THE CHALLENGE of FOREIGN COMPETITION

To the U.S. Jet Transport Manufacturing Industry

AEROSPACE INDUSTRIES ASSOCIATION OF AMERICA, INC.

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The mission of the Aerospace Research Center is to engage in research, analyses and advanced studies designed to bring perspective to the issues, problems and policies which affect the industry and, due to its broad involvement in our society, affect the nation itself. The objectives of the Center's studies are to improve understanding of complex subject matter, to contribute to the search for more effective government-industry relationships and to expand knowledge of aerospace capabilities that contribute to the social, technological and economic well being of the nation.

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INTRODUCTION

When, in the mid 1970s, the Aerospace Industries Association of America (AIA) first prepared an analysis on The Challenge of Foreign Competition,[1] the United States was approaching the end of its second recession in five years, Japan was pulling out of its only recession in the past quarter century, and Europe was still in the midst of recession. Internationally, there was a mood of general pessimism with much talk of travel restrictions, trade protectionism, and a need to adjust to a steadily declining standard of living.

At that time, the U.S. civil aircraft industry was in a position of having about 95 percent of the world's orders for airliners (excluding Soviet production) but it also had the lowest backlog of orders in more than two decades. Over 7,000 aerospace workers had been laid off as the industry retrenched. The jet transport manufacturers faced cash flow problems; in fact, the yet unrecovered development costs of the latest wide-bodies (Boeing B-747, McDonnell Douglas DC-10 and Lockheed L-1011) exceeded the companies' net worth. Meanwhile, the governments of France, Germany, Japan, and the United Kingdom were increasing support of their domestic aircraft manufacturers and moving toward transnational joint ventures in aircraft production.

The AIA analysis concluded by noting a need for:

- A healthy and vigorous U.S. domestic economy capable of generating an increased demand for air transportation and sufficient new U.S. airline orders to maintain cost competitive prices,
- Long-term financing for both U.S. and foreign airlines to facilitate aircraft purchases,
- A world trade environment in which U.S. manufacturers would have equality of marketing opportunity, and
- Government and industry investments in R&D to improve the aeronautical technology data base.

Since that time, some improvements in these areas have been experienced. New impediments for the industry, however, have been growing at a fast pace.

[1] Aerospace Industries Association, *The Challenge of Foreign Competition*, (Washington, D.C., 1975).

Current Situation

When the decade of the seventies ended, the U.S. aircraft industry was in a very different and overall improved financial situation from that of the mid-seventies. Sales and exports were strong; in 1980, the current dollar backlog of orders was nearly three times that of 1975, and employment was higher than at any time since 1969. Moreover, a favorable new code of conduct for marketing civil aircraft worldwide had been implemented through the 1979 Agreement on Trade in Civil Aircraft, part of the General Agreement on Tariffs and Trade (GATT).

The U.S. commercial jet transport industry still leads in sales to the world market but foreign manufacturing industries are taking an increasingly significant share. Shown here, the McDonnell Douglas DC-9 production line.

The A-300 is produced by a European consortium of nations with strong financial commitments to the survival of their aircraft industries.

At the same time, the industry has not been immune from the economic trauma suffered by most of the major industrial countries and the outlook is hazy. After six years of strong economic growth—when demand for airline passenger services and for air freight increased 50 percent—the industrial counties as a whole anticipate only moderate economic growth. The near-term demand for air service and for new jetliners has had a dramatic decline and foreign competition has strengthened. While foreign competition accounted for less than 5 percent of aircraft orders during the period of the earlier AIA study (1974–75), Airbus Industrie orders in 1979 represented 30 percent of the total market. The European success has depended, in no small measure, on the active political and financial support of the governments of France, West Germany, and the United Kingdom.

Today, export financing has become the decisive factor in many world market competitions. Private capital is both scarce and expensive, complicating the situation for manufacturers and potential buyers of commercial jet transports. Foreign collaboration on aircraft production has become an increasingly appealing option when capital, technology and marketing assistance are readily available from foreign governmental institutions which emphasize high-technology industry development.

The Future

The anticipated demand for new jetliners over the next decade will be between 4,000 and 5,000 airplanes (or approximately $125 billion in 1980 dollars). A similar demand ($100–$150 billion) is forecast for 1990–2000. About 60 to 65 percent of this market (excluding the USSR) will be with non-U.S. carriers. The dynamic environment of this marketplace is characterized by the rising costs of fuel and labor and by reduced regulation of service patterns. The 1981 air traffic controller's strike has added another dimension of uncertainty.

To meet this demand, U.S. companies are offering a mixture of new designs (e.g. Boeing B-757 and B-767) and advanced derivatives (DC-9-80, B-737-300 and L-1011-500) incorporating the newest, advanced technology to meet various range and size requirements. Europe's Airbus Industrie's competitive model A310 will soon enter airline service and another version, the A320, is about to be launched.

Capital commitments and associated costs for all manufacturers now launching new aircraft models are staggering and the number of unit sales required to reach program profitability is greater with each new generation. The U.S. aerospace industry's profit per sales dollar continues to be less than the average for all manufacturing industries. The future profitability of the industry is in serious question, in part due to the increasingly competitive environment.

Competition is essential in a free market society to ensure the best products at the lowest cost. In today's world, however, civil aircraft competition is sometimes influenced by more than just the free market selection process. Foreign companies and programs have been continued by government supports that perpetuate marginal programs. Some new programs have been started more as a matter of national requirements (e.g. pride and employment) than for profit. This policy can lead to major financial hardships for U.S. private industry, since it must compete against national governments, as opposed to profit-oriented enterprises. Nonetheless, U.S. aircraft manufacturers must either invest heavily in new aircraft model production or suffer a slow death from product obsolescence as foreign suppliers strengthen their capabilities.

