting the increasing use of leasing arrangements by the airline industry over the period concerned Among the indirect expenses, "general, administrative and other operating expenses" rose by 3.8 percentage points, while "ticketing, sales and promotion" fell by 8 percentage points during the same period (see Chapter 2, paragraphs 52 and 53 regarding cost savings on this item).

9. Estimates of the distribution of total operating revenues and expenses according to the region of airline registration are given, together with the corresponding operating results, in Table 4-4 for 1985 and 2005. In 2005, about 36 per cent of operating revenues and operating expenses of the world's airlines were attributable to North American airlines, some 31 per cent of revenues and expenses to European airlines and some 22 per cent of revenues and expenses to airlines of Asia/Pacific, with the remaining 11 per cent of revenues and expenses, divided among those of Africa, the Middle East and Latin America/Caribbean. Compared to 1985, the 2005 shares of operating revenues and expenses of the airlines of Europe and Asia/Pacific represented a gain of some 6 and 5 percentage points of the world total, respectively, while those of the North American carriers declined by about 9 percentage points in both revenues and expenses. The shares of the airlines of the remaining regions declined marginally.

Table 4-3. Distribution of operating revenues and expenses — World (1985 and 2005)
(Total services of scheduled airlines of ICAO Contracting States)

	Distribution by category (per cent)		Change in per cent share of item
	1985[1]	2005	1985 to 2005
OPERATING REVENUES			
Scheduled services (total)	90.9	87.2	–3.7
Passenger	77.5	76.5	–1
Freight	11.9	10.2	–1.7
Mail	1.5	0.5	–1
Non-scheduled operations	3.1	2.5	–0.6
Incidental	6.0	10.3	4.3
TOTAL	100.0	100.0	—
OPERATING EXPENSES			
Direct aircraft			
Flight operations (total)	32.3	37.7	5.4
Flight crew	6.7	7.8	1.1
Fuel and oil	22.0	21.9	–0.1
Other	3.6	8.0	4.4
Maintenance and overhaul	10.2	10.2	0
Depreciation and amortization	7.2	6.1	–1.1
Subtotal	49.7	54	4.3
Indirect			
User charges and station expenses (total)	16.1	16.2	0.1
Landing and associated airport charges	3.3	3.8	0.5
Other	12.8	12.4	–0.4
Passenger services	9.5	9.3	–0.2
Ticketing, sales, promotion	17.1	9.1	-8
General, administrative and other	7.6	11.4	3.8
Subtotal	50.3	46	–4.3
TOTAL	100.0	100.0	—

1. Excluding domestic operations of airlines registered in the former USSR.

Source: ICAO Air Transport Reporting Forms A and EF.

Table 4-4. Distribution of operating revenues and expenses — Regions of airline registration (1985[1] and 2005)
(Total services of scheduled airlines of ICAO Contracting States)

		Operating revenues		Operating expenses		Operating result	
	Year	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
	2005	9 400	2.3	9 760	2.4	–360	–3.8
Asia and Pacific	1985	19 100	17.0	18 100	16.8	1 000	5.2
	2005	92 200	22.3	90 740	22.2	1 460	1.6
Europe	1985	27 800	24.8	26 400	24.4	1 400	5.0
	2005	129 780	31.4	126 800	31.0	2 980	2.3
Latin America and Caribbean	1985	5 530	4.9	5 500	5.1	30	0.5
	2005	17 370	4.9	17 230	5.1	140	0.8
Middle East	1985	5 200	4.7	5 100	4.7	100	1.9
	2005	16 320	3.9	15 950	3.9	370	2.3
North America	1985	50 730	45.2	49 110	45.4	1 620	3.2
	2005	148 180	35.9	148 460	36.3	–280	–0.2
World[2]	1985	112 200	100.0	108 100	100.0	4 100	3.7
	2005	413 300	100.0	409 000	100.0	4 310	1.0

1. Excluding domestic operations of airlines registered in the former USSR.
2. World totals have been rounded to the nearest hundred.

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

OUTLOOK

10. The prospects for airline yields are closely related to cost developments and market conditions in the airline industry. Faced with increasing competition, airlines had to define and implement aggressive cost-cutting and productivity-improvement measures with particular focus on ticketing, sales and promotion (notably in connection with product distribution), and general/administrative expenses. While some cost items are not under their direct control, such as fuel prices and user charges, airlines have put significant pressure on suppliers to improve their efficiency. Over the forecast period 2005–2025, the airline industry is likely to continue improving efficiency through productivity gains, but unit costs are not expected to fall significantly further due to factors such as fuel, labour and capital.

11. Over this forecast period average passenger yields (fares) as well as average freight yields (rates) are expected to remain constant in real terms.

Chapter 5

FORECASTS OF AIRLINE TRAFFIC TO THE YEAR 2025

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.

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 number 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 passenger-kilometres achieved by scheduled airlines on major 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 as well as other factors pertinent to the particular route group, such as historical traffic trends and demographics.

MAIN ASSUMPTIONS AND ECONOMETRIC MODELS

5. The following are the main assumptions concerning trends, over the period 2005 to 2025, in the factors that underlie traffic growth:

a) a “most likely” average rate of world economic growth of 3.5 per cent per annum (in real terms);

b) moderate growth in world trade at a “most likely” average rate of about 5.5 per cent per annum;

c) no change in average passenger yields (fares) and in freight yields (rates) in real terms 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 historical data, several econometric models were developed for scheduled passenger travel demand, for freight traffic demand 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 and total world freight tonne-kilometres 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 (in real terms).

GLOBAL PASSENGER FORECASTS

8. Inserting the above economic and yield assumptions into these models resulted in growth rates for the period 2005–2025 for world scheduled traffic of 4.6 per cent per annum for passenger-kilometres. In view of the recent traffic trends and expectations of future developments of the underlying factors, this growth rate has been deemed as a fair representation of future traffic growth up to 2025, barring any unforeseen events of significance.