A key question facing the worldwide aerospace community today is not "How many suppliers of jet transport aircraft are needed to meet the demand?" but "How many different manufacturing entities, each competing for a favorable share of a finite market, can the world airline industry support?" The civil jet transport industry may well be at a crossroads. Faced with the economic realities of severe market swings, large numbers of sales needed to break even, overcapacity and fierce competition, several provocative questions await answers. Is the industry destined to further politicization in the years to come? Will public funds continue to be committed to support civil jet programs or will the natural forces of free enterprise be permitted to shape the industry into a self-sustaining and profitable one?

For the United States, the question is: "How is the U.S. aircraft industry likely to fare in the highly competitive environment of the eighties?"

CONCLUSIONS

- U.S. aircraft and engine manufacturers have dominated the world market since the introduction of the commercial jet transport, but with the emerging success of the European Airbus program, this leadership is being challenged. General aviation and helicopter manufacturers are also feeling the pressure of increasing competition by rapidly developing foreign aeronautical industries.

- The United States' effort to maintain its lead in the international transport market is made more difficult by the increasing capital, marketing and political risks of committing a modern commercial jet transport to production. Unfortunately, for U.S. manufacturers, the means to minimize risks are fewer than for manufacturers abroad, due to differences in economic systems, national priorities and business/government relations. The U.S. commercial transport industry is functioning in a world trading environment increasingly characterized by the national promotion and subsidization of exports.

- The commercial jet transport is one of a waning number of examples of American technological superiority. Still, foreign R&D capabilities have expanded rapidly while overall aerospace industry R&D funding, in constant dollars, declined from the late sixties through the mid-seventies and has not again reached the levels of the sixties. The U.S. aircraft industry's technological leadership is in danger of erosion and, as a result, the industry's competitiveness has become more sensitive to export financing and other aspects of government policy.

- Fulfillment of the Civil Aircraft Agreement, concluded in the Tokyo Round of the General Agreement on Tariffs and Trade, is essential to an improved trading environment, as are amendments to meet changing world trade conditions. The problems of implementing the agreement will not be resolved without industry and the U.S. government working together. The government is moving slowly to respond to information and policy recommendations provided by the Industry Sector Advisory Committee.

- Major financial incentives offered the aircraft industry by the U.S. government to expand export marketing include some funding of basic research and development, the Domestic International Sales Corporations (DISCs) and the Export-Import Bank. The survival of DISC is in question, as it is under attack both abroad and in Congress. Export-Import Bank financing, upon which aircraft export sales have relied heavily, is also endangered by Administration and Congressional criticism. Unless U.S. civil aircraft manufacturers can provide export financing comparable to foreign government offerings, they are economically disadvantaged in international competition.

- Export disincentives include administrative delays, unilateral export controls for foreign policy reasons, and the uncertainty caused by antitrust legislation and the Foreign Corrupt Practices Act. When not shared by the foreign competitor, such disincentives tend to disadvantage U.S. exporters and provide unwarranted sales opportunities for other nations.

- In the last few years, the restructuring of the competition, changes in the world marketplace for civil aircraft, and the enormous cost of new programs have caused collaborative relationships to develop between U.S. and foreign companies. Aircraft companies will continue to enter into such agreements in order to acquire market share, diminish risk, expand, or simply survive. Although technology transfer is a source of concern and constraint, acceptable controls will evolve within the industry and be applied without disrupting the careful balance required of transnational relationships.

- Although several major aerospace companies are involved in foreign partnerships to some degree, foreign competition continues to be an issue of significant concern. The industry's importance to national security and the U.S. trade balance dictates that the nation work to assure its continued strength. It must:

  — Support research and development policies that will

assist high-technology industries to maintain their competitive edge.
— Maintain a strong trade position by seeking the fullest possible benefits from trade agreements, by providing incentives to export and removing disincentives, and by working to make export credit financing a neutral element in the competition for world markets.

- The United States cannot afford to assume its dominance in the important world aircraft market will continue without effort.

RECOMMENDATIONS

The foreign challenge to the market domination of U.S. civil jet transport manufacturers is real. In order to meet it, both the U.S. government and industry must renew efforts to keep the aircraft industry technologically and economically competitive.

Government

Financing

- Increase the Export-Import Bank's lending and guarantee authority so that it can provide assistance to exporters consistent with the terms and interest rates offered by foreign governments.
- Work to make export credit financing a neutral element in the competition for world markets by: elevating export credit agreements to the status of a multilateral treaty within the Organization for Economic Cooperation and Development; establishing an international agreement that would result in longer-term financing at market rates; encouraging innovative alternatives to subsidized export financing—alternatives such as an international equipment trust.

Research & Development

- Establish a long-term national R&D policy to be developed jointly by the Executive Branch, Congress and private industry. The policy should be based on a government/industry partnership concept, reflect a national perspective by setting broad goals for the development of U.S. industrial sectors, and stress a balance between government, academic and industry-related research and development.

Incentives

- Establish exports as a high national priority
  — Promote and actively seek broader acceptance—by the federal government, industry, organized labor and the public—of the beneficial relationship between increased exports, more jobs and a healthy economy.
  — Develop export strategies and programs for those industry sectors capable of large export growth.
- Retain the benefits of the DISC program or provide similar benefits in a program that will be consistent with the terms of international trade agreements.
- Insure adherence on the part of signatory nations to the Multilateral Trade Negotiation Agreements and act, if necessary, against tariff or non-tariff barriers imposed by other nations in violation of the Agreements.

Disincentives

- Alleviate the uncertainties created by the disincentives of U.S. antitrust laws, boycott strictures, and the Foreign Corrupt Practices Act, with a negative impact on export efforts.
- Repeal foreign policy export controls targeted specifically to civil aircraft.

Industry

- Work with all aircraft manufacturers and private financial institutions worldwide to develop the mechanisms by which aircraft purchasers can achieve longer-term financing.
- Work with the U.S. government in monitoring adherence to the GATT agreements and OECD Finance Agreements.

EXECUTIVE SUMMARY

At one time, commercial aircraft sales were made simply on the basis of the best price and the best product, the latter measured in terms of aircraft economics, quality, support and delivery schedules. While these things are still important today, the sale of commercial transports in the world market now also depends upon various political and economic factors that stem from worldwide events and trends of the past five-seven years. Among them:

Worldwide economic recession of 1974–75—During the recession, world airline passenger traffic growth slowed, and U.S. airlines experienced no traffic growth at all. Worldwide orders for new aircraft dropped from an average of about $6 billion per year to around $3 billion for 1974–75.

Accelerating fuel prices—Airline fuel costs rose from 18 percent of total operating costs in 1975 to 31 percent in 1980 with a negative impact on operating earnings. Air travel prices were forced higher and, consequently, traffic declined. Fuel prices have added to inflation and today's higher interest rates are making it difficult to finance the purchase of new aircraft and, as a result, pressure has been placed on governments to aid in the financing of aircraft for exports. At the same time, higher fuel prices have increased the need for more fuel-efficient aircraft, and accelerated retirement or retrofit of less fuel-efficient planes.

Decline in U.S. productivity—Since 1975, U.S. productivity has grown only 4.3 percent, while in other leading industrial nations it has increased from 10 to 25 percent. This has heightened the importance of highly productive industries. U.S. commercial transport manufacturers have maintained a high level of productivity through economy of scale as a large overseas market, and large domestic market, have permitted large production runs.

U.S. domestic policy—Legislation deregulating U.S. airlines has led to a dramatic increase in airline fares to cover rising costs of fuel and labor, and to a rapid restructuring of most airlines' route systems. In particular, the larger carriers have released less profitable short-range routes, on which they were flying relatively large equipment, creating a void in the short-range commuter market.

U.S. defense and foreign policy—The modest defense procurement and R&D increases of the late seventies have taken their toll as military technology had long been a significant ingredient (now decreasing in importance) in the formula for U.S. superiority in the commercial transport business. Additionally, Congress and the Executive Branch have made strong efforts to limit the export of military goods and imposed controls on shipments of commercial transports to certain countries for foreign policy reasons.

The Multilateral Trade Negotiations—The Tokyo Round of the Multilateral Trade Negotiations (MTN), concluded in 1979, established a new framework for fair and equal trade policy among nations. The Civil Aircraft Agreement, if realistically implemented, has the potential of normalizing the lopsided balance generated by foreign government influence that is now so important in the sale of commercial transports internationally.

The U.S. in world affairs—Beginning with the trauma and frustration of Vietnam, the United States has experienced a series of image losses at home and abroad which can be seen as a weakening of U.S. posture in relation to other major powers.

All of these events and trends form a background against which to view the important role of exports in the U.S. economy, and the United States' changing world trade position. While exports as a percentage of U.S. GNP have increased from 4.3 percent in 1970 to 8.2 percent in 1979, U.S. exports as a percentage of total world trade have declined from 15.2 per cent in 1970 to 11.9 percent in 1980. This is due in part to the change in comparative economic advantages among nations but also to the slow awakening of the U.S. government to the need to promote exports.

While the export performance of U.S. industry in general has been less than outstanding, the commercial aircraft sector has made a strong contribution to trade balance. Since 1970, civil jet transport deliveries and sales of spare parts have resulted in a net surplus of exports over imports. In 1979, the industry was producing the largest trade surplus of any American manufacturing industry. In that year, and again in 1980, an aerospace firm was the nation's largest single exporter; in fact, five of the top ten exporting companies were aerospace firms.