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 passenger yields, a “low” passenger traffic forecast of 2.6 per cent per annum results from assumptions of 2.5 per cent per annum average growth of GDP in real terms and an increase in real fares (yield) of 2.0 per cent per annum during the forecast horizon. A “high” forecast of 6.2 per cent per annum results from assumptions of 4.5 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. The “low” and “high” series depict the extreme cases beyond which it is unlikely that traffic would fall. Under reasonable assumptions about future conditions affecting the industry, the actual outcome is expected to lie close to the central forecast.

10. International scheduled passenger traffic (in PKPs) is forecast to grow at an average rate of 5.3 per cent per annum compared with 3.4 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 62 per cent of all domestic scheduled traffic is accounted for by the already highly developed domestic system in the United States where growth rates are expected to be 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 world scheduled passengers carried is expected to be somewhat lower than growth in passenger-kilometres because the latter includes the effect of an anticipated increase in the average passenger journey distance at an annual rate of 0.5 per cent. The number of passengers carried is projected to reach some 4.5 billion worldwide by 2025.

12. The increase in the average passenger journey distance for international traffic had been pronounced in the sixties and seventies, but has become modest during the 1985–2005 period. As a result, the growth of passengers carried on international services was slightly below the growth of passenger-kilometres during the same period. It is expected that the growth in average international passenger journey would remain almost unchanged during the forecast period, and the number of passengers carried on scheduled international services will reach close to 2 billion by the year 2025.

13. Putting the expected growth in passenger traffic in perspective, the passenger-kilometres performed and passengers carried are expected to more than double between 2005 and 2025. In absolute terms, the increase in passenger-kilometres during the forecast period is expected to be some 5 460 billion, which is more than twice the 2 355 billion increase during the period 1985–2005. The absolute increase in passengers carried is projected to be slightly below 2.5 billion by 2025, compared with about 1.13 billion between 1985 and 2005.

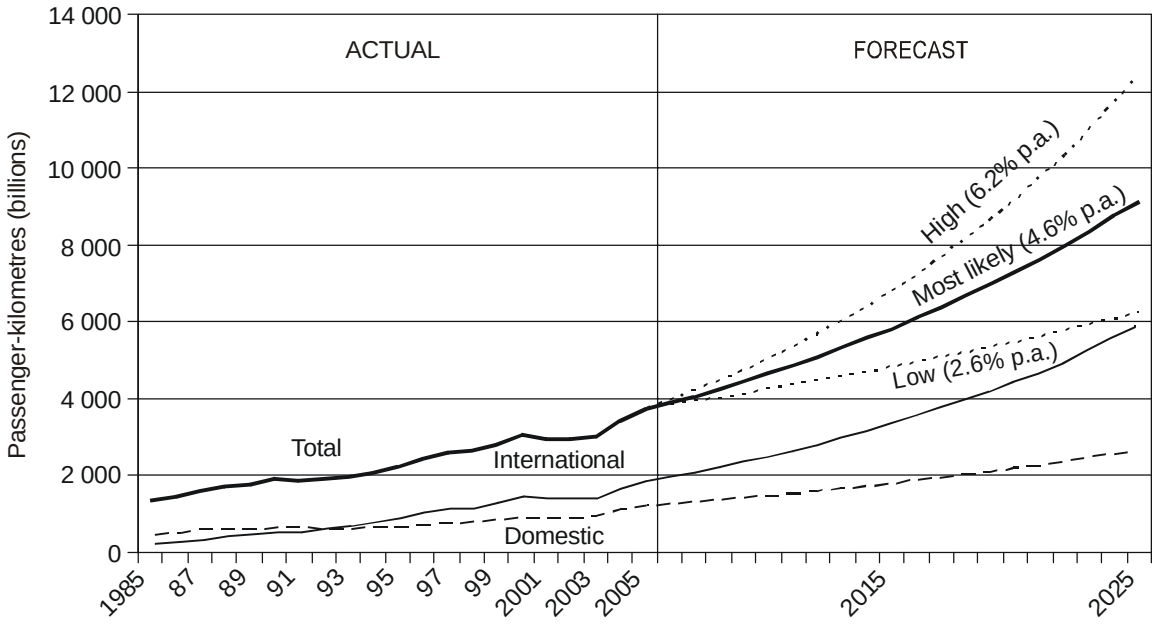


Figure 5-1. Trends in scheduled passenger traffic — World (1985–2025)
(ICAO Contracting States)

Table 5-1. ICAO scheduled passenger traffic forecasts — World (1985–2025)
(ICAO Contracting States)

	Actual 1985	Actual 2005	Forecast 2025	Average annual growth rate (per cent) 1985–2005	2005–2025
Passenger-kilometres (billions)					
Scheduled services	1 365	3 720	9 180	5.1	4.6
International	589	2 198	6 225	6.8	5.3
Domestic	776	1 522	2 955	3.4	3.4
Passengers carried (millions)					
Scheduled services	896	2 022	4 500	4.2	4.1
International	194	704	1 950	6.7	5.2
Domestic	702	1 318	2 550	3.2	3.4

Source: ICAO.

REGIONAL PASSENGER FORECASTS

14. The "most likely" forecasts of scheduled airline passenger traffic by region of airline registration are given in Table 5-2, together with historical figures for 1985 and 2005. The airlines of the Middle East and Asia/Pacific regions are expected to show the highest growth in passenger traffic, at 5.8 per cent per annum through to the year 2025, while the airlines of North America are anticipated to show the lowest growth, around 3.6 per cent per annum. Traffic of the airlines of the African and the Latin America/Caribbean regions are expected to grow at 5.1 per cent and 4.8 per cent per annum respectively, whereas traffic of European airlines is forecast to grow at 4.3 per cent, below the world average.