World Economic Outlook and the Market for Commercial Transports

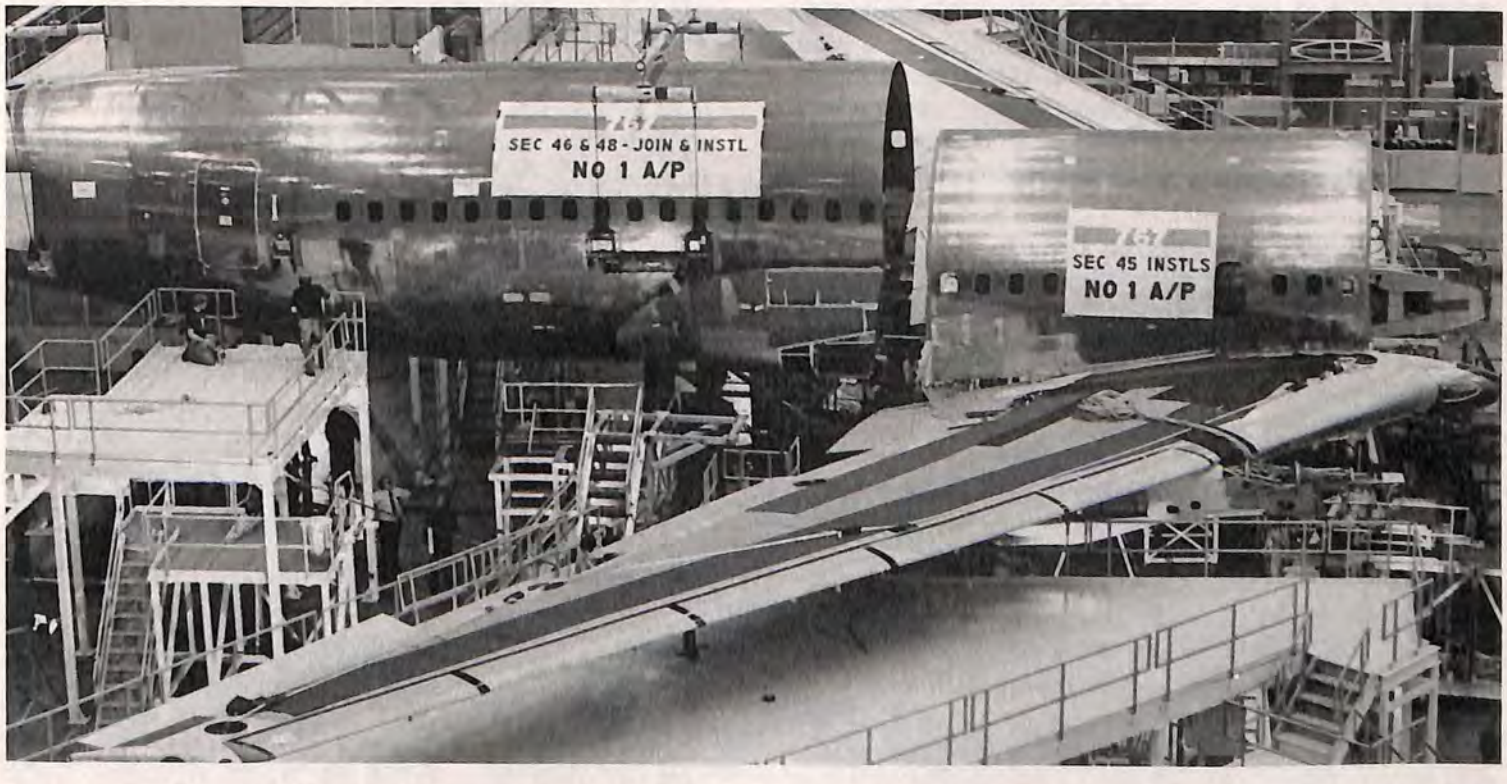
The nations of the world are experiencing a reduction of economic growth and even with improvements expected in the long-term, world real GNP growth should be less than that experienced historically. The United States and Europe will average around 3 percent growth while the rest of the world will average closer to 5 percent. Based on growth forecasts and a number of assumptions about the world economy, transport aircraft manufacturers regularly assess the world aircraft market. Although each manufacturer's assessment varies somewhat from the others, the value of the aircraft to be delivered during the eighties, in today's dollar, is expected to be between $110 and $140 billion.

The U.S. industry, however, faces strong competition for that market. It can no longer claim 90 percent of the world aircraft market as it did for 15 years prior to 1979. In 1979, the European consortium, Airbus, received 31 percent of wide-body orders placed. In 1980, Airbus achieved 32 percent of orders placed and, as of September 1981, held 43 percent of the world wide-body backlog. There is every reason to believe growth of non-U.S. jet transport manufacturing and marketing will continue. The largest forecast growth in travel demand, moreover, is outside the United States and this could prove an asset to foreign manufacturers.

Risks Involved in Civil Aircraft Production and Marketing

The strong foreign competition experienced by the industry greatly increases the already high risks of committing to production of a modern jet transport for commercial markets. Capital risks in the jet transport industry are extremely high; since jet transport technology was introduced into commercial service, the ratio of program launching costs to equity has always exceeded 1.3 to 1.0. Billions of dollars in pre-production commitments are required in the design, subcontracting, tooling, marketing and certification stages of aircraft production. Most of these costs are not recoverable for years—typically 10 to 15 years. Moreover, few jet transports have sold in sufficient numbers in the dynamic markets of the last 25 years to have earned a profit for their makers or the governments that sponsored them.

There is an enormous uncertainty involved in new aircraft introduction because many factors significantly affect the model's acceptance and the manufacturer's return on initial investments. However, the larger the marketplace, the more likely a program is to be successful. And the wider the product line, the greater the market for a particular manufacturer, and the more flexibility to meet planned and unplanned demand changes. The loss of opportunity to compete in the market increases the risk of the total program and, for that reason, initial sales of particular jet transport equipment to each single customer are critical. The loss of an initial sale to an airline will likely result in the loss of that carrier's market—for that size aircraft—for 15 to 20 years. It is also true that initial sales success or failure with a particular regional airline can influence the decisions of other carriers in that market. A recent example is Airbus penetration of the Silk Route market which encompasses the Pacific Rim, Asian subcontinent and Arabian Gulf.



The commercial transport industry faces enormous risks in committing to production of a modern first-generation airliner such as the Boeing 767.

Government involvement is a particularly important factor in new aircraft introduction. The manufacturing and marketing of U.S. commercial jet aircraft have been financed over the years in a free enterprise system in which private capital flows to commercial ventures with the potential to protect and multiply that capital. Many foreign manufacturers, however—such as Fokker, Airbus Industrie, and British Aerospace—have received at least part of this funding from their national treasuries. Because of fundamental differences between the U.S. economic system and those systems of its competitors, the means available to minimize the risks of an aircraft program undertaking are significantly different.

Increasingly, the risks involved in aircraft manufacturing involve political as well as capital and marketing concerns, and these are closely identified with differences in national priorities. The priorities of the European and Japanese governments include financial support to industries designated as important to the future of the country. These nations are less concerned with return on investment from a company point of view than on overall national return such as employment, and development and perpetuation of a high-technology aircraft and aerospace industry.

In the United States, trade restraints to promote foreign policy objectives are an increasingly common form of political risk for private industry. As these policy objectives are often not supported by other developed nations, the United States is, in effect, abandoning a particular marketplace to other countries.

Still other political risks center on financing terms, now a pivotal item in sales to non-U.S. carriers. The inflation-caused limitations on private U.S. banking institutions, combined with funding constraints on the U.S. Export-Import Bank, are denying U.S. exporters competitive equality, given the national treasury support of their aircraft industries by the nations of the European Economic Community.