Table 5-2. ICAO scheduled passenger traffic — Regions of airline registration (1985–2025)
(ICAO Contracting States)

	Passenger-kilometres (billions)			Average annual growth rate (per cent)		Regional share of world traffic (per cent)		
	Actual 1985	Actual 2005	Forecast 2025	1985–2005	2005–2025	1985	2005	2025
Africa								
Total	36.7	84.8	230	4.3	5.1	2.7	2.3	2.5
International	28.5	72.2	205	4.8	5.4	4.8	3.3	3.3
Domestic	8.2	12.6	25	2.2	3.5	1.1	0.8	0.8
Asia/Pacific								
Total	222.3	967.4	2 980	7.6	5.8	16.3	26.0	32.5
International	150.3	622.5	2 100	7.4	6.3	25.5	28.3	33.7
Domestic	72.0	344.9	880	8.1	4.8	9.3	22.7	29.8
Europe								
Total	428.2	1 004.9	2 350	4.4	4.3	31.4	27.0	25.6
International	214.4	865.9	2 160	7.2	4.7	36.4	39.4	34.7
Domestic	213.8	139.0	190	–2.1	1.6	27.5	9.1	6.4
Latin America/Caribbean								
Total	68.3	159.2	410	4.3	4.8	5.0	4.3	4.5
International	36.5	95.1	260	4.9	5.2	6.2	4.3	4.2
Domestic	31.8	64.1	150	3.6	4.3	4.1	4.2	5.1
Middle East								
Total	42.7	168.9	520	7.1	5.8	3.1	4.5	5.7
International	35.1	152.5	480	7.6	5.9	6.0	6.9	7.7
Domestic	7.6	16.4	40	3.9	4.6	1.0	1.1	1.4
North America								
Total	567.4	1 334.5	2 690	4.4	3.6	41.5	35.9	29.3
International	124.5	389.2	1 020	5.9	4.9	21.1	17.7	16.4
Domestic	442.9	945.3	1 670	3.9	2.9	57.1	62.1	56.5
World								
Total	1 365.6	3 719.7	9 180	5.1	4.6	100.0	100.0	100.0
International	589.3	2 197.4	6 225	6.8	5.3	100.0	100.0	100.0
Domestic	776.3	1 522.3	2 955	3.4	3.4	100.0	100.0	100.0

Source: ICAO.

Note.— Shares may not add up to 100 per cent due to rounding.

15. As a result of the projected growth in passenger traffic, the airlines of the Asia/Pacific region are expected to increase their share of world passenger traffic (in terms of passenger-kilometres) by about 6.5 percentage points to 32.5 per cent, the highest among all the regions, with their share of total international scheduled passenger traffic increasing to about 33.7 per cent.

16. A significant change in regional share is expected to occur in North America, whose airlines' share is anticipated to decline by about 6.6 percentage points to 29.3 per cent by the year 2025. The shares of international and domestic scheduled traffic of North America are expected to decrease, but the region will still hold the highest share of world domestic traffic at 56.5 per cent. The shares of the European airlines are also expected to decline but their share in international scheduled traffic will remain the highest. Changes in the shares of airlines of other regions are anticipated to be small.

PASSENGER FORECASTS BY ROUTE GROUP

17. Following the overall decline in traffic in 2001 and the modest performance in 2002 and 2003, most international route groups recovered their 2000 traffic levels in 2004, led by the Europe-Asia/Pacific and Intra-Europe route groups. The recovery of the North Atlantic and Trans-Pacific route groups did not materialize until the year 2005, given the difficulties faced by U.S. carriers and the restructuring and capacity redeployment that ensued.

18. The traffic forecasts, originally developed at the global level, were disaggregated to the major route groups level (Table 5-3) on the basis of the most recent historical performance and the expectations about future growth. All international route groups are anticipated to grow at average rates ranging from 3.5 per cent to 6.6 per cent per annum over the forecast time horizon. The fastest growing route groups are those to, from and within the Asia/Pacific region due to the expectations of relatively high economic and tourism growth for the region and its expanding middle class. Routes between Europe and Africa, Europe and the Middle East and Intra Africa are also expected to grow at similar rates owing to their lower base and the anticipated faster economic growth for North America and the Middle East. Average growth rates on all domestic route groups will vary from 2.5 per cent per annum for North America to 5.4 for Africa.

GLOBAL FREIGHT FORECASTS

19. The econometric analysis, together with the assumptions mentioned earlier, resulted in a "most likely" projected growth rate of 6.6 per cent per annum for world scheduled freight tonne-kilometres for the period 2005–2025. This is about the same growth registered for the 1985–2005 period. Alternative assumptions concerning the underlying factors affecting air freight suggest a band of forecast growth rates ranging from a "low" of 4.9 per cent per annum to a "high" of 7.8 per cent per annum as illustrated in Figure 5-2.

20. 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.

Table 5-3. ICAO air traffic forecasts — Route groups (1985–2025)
(ICAO Contracting States)

	Passenger-kilometres performed (billion)			Average annual growth rate (per cent)	
	Actual 1985	Actual 2005	Forecast 2025	1985–2005	2005–2025
International scheduled services					
Mid-Atlantic	11.0	58.2	154	8.7	5.0
North Atlantic	139.9	434.9	1 049	5.8	4.5
South Atlantic	12.5	69.4	210	8.9	5.7
Trans-Pacific	67.4	262.5	842	7.0	6.0
Between Europe and Africa	37.6	121.8	363	6.0	5.6
Between Europe and Asia/Pacific	69.2	263.9	815	6.9	5.8
Between Europe and Middle East	25.0	73.2	235	5.5	6.0
Between Middle East and Asia/Pacific	23.0	98.4	355	7.5	6.6
Between North America and Central America/Caribbean	21.5	63.1	152	5.5	4.5
Between North America and South America	13.1	59.8	159	7.9	5.0
Intra Africa	4.6	13.4	43	5.5	6.0
Intra Asia/Pacific	70.5	295.8	949	7.4	6.0
Intra Europe	60.5	253.3	555	7.4	4.0
Intra Latin America	8.0	22.6	72	5.3	6.0
Intra Middle East	4.5	15.0	44	6.2	5.5
Intra North America	15.0	27.4	55	3.0	3.5
Other international routes	5.9	65.3	173	12.8	5.0
Total international	589.3	2 198.0	6 225	6.8	5.3
Domestic scheduled services					
Africa	8.1	12.6	36	2.2	5.4
Asia/Pacific	72.0	344.9	933	8.1	5.1
Europe	213.8	139.0	228	–2.1	2.5
Latin America	31.8	64.1	169	3.6	5.0
Middle East	7.5	16.4	40	4.0	4.6
North America	442.9	945.3	1 549	3.9	2.5
Total domestic	776.2	1 522.3	2 955	3.4	3.4
Global (international + domestic)	1 365.5	3 720.3	9 180	5.1	4.6

Note.— The historical database has been developed from several sources, including ICAO and IATA.

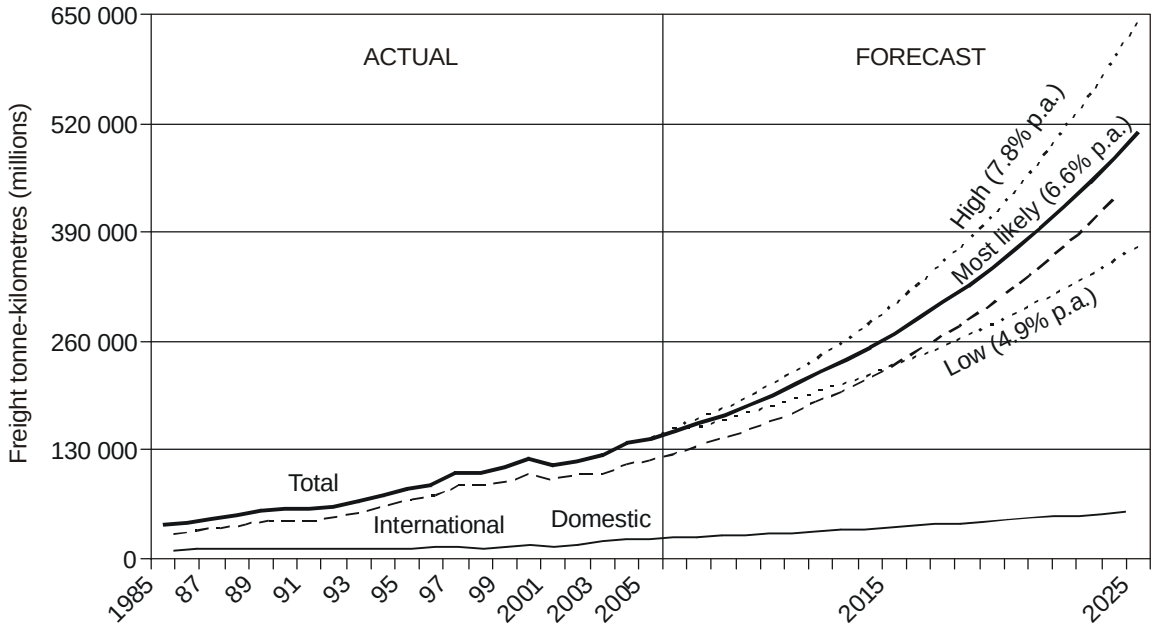


Figure 5-2. Trends in scheduled freight traffic — World (1985–2025)
(ICAO Contracting States)

Table 5-4. ICAO scheduled freight traffic forecasts — World (1985–2025)
(ICAO Contracting States)

	Actual 1985	Actual 2005	Forecast 2025	Average annual growth rate (per cent) 1985-2005	2005-2025
Freight tonne-kilometres (millions)					
Total	39 813	142 580	510 000	6.6	6.6
International	29 384	118 480	452 120	7.2	6.9
Domestic	10 429	24 100	57 880	4.3	4.5
Freight tonnes carried (thousands)					
Total	13 742	37 660	145 000	5.2	5.5
International	5 884	22 630	110 000	7.0	6.5
Domestic	7 858	15 030	35 000	3.3	3.4

Source: ICAO.

REGIONAL FREIGHT FORECASTS

21. 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 and the Middle East are expected to remain the fastest growing regions, although their forecast growth rates are somewhat lower than the growth rates achieved during the 1985–2005 period.

Table 5-5. ICAO scheduled freight traffic — Regions of airline registration (1985–2025)
(ICAO Contracting States)