Government Support of Aircraft Exports

The national promotion of exports has clearly emerged as a significant factor in world market competitions. Export credit financing and insurance, tax avoidance or reduction incentives, direct promotion, bilateral agreement negotiations, and direct financial assistance are increasingly common. The commercial jet transport industry has become a high priority for export support among industrialized nations—so much so that, until recently, a virtual export credit war was underway.

U.S. efforts to bring export financing in line with current market conditions had stalled through December 1980 in the face of tough opposition to change by the French. Then in 1981, the United States, France, West Germany and Britain concluded an interim arrangement covering Airbus and U.S. aircraft which established minimum interest rates (U.S. dollar—12 percent; French franc—11.4 percent; German deutsche mark—10 percent) and limited the cover to 42.5 percent for Eximbank type credits and 62.5 percent for European credits. (Average term of loan is equivalent because of different repayment requirements.) Participation in excess of the 42.5 percent on Eximbank financing would be limited to guarantees. This interim agreement, like the Standstill Agreement entered into by aircraft-exporting nations in 1975, continues the repayment term at 10 years.

Jet transport production provides jobs not only in the aerospace industry but throughout the economy.

The Role of Research and Development

U.S. commercial jet transport manufacturers are working hard to maintain their competitive position in the world market. They have committed billions to introduce new and improved, fuel-efficient models in several market areas. Similar commitments of funds have been made by aircraft engine manufacturers. The aircraft manufacturers represent a bright spot in U.S. industrial productivity and have been able to modernize and expand production capabilities. As a result, the U.S. commercial transport aircraft is still a sound competitor in fuel efficiency and price—when price reflects real cost. Nonetheless, the expansion of foreign R&D capabilities—much of it funded by the governments involved—is challenging U.S. leadership and, in some cases, foreign developments are outpacing U.S. programs. Because of this, the U.S. industry's competitiveness has become much more sensitive to export financing and other aspects of government policy.

U.S. Export Incentives and Disincentives

The U.S. government offers incentives to exporters including (1) promotional programs, (2) assistance to small and minority-owned firms, (3) the improvement of trading opportunities through international trade agreements, and (4) financial incentives. Commercial jet transport and related

supplier marketers can find assistance only in the last two categories.

U.S. negotiators were particularly aggressive on behalf of aircraft exporters during the Tokyo Round of the General Agreement on Tariffs and Trade. The fruit of their efforts was a Civil Aircraft Agreement among 14 nations eliminating import duties on civil aircraft and most related parts, as well as a variety of non-tariff barriers to free and competitive trading opportunities. Signatory governments also agreed that aircraft prices should be based on a reasonable expectation of recoupment of all costs and, further, that governments should not require nor exert unreasonable pressure on airlines, aircraft manufacturers or other entities engaged in the purchase of civil aircraft, to procure civil aircraft from any particular source. It is nonetheless true that the governments of Airbus Industrie participants still have a wider range of marketing opportunities available to them, due to the close relationship in those countries of political and commercial interests.

When the Civil Aircraft agreement went into effect, the United States immediately eliminated a 5 percent duty on most aircraft-related imports. Concessions by other signatories were related more to non-tariff issues, and the U.S. aircraft industry anticipates some substantive difficulties over unresolved matters, as well as over questions of interpretation of the Agreement.

Financial incentives that assist civil aircraft industry exports are limited to the Domestic International Sales Corporations (DISCs), Export-Import Bank financing, and some funding of basic research and development. The future of the DISC as an export incentive is in doubt due to Congressional criticism of the allowed deferral of taxes on foreign sales income and a concerted effort by EEC countries through the GATT to eliminate DISC benefits.

The current high cost of funds to the Export-Import Bank and the below-market-rate offerings of foreign export credit agencies have endangered the standing and capability of this favorable export incentive. Moreover, this type of financing, while not particularly troublesome to foreign governments, is a controversial issue in the U.S. Congress.

U.S. aircraft export sales have relied heavily upon Eximbank financing in recent years. A small fraction of a percentage difference in export financing can make a significant difference in the total operating cost of a jet transport over the period of a loan. U.S. capital costs have risen precipitously in recent years and, as a result, U.S. manufacturers are at a serious disadvantage when competitive foreign export financing programs, providing fixed rates, are compared to U.S. export financing programs, which include commercial bank fluctuating rates combined with Eximbank fixed rates. With the prime rate above 15 percent, the difference between a foreign competitive fixed rate offer at 8¾ percent and a U.S. blended rate could range between 300 and 400 basis points. For a 10-year loan, this translates into additional capital costs of between $15.8 to $26.3 million for each $100 million of financing.

In the course of shopping for future fleets, customer airlines are looking at total operating costs, including debt financing and its service costs. U.S. jet transport makers have been economically disadvantaged in an otherwise open competition unless export financing comparable to foreign government offerings was available from Eximbank. Even recent agreements on minimum interest rates do not guarantee parity to U.S. firms.

The aircraft industry has also encountered active disincentives to export including administrative delays and unilateral export controls for foreign policy reasons. In addition, while antitrust laws are not themselves credited with many lost export opportunities, the uncertainty caused by their interpretation and application, combined with the burden of antiboycott strictures and the Foreign Corrupt Practices Act, tends to disadvantage exporters and provide sales opportunities for other nations.

Exports of jetliners such as the Lockheed L-1011 have depended heavily on Eximbank financing.

Emerging International Collaboration

In the last few years, with the restructuring of competition in the aircraft market, changes in the world marketplace and increases in program costs, some U.S. aerospace companies have entered new relationships with foreign companies. These U.S. firms have made collaborative agreements with foreign firms to gain market share and decrease financial risk. In fact, it must be noted that approximately one-third of the Airbus A300 is of U.S. manufacturing content.