	Freight tonne-kilometres (millions)			Average annual growth rate (per cent)		Regional share of world traffic (per cent)		
	Actual 1985	Actual 2005	Forecast 2025	1985–2005	2005–2025	1985	2005	2025
Africa								
Total	1 163	2 349	6 000	3.6	4.8	2.9	1.6	1.2
International	1 070	2 256	5 870	3.8	4.9	3.6	1.9	1.3
Domestic	93	93	130	0.0	1.7	0.9	0.4	0.2
Asia/Pacific								
Total	9 605	50 105	235 000	8.6	8.0	24.1	35.1	46.1
International	8 589	45 070	215 000	8.6	8.1	29.2	38.0	47.6
Domestic	1 016	5 035	20 000	8.3	7.1	9.7	20.9	34.6
Europe								
Total	14 422	37 875	97 000	4.9	4.8	36.2	26.6	19.0
International	11 589	36 981	95 900	6.0	4.9	39.4	31.2	21.2
Domestic	2 833	894	1 100	–5.6	1.0	27.2	3.7	1.9
Middle East								
Total	1 880	8 880	40 000	8.1	7.8	4.7	6.2	7.8
International	1 808	8 764	39 750	8.2	7.9	6.2	7.4	8.8
Domestic	72	116	250	2.4	3.9	0.7	0.5	0.4
North America								
Total	10 638	38 803	120 000	6.7	5.8	26.7	27.2	23.5
International	4 841	21 634	85 000	7.8	7.1	16.5	18.3	18.8
Domestic	5 797	17 169	35 000	5.6	3.6	55.6	71.2	60.5
Latin America/Caribbean								
Total	2 105	4 567	12 000	3.9	4.9	5.3	3.2	2.4
International	1 487	3 777	10 600	4.8	5.3	5.1	3.2	2.3
Domestic	618	790	1 400	1.2	2.9	5.9	3.3	2.4
World								
Total	39 813	142 579	510 000	6.6	6.6	100.0	100.0	100.0
International	29 384	118 482	452 120	7.2	6.9	100.0	100.0	100.0
Domestic	10 429	24 097	57 880	4.3	4.5	100.0	100.0	100.0

Source: ICAO.

Note.— Shares may not add up to 100 per cent due to rounding.

22. By the year 2025, airlines of the Asia/Pacific region are expected to increase their share of air freight traffic by more than 10 percentage points to slightly over 46 per cent of total world freight, a share well above that of any other region.

ACCURACY OF PREVIOUS FORECASTS

23. Previous ICAO forecasts tended to somewhat overestimate the actual passenger traffic growth which remained nevertheless within the forecast margins, while freight traffic growth forecasts mostly matched the actuals. The accuracy of the most recent forecasts published in 2001 and 2004 could not be assessed given that their time horizon extends to 2010 and 2015, respectively. The accuracy of the other sets of ICAO long-term passenger and freight forecasts is depicted in Figures 5-3 and 5-4. The last set of forecasts shown on both figures was developed in 1997. Despite several unforeseen events including the Asian economic crisis in the second half of 1997, the events of 11 September 2001, the war in Iraq and the SARS epidemic in 2003, actual passenger-traffic growth for the period 1995–2005 was very close to the most likely forecast, due in part to the speedy recovery in 2004 and 2005. This was not the case for actual freight traffic growth which was close to the low forecast.

SUMMARY OF AIR TRAFFIC FORECASTS BY OTHER ORGANIZATIONS

24. Some recent long-term forecasts by major airframe and engine manufacturers of growth in world scheduled traffic are given in Table 5-6. These forecast growth rates are in the range of 4.8 to 5.0 per cent per annum for passenger-kilometres, with freight tonne-kilometres generally forecast to grow at a slightly higher rate for the period ranging from 2005 to 2026.

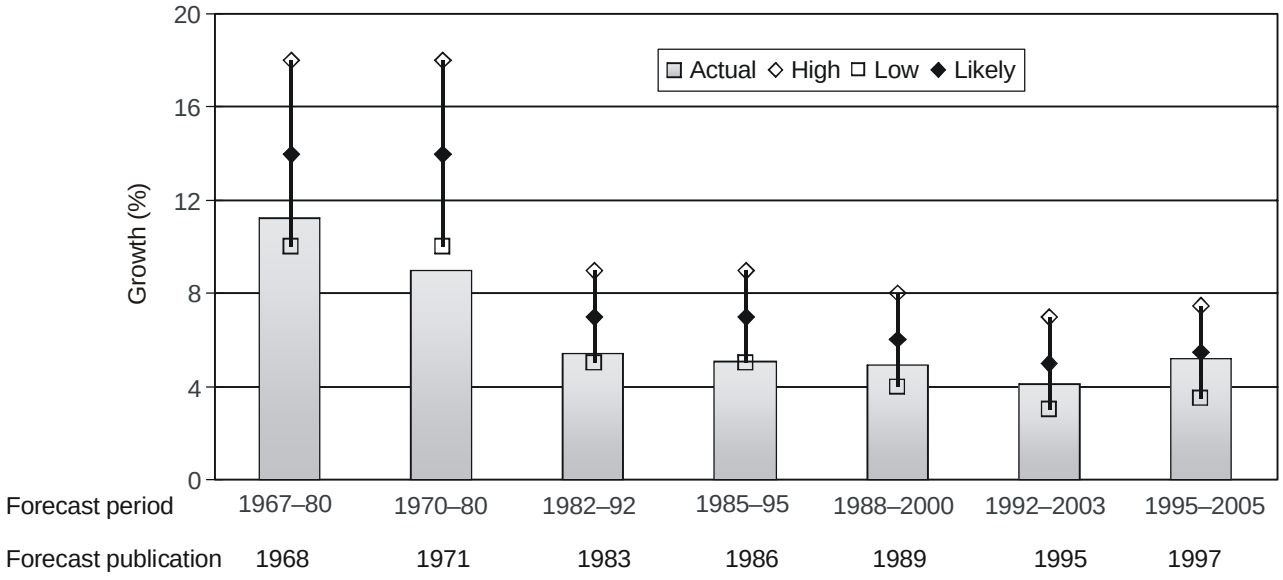


Figure 5-3. ICAO forecast accuracy (growth of passenger-kilometres performed)

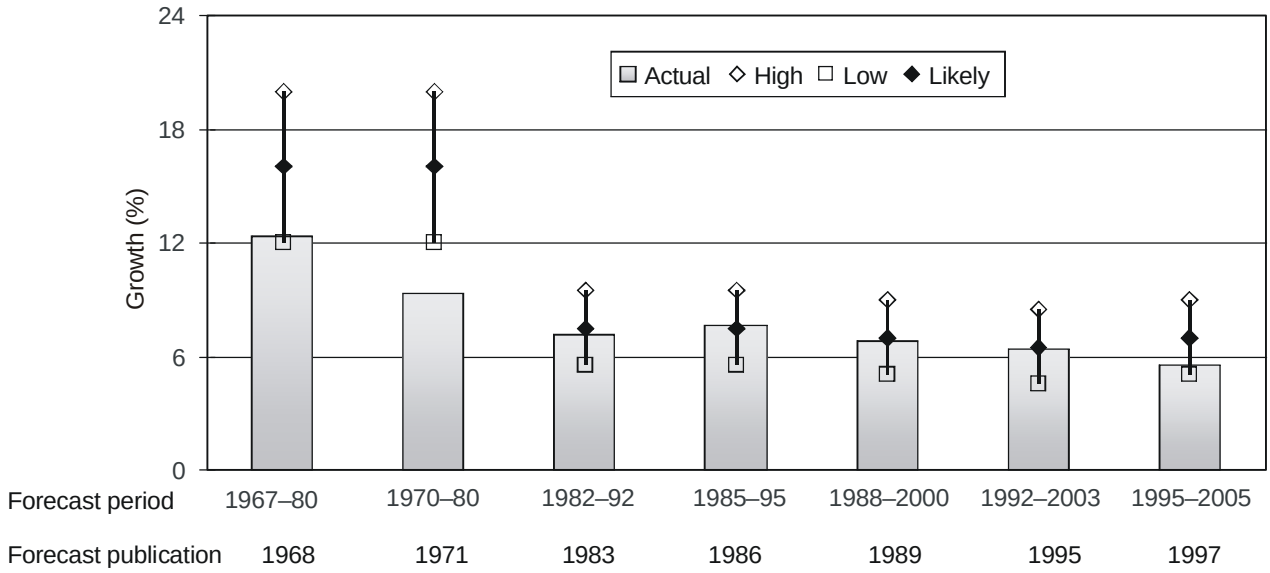


Figure 5-4. ICAO forecast accuracy (growth of freight tonne-kilometres)

Table 5-6. Global scheduled traffic forecasts by aerospace manufacturers

	Forecast period	Average annual growth rate (per cent)	
		Passenger-kilometres	Freight tonne-kilometres
Airbus Industrie	2006–2025	4.8	6.0
Boeing	2005–2025	4.9	—
Embraer	2007-2026	5.0	—
Rolls-Royce	2006–2025	4.8	6.8

Source: Airbus Industrie, "Global Market Forecast", 2006; Boeing Commercial Airplanes, "Current Market Outlook", 2006; Rolls-Royce, "The Outlook", 2006.

25. Forecasts developed by the Airport Council International (ACI) for the period 2006–2025 indicate average annual growth rates of 4 per cent and 5.4 per cent in the total number of passengers and freight tonnes, respectively.

26. Separate forecasts (medium-term only) for the number of passengers carried and passenger-kilometres performed on world international services by member airlines, are regularly prepared by the International Air Transport Association (IATA). The most recent forecasts, covering the 2006–2010 period, indicate an average growth of 4.8 per cent per annum for passengers and 5.3 per cent per annum for freight tonnes.

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Chapter 6

FORECASTS OF AIRCRAFT MOVEMENTS TO THE YEAR 2025

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 steadily during most of the past decade, increasing the pressure on airport and air navigation services. Poor traffic performance in the years 2001, 2002 and 2003 has somewhat eased this pressure in the regions concerned, but with the traffic recovery observed since then, airport and airspace congestion have built up again.

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 remained quite small despite rapid growth in passenger traffic. However, in the 1980s, the trend in average aircraft size remained almost unchanged as airlines began to introduce more mid-size and smaller aircraft into their fleets. From the early 1990s, the average aircraft size began to decrease and in recent years, the decline has been more pronounced. Past trends in average aircraft size and average load factor for total world scheduled services are illustrated in Figure 6-1.

4. Gradual improvements in average load factors have resulted from marketing initiatives, enhanced capacity management and revenue management programmes. During the period 2001–2003 some markets experienced exceptionally low load factors due to traffic declines, but load factors improved substantially in the years 2004 and 2005 as a result of a measured supply response to the increase in traffic through tight capacity control. It is expected that the world average scheduled passenger load factor, which increased from 63 per cent in 1985 to 75 per cent in 2005, will rise to about 80 per cent by 2025.