In some instances, countries are using cooperative relationships as a means of acquiring advanced technology capabilities. Transborder partnerships also permit the sharing of costs of research and development, of launching engine and airframe programs, and of supporting production facilities. They can minimize political risk and provide improved access to markets that were previously unavailable or restricted. U.S. manufacturer involvement in international agreements has been encouraged by attitudes, policies and laws of the United States that inhibit exports. Further, the Department of Defense has promoted the trend through collaborative weapons production agreements in the interest of cost reduction and of hardware commonality with NATO nations.

Increasingly, U.S. firms have found that in order to participate in the international defense market, they must collaborate with foreign companies, many of which are either owned or strongly influenced by their governments. For U.S. manufacturers, "offset" required by foreign governments has frequently become an integral part of selling efforts. Offsets consist not only of the seller's buying foreign products to partially offset his sales—and, therefore, to offset the balance of trade gains—but may also involve the manufacture, under license, of part or all of a seller's product within a foreign buyer's country.

While technology transfer is a concern in these cooperative relationships between countries, there is every reason to expect that active transnational cooperation in the aircraft industry will continue. There is a need for caution, however, in considering this trend and drawing inferences about the nature of the aerospace export market. Transborder relationships will change with time and those who are partners today will not necessarily be partners tomorrow. In addition, not all major U.S. aerospace companies are involved in foreign partnerships to the same extent. Foreign competition remains an important issue for an industry in which rival firms and nations risk very high stakes for a limited number of commercial aircraft sales.

Turn to page 69 for a detailed look at the rapidly expanding aircraft capabilities of other nations.

THE OUTLOOK FOR THE WORLD ECONOMY AND THE COMMERCIAL JET TRANSPORT MARKET

A particular concern of this report is that the sales of commercial aircraft are no longer simply a function of price, aircraft economics, quality, support and delivery schedule, but are dependent upon other factors as well—factors that stem from issues and problems confronting the world political and economic systems. Some of the more salient of these worldwide political and economic events and trends in the past five years, and their direct or indirect impact on the commercial transport industry, are presented in Figure 1 and discussed below.

Worldwide economic recession of 1974 and 1975—Most of the developed countries did not experience real economic growth in the 1974–1975 period. In the United States, where about one-third of passenger air traffic is generated, the economy actually declined in real terms. The greatest impact on the commercial air transport industry was the stagnation of growth in traffic and the corresponding reduction of orders for new aircraft. World passenger traffic, which had been growing 12 to 13 percent per year in 1972 and 1973, was reduced to 3 to 5 percent growth in 1974 and 1975. The U.S. airlines were most affected and experienced no traffic growth in the recession years. Worldwide orders for new aircraft dropped from an average of about $6 billion dollars per year to around $3 billion dollars for the years 1974 and 1975.

Accelerating fuel prices—The rise in fuel prices, by nearly a factor of seven in current dollars since 1975, has continued to shock almost every aspect of the world political and economic systems. More specifically, it has affected the commercial transport industry in many ways.

The rise in fuel prices, for example, has substantially increased airline operating costs. In the United States, fuel costs have risen from 25 percent of direct operating costs in 1974 to 57 percent in 1980. Not only has this had a negative impact on operating earnings but it has forced air travel prices higher and, consequently, has had a negative impact on travel.

Fuel prices have added to inflation and today's higher interest rates are making it difficult to finance the purchase of new aircraft. As a result, pressure has been placed on governments to aid in the financing of aircraft for exports.

Importantly, higher fuel prices have forced nations to stress exports in order to balance the accelerating costs of importing oil and the increased need to export has produced a tendency among nations to limit imports or lean toward protectionist attitudes. In the case of the balance of trade between the United States and Europe, the United States has been running a surplus, thereby increasing the need for Europeans to export. Obviously, for Europe as for the United States, the export of commercial jet transports is hardly insignificant with respect to improving the balance of trade. Those nations that have real difficulty in increasing exports, yet must continue to import fuel at higher prices, can only increase their debt or reduce their standard of living. A choice to increase the level of debt will only add to world monetary problems and a reduction in the standard of living has a negative effect on the purchase of commercial transports and all other goods.

One of the more direct impacts of higher fuel prices on the commercial transport industry has been the emphasis now placed on research and development to improve aircraft fuel efficiency. The need for more fuel-efficient aircraft has already changed the character and timing of proposed new aircraft programs.

Still another effect of higher fuel prices is on the retirement of older, less fuel-efficient aircraft and on the retrofit of older aircraft with new engines. It is estimated that over half of the aircraft in the world fleet today will be out of service by 1990.

Decline in growth of U.S. productivity—Productivity stands out as a significant economic factor in the United States in 1980, and there is seemingly general agreement that government policy should be directed toward improving it. Since 1975, U.S. productivity has grown only 4.3 percent, and this low rate of growth has occurred in a period of economic recovery from the most severe recession since World War II. During the same period, productivity increases in West Germany were 17.7 percent; and France, 15.1; Italy, 15.9; United Kingdom, 10.4 and Japan, 24.6 percent.[1] Scholars on

[1] Office of Industry Productivity Studies, Bureau of Labor Statistics, U.S. Department of Labor.

the subject conclude the U.S. government should give increased attention to productivity in order to improve competitiveness in world markets.

The decline in U.S. productivity growth overall has heightened the importance of highly productive industries. U.S. commercial transport manufacturers have maintained a high level of productivity through economy of scale as a strong overseas market—and large domestic market—have permitted large production runs.

U.S. domestic policy—Legislation deregulating U.S. airlines has led to a dramatic increase in airline fares to cover rising costs of fuel and labor, and to a rapid restructuring of most airlines' route systems. In particular, the larger carriers have released less profitable short-range routes, on which they were flying relatively large equipment, creating a void in the short-range commuter market. Deregulation has caused manufacturers to re-think their opportunities for producing existing and future types of aircraft.