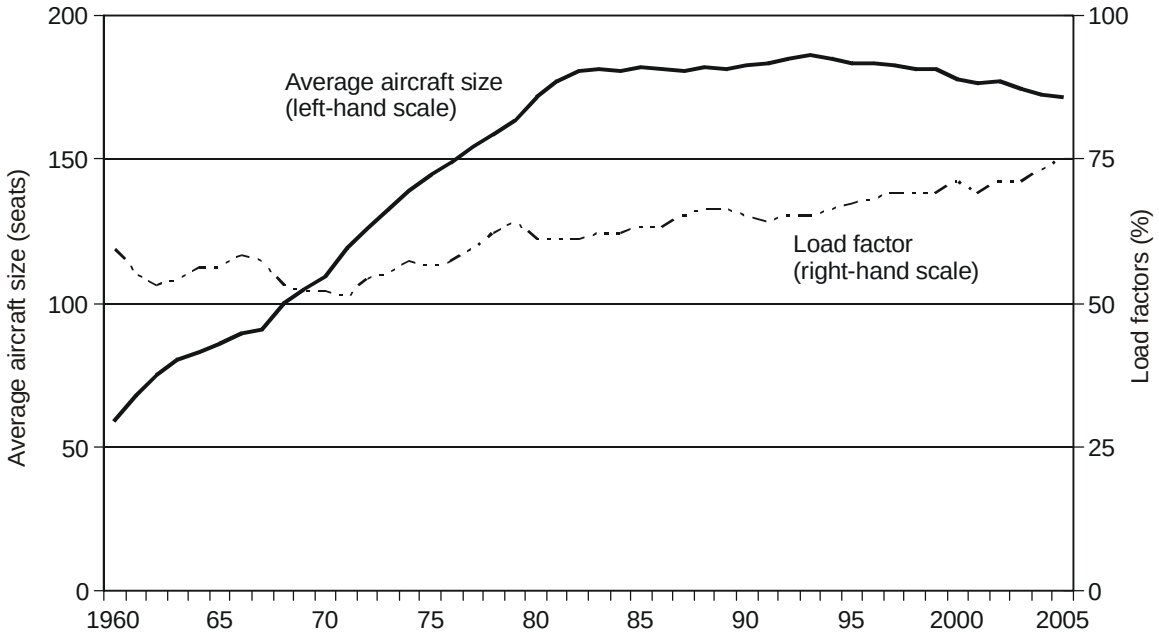
5. The services provided by carriers to meet demand result from a large number of decisions concerning network structure, aircraft types and service frequency. These decisions depend on factors such as the availability of traffic rights, the characteristics of alternative aircraft, and consumer preferences 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 seating capacity 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, followed by gradual liberalization of air services within the European Union. The evolution of competitive strategies and market structures has continued since then. Adequate frequency and convenient interline and online connections, as well as low price, have become important competitive tools. A more liberal regulatory environment has also emerged 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-size, 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 the 1980s, the airlines started to introduce mid-size aircraft such as the B-757, B-767, MD-80 and A-310. This trend continued well into the 1990s, and the airlines witnessed the introduction of additional mid-size aircraft such as the B-777, A-330 and A-340 into their fleets. Consequently, fleet replacement and expansion led to a modest decline in the average aircraft seating capacity during the late 1990s.

8. Recent trends have shown that there has been a gradual deployment of mid-size to smaller aircraft on almost all route groups as the need for more direct services has become a priority for travellers. Regulatory developments and the characteristics of these new aircraft types may have also been prevailing factors for their introduction. This change has resulted in a proliferation of services aimed at cost-cutting measures by reducing flight time and the distance flown, especially on longer routes linking two regions. Route groups such as North Atlantic and Trans-Pacific are the prime examples where such aircraft types have increasingly been introduced.

9. The regulatory and technological factors described above are likely to continue and will motivate airlines to opt for mid-size to smaller aircraft in the coming years. The number of such aircraft placed on order during the past decade or so also supports the continuation of this trend into the future. During the past decade the average aircraft size has been declining steadily and, in the year 2005, it reached its lowest level. However, progressive liberalization and competitive forces are encouraging consolidation and alliances among airlines which might eventually reduce the pressure to increase flight frequency at the expense of aircraft size. The build-up of airport and airspace congestion during the forecast horizon is another factor which may favour larger aircraft. Based on these factors, it is assumed that over the forecast period, the world average aircraft size will increase to about 175 seats by the year 2025. Moreover, the average seat size may increase on some of the major route groups, such as Europe-Asia/Pacific, with the anticipated introduction of larger aircraft during the forecast horizon.



Source: ICAO Reporting Form A.

Note.— Excluding all-freight operations. Excluding the CIS.

Figure 6-1. Average aircraft size and load factor — World (1960–2005)
(Passenger aircraft on scheduled services)

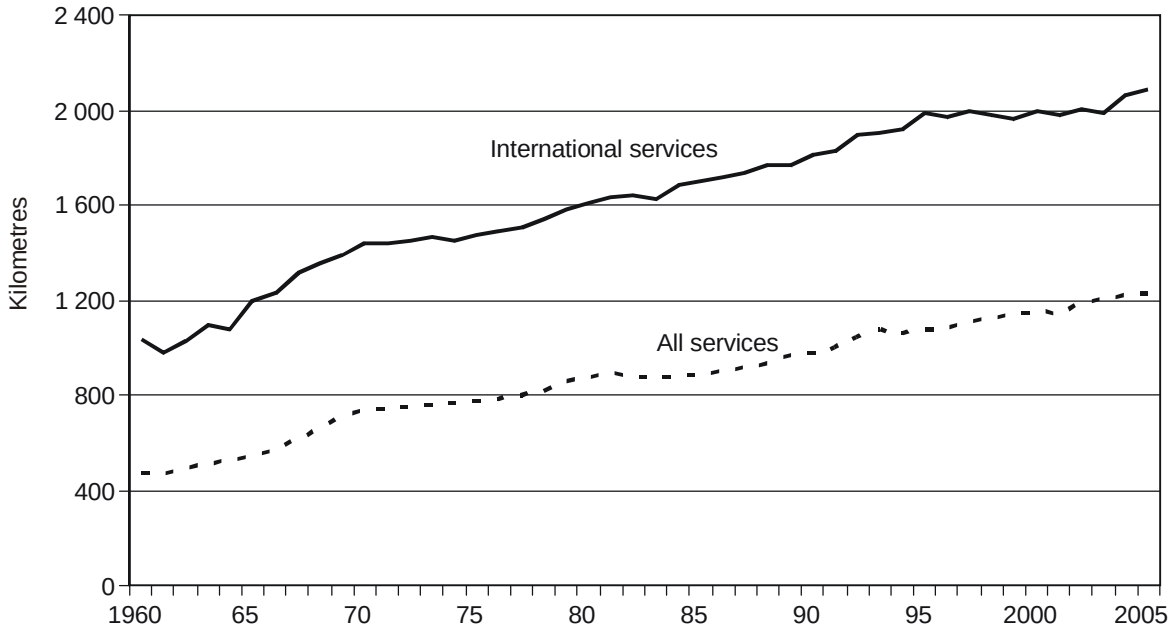
MEASURES OF AIRCRAFT MOVEMENTS

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, excluding operations of airlines registered in the former USSR, increased by more than 4 per cent per annum, and thus aircraft-kilometres grew about 4 per cent per annum faster than aircraft departures. During the 1970s, these growth rates were much lower. Over the last decade, the aircraft-kilometres of world scheduled airlines, have grown over 4.7 per cent per annum, about 1.3 percentage points higher than departures. The growth in average stage length has been about 1.3 per cent per annum during the same period. 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. Over the forecast period (2005 to 2025), the average stage length is assumed to grow at about 0.5 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.