U.S. defense and foreign policy—In the five years preceding 1981, while the Soviet Union has continued to build up its military procurement and research and development activities, the United States has made only modest increases in defense procurement and military research and development expenditures. In constant dollar terms, defense budgets have been well below those of the sixties and early seventies. This period of decline has taken its toll on commercial transport development since military technology had long been applied to commercial transport development and been a significant ingredient (now decreasing in importance) in the formula for U.S. superiority in the commercial

FIGURE 1

THE WORLD ECONOMIC AND POLITICAL ENVIRONMENT AS IT BEARS ON THE COMMERCIAL TRANSPORT INDUSTRY

Events and Trends	Impact
☐ Worldwide Economic Recession of 1974–75	☐ Dampened industry business volume.
☐ Accelerating Fuel Prices	☐ Increased airline operating costs.
	☐ Reduced airline operating earnings.
	☐ Increased ticket price.
	☐ Decreased air travel.
	☐ Made the financing of new aircraft more difficult.
	☐ Stimulated foreign countries to increase exports.
	☐ Promoted protectionist attitudes.
	☐ Reduced standard of living in oil importing countries, reducing travel and purchases of aircraft.
	☐ Stimulated R&D to improve fuel efficiency of commercial transports.
	☐ Accelerated the retirement of inefficient aircraft.
☐ Decline in U.S. Productivity	☐ Prompted recognition of the need to adopt policies to strengthen U.S. industry and particularly the more efficient ones such as the aircraft industry.
☐ U.S. Domestic Policy	☐ Promoted competition through airline deregulation, changing network structure, introducing more uncertainty into size and number of transports for specific markets.
	☐ Provided wider freedom in structure of airline fares.
	☐ Instituted regulations to ensure quieter aircraft, prompting aircraft retirement and increasing the cost of air travel.
☐ U.S. Foreign Policy	☐ Imposed disincentives for U.S. aircraft manufacturers interested in promoting foreign exports.
☐ Infusion of Technology Worldwide	☐ Shifted countries' emphasis to higher technology, knowledge-intensive industries such as civil aircraft.
☐ The Multilateral Trade Negotiations	☐ Provided the framework for fair and equal civil aircraft trade policy.

transport business. At the same time, Congress and the Executive Branch—out of concern that arms transfer has become an automatic, unregulated process—have made strong efforts to limit the export of military goods and applicable technology from the United States.

A more direct impact on U.S. commercial transport exports stems from U.S. foreign policy to counter international terrorism and involves the imposition of controls on shipments of commercial transports to some countries in North Africa and the Middle East. Without judging the merits of the policy, it must be realized that much of the demand in those regions is being satisfied by non-U.S. suppliers, and that these export controls represent a large dollar loss to U.S. aircraft exporters.

The infusion of technology worldwide—As international trade has grown, transnational companies have been infusing technology and production processes in many parts of the world, particularly in the advanced developing countries such as Korea, Hong Kong, Taiwan, Singapore, Brazil and Mexico. As the capabilities of those countries increase, they become competitive in industries once dominated by the now developed countries. This process has created the need for the developed nations to specialize in areas where they can be more efficient; often this means being less labor-intensive and more technologically-intensive. As a direct consequence of the technology infusion process, other countries are now increasing their aircraft industry capabilities. The Japanese government, in particular, is reducing its support for such industries as steel and shipbuilding and increasing support in other areas, such as aircraft manufacturing. Japan has declared, as part of its long-range policy, its intention to grow in the commercial transport business.

The Multilateral Trade Negotiations (Tokyo Round)—By the conclusion of the Tokyo Round of the Multilateral Trade Negotiations (MTN) in 1979, a new framework for world trade had been established. The revised General Agreement on Tariffs and Trade mutually reduced tariffs among the signatories and, more importantly, made clear the conditions under which a non-tariff barrier such as a subsidy should operate. Included in the agreement was a special and separate Agreement on Trade in Civil Aircraft, which embodies the realization that trade policy and implementation among nations must be fair and equal. The Aircraft Agreement is significant because it has the potential of changing the nature of government influence, as it has recently evolved, in the export of commercial transports. The MTN agreements recognize that domestic subsidies, (e.g., government support for manufacturing in designated geographical areas, and interest-free loans and grants) are a proper matter of international concern because they have an impact upon foreign trade. The agreements in themselves, however, do not guarantee success in resolving the difficult and detailed non-tariff issues. It is essential to monitor compliance with the agreements and establish—and effect—a firm U.S. policy in the event of non-compliance.

The U.S. in world affairs—Following World War II, due to the devastation of much of the industrial capacity of the world, the United States was by far the strongest nation by any measure—military, political or economic. Since that time, however, Europe as a community of nations has risen to political and economic—though not military—parity. The Soviet Union, with an economy smaller than that of the United States, may have exceeded the United States militarily. Japan's standard of living has risen sharply and is approaching that of the United States.

While the United States is still the most prosperous nation in the world, it has become increasingly frustrated over events and trends beyond its borders. Many aspects of the daily lives of Americans—economic conditions, availability and cost of goods and services, even domestic policies—are strongly influenced by foreign actions or events over which the nation has little or no control.

The trauma and frustration of the Vietnam war and the departure of Americans from Vietnam in 1975 marked a turning point in U.S. influence in world affairs. Since 1975, the United States has experienced a series of image losses both at home and abroad which, looked at in broad perspective, can only be gauged as a weakening of U.S. posture vis-a-vis other major powers. To list some examples:

- The inability of the United States to control inflation.
- Nearly five years required for U.S. lawmakers to pass energy legislation, which may prove inadequate in the end.
- The Watergate Affair
- The 444 days necessary to retrieve the U.S. hostages from Iran and one spectacularly unsucessful attempt to rescue them.
- The trend of European allies toward neutrality, e.g.:
  - — Limited support by Europeans of U.S. policy on Soviet invasion of Afghanistan.
  - — Limited support of U.S. policy to sanction Iran for the takeover of the U.S. embassy and holding of personnel as hostages.
  - — French and German leaders' independent consultations with leaders of the Soviet Union.
  - — Stronger economic ties to Eastern bloc countries.
  - — Independent European monetary system.
  - — European supply of military and commercial goods to countries deemed off-limits by the United States for political reasons.
- The inability to protect U.S. interests in the Middle East, and provide citizen and investment security in the rest of the world.