Source: ICAO Reporting Form A.

Note.— Excluding all-freight operations. Excluding the CIS.

Figure 6-2. Average aircraft stage length — World (1960–2005)
(Scheduled services of airlines of ICAO Contracting States)

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 5 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 2005–2025 are given below:

a) a growth in passenger-kilometres of 4.6 per cent per annum;

b) an increase in average load factor from 75 to 80 per cent;

c) an increase in average passenger aircraft size (in terms of seats) from 172 to 175 seats; and

d) a growth in average aircraft stage length of 0.5 per cent per annum.

FORECASTS OF WORLD SCHEDULED AIRCRAFT MOVEMENTS

14. The above analyses resulted in forecast average world annual growth rates of 4.1 per cent for aircraft-kilometres and 3.6 per cent for aircraft departures over the period 2005 to 2025.

15. Over the forecast horizon, the growth rate for aircraft-kilometres is below the growth rate for passenger-kilometres by 0.5 percentage points per annum because of the increase in load factor and in aircraft size. Growth in aircraft departures is below the growth in aircraft-kilometres by 0.5 percentage point per annum, which is equal to the growth in stage length.

16. In Table 6-1, the forecasts of aircraft movements are compared with actual past movements. The rates of growth reported in the table are *average* measures over the relevant periods; the rates over shorter periods may vary.

Table 6-1. ICAO aircraft movements forecast — World (1995–2025)
(Scheduled services of airlines of ICAO Contracting States)

	Actual	Actual	Forecast	Average annual growth rate (per cent)	
	1995	2005	2025	1995–2005	2005–2025
Aircraft-kilometres (millions)	19 470	30 843	69 040	4.7	4.1
Aircraft departures (thousands)	17 816	24902	50 450	3.4	3.6

Note.— including all-freight movements.
Source: ICAO

17. The forecasts imply the doubling of aircraft-kilometres and aircraft departures between 2005 and 2025. In absolute terms, the increase in aircraft-kilometres is expected to be some 38.2 billion, while the absolute increase in aircraft departures is forecast to be about 25.5 million. While the interruption of traffic growth in the early

2000s eased the demand pressure on aviation infrastructure to some extent (see Chapter 2, paragraph 29), overall increases of this magnitude could result in serious congestion of certain already hard-pressed airport and airspace facilities. It is important to recognize that in arriving at these forecasts, no allowance has been made for the effect that potential supply constraints might have on traffic volumes. In other words, if the supply of air traffic control and airport services does not keep pace with demand in the same way that it has in the past, then actual traffic flows may be suppressed below the levels of demand forecast here.

Appendix 1

ECONOMETRIC MODELS OF DEMAND FOR WORLD SCHEDULED AIR TRAFFIC

The basic model form assumed was:

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

For the model of passenger traffic:

y = passenger-kilometres performed (PKPs)

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 (FTKs)

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 31 years for the passenger model and 36 years for the freight model. A dummy variable was introduced in the passenger model to take into account the special years where traffic and prices (as measured by yields) grew in the same direction. The data for the CIS are excluded from the freight model. ICAO and the IMF were the sources for the airline and general economic data, respectively, used in the models.

Estimated passenger model:

$$ln\ \text{PKP} = 2.31 + \underset{(10.6)}{1.27}\ ln\ \text{GDP} - \underset{(2.2)}{0.34}\ ln\ \text{PYIELD} + \underset{(3.2)}{0.08}\ \text{Dummy} \qquad R^2 = 0.995$$

Estimated freight model:

$$ln\ \text{FTK} = 8.59 + \underset{(8.7)}{1.15}\ ln\ \text{EXP} - \underset{(1.9)}{0.31}\ ln\ \text{FYIELD} \qquad R^2 = 0.986$$

The figures in brackets are the "t" values of the corresponding coefficient estimates. The "t" value corresponding to a particular coefficient estimate is a statistical measure of the confidence that can be normally placed in the estimate.

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:

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

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

The forecast for aircraft-kilometres for scheduled passenger aircraft in the year 2025 was generated by substituting into this expression the assumptions for passenger-kilometres, average load factor and average aircraft size in the year 2025. 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 2005 to 2025 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:

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

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

The forecast for aircraft departures in the year 2025 was generated by substituting into this expression the forecast for aircraft-kilometres and the assumption for average stage length in the year 2025.

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. 2005 to 2025).

Equation (1) becomes:

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

Equation (2) becomes:

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

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

5. The actual historical 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. Growth in aircraft movements and contributing factors — World (1995–2025)

	Actual 1995	Actual 2005	Forecast 2025	Average annual growth rate (per cent) 1995–2005	2005–2025
Passenger-kilometres (billions)	2 248	3 720	9 140	5.2	4.6
Passenger load factor (%)	67	75	80	1.1	0.3
Passenger aircraft size (seats)	182	171	175	–0.7	0.1
Aircraft stage length (km)	1 093	1 239	1 368	1.3	0.5
Aircraft-kilometres (millions)	19 470	30 843	69 040	4.7	4.1
Aircraft departures (thousands)	17 816	24 902	50 450	3.4	3.6

Source: ICAO.

— END —

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