All of these events and trends form a background against which to view the important role of exports in the U.S. economy, and the United States' changing world trade position.

World Trade and the U.S. Share

World trade in terms of volume of goods and services, has grown at an annual rate of 6 percent since 1953, and for most

major industrial nations exports and imports are becoming an increasingly larger portion of gross national product (Table 1). For the United States, exports as a percentage of gross national product (GNP) have increased from 4.3 percent in 1970 to 8.2 percent in 1980. For the United States, however, exports are a lesser part of the total economy than for other industrialized nations; this lower ratio of exports to GNP is explained in part by the fact that the U.S. economy is itself larger than any other single national economy. Still, U.S. exports as a percentage of total world trade have declined from 16.1 percent in 1968 to 11.9 percent in 1980 (Table 2). Table 3 shows a similar decline in the U.S. share of world exports of manufactures since 1970. This is due in part to the change in comparative economic advantages among nations but also to the slow awakening of the U.S. government to the need to promote exports. On this point, the Joint Economic Committee of Congress stated that "The U.S. government acts as a naysayer to its own exporters by shackling them with a host of tax burdens, disincentives and restrictions, while the home governments of our world trade competitors act as coaches to their exporting firms."

U.S. technological competitiveness is strong in some areas and weak in others. Europe and Japan are competing with the United States on equal terms in areas such as iron, steel, machine tools, and non-ferrous metals, but lagging in computers and in some electronic components. The economies of Europe and Japan are promoting national industries, particularly those that offer the highest possible return. In the United States, the same kinds of government-support mechanisms do not exist and weaker industries often receive more government support than the stronger industries that could aid the economy through increased exports. As indicated

TABLE 1

RATIOS OF EXPORTS AND IMPORTS TO GNP[a] OF U.S. AND LEADING INDUSTRIAL NATIONS 1970–1980

Year	United States	France	West Germany	Italy	United Kingdom	Japan	Canada
	Ratio of Exports to GNP						
	(Exports, f.a.s.)						
1970	4.3	12.7	18.4	14.2	15.9	9.5	19.6
1971	4.1	13.0	18.0	14.8	16.1	10.4	18.9
1972	4.2	13.4	18.0	15.6	15.6	9.5	19.1
1973	5.4	14.3	19.4	15.7	17.1	8.9	20.6
1974	6.9	17.3	23.4	19.5	20.1	12.0	22.0
1975	6.9	15.4	21.4	18.2	19.2	11.2	20.2
1976	6.6	15.8	22.6	20.0	20.8	12.0	20.1
1977	6.2	16.5	22.7	21.1	23.3	11.7	21.3
1978	6.6	16.0	22.1	21.4	22.7	10.1	23.2
1979	7.4	17.0	22.5	22.2	22.5	10.3	25.2
1980	8.2	17.8	23.4	19.8[b]	22.3	12.5	26.4
	Ratio of Imports to GNP						
							(Imports, f.o.b.)
1970	4.3	13.6	16.1	16.1	17.8	9.2	16.3
1971	4.6	13.5	15.9	15.6	17.3	8.5	16.5
1972	5.1	13.8	15.6	16.2	17.8	7.8	17.7
1973	5.6	14.9	15.8	19.8	21.7	9.2	18.9
1974	7.6	20.0	18.2	26.3	28.1	13.4	21.5
1975	6.4	15.9	17.8	20.1	23.2	11.6	21.0
1976	7.2	18.3	19.6	23.3	25.1	11.6	19.6
1977	7.8	18.3	19.5	22.4	25.8	10.4	20.3
1978	8.1	17.2	18.9	21.5	24.9	8.3	21.8
1979	8.7	18.7	20.9	23.9	25.5	11.1	24.1
1980	9.3	21.1	22.8	25.3[b]	23.2	13.6	23.9

SOURCE: Department of Commerce, International Trade Administration, *International Economic Indicators.* Figures for 1975–1979 revised as of September 1981.

a Exports are f.o.b. and imports are c.i.f. except as noted
b Preliminary

TABLE 2

WORLD EXPORTS AND U.S. EXPORTS AND U.S. EXPORTS AS PERCENTAGE OF TOTAL 1968–1980 (Billions of Dollars)

Year	World	U.S.	U.S. Exports as Percentage of World Exports
1968	215.2	34.6	16.1
1969	246.4	38.0	15.4
1970	283.5	43.2	15.2
1971	317.0	44.1	13.9
1972	37).1	49.8	13.2
1973	523.7	71.3	13.6
1974	772.0	98.5	12.8
1975	795.8	107.6	13.5
1976	906.5	115.0	12.7
1977	1,023.7	120.2	11.7
1978	1,193.8	143.6	12.1
1979	1,508.0	181.8	12.0
1980	1,846.0	220.7	11.9

SOURCE: International Monetary Fund, August 1981

earlier, labor productivity has increased much more slowly in the United States than in Western Europe or Japan. To some extent, the relatively poor rate of productivity increase in the United States can be traced to a relatively low rate of investment in plant and equipment and to restrictive tax laws; but low productivity can also be traced to the lack of emphasis on more efficient industries.

In recent years, there has been a tendency for many American industries to devote a smaller share of their research and development (R&D) expenditures to basic research, long-term projects, and technically ambitious R&D projects. According to data compiled by the National Science Foundation (NSF), U.S. R&D spending shrank from 3 percent of GNP in 1964 to 2.2 percent in 1978, while in most other industrial nations—with the exception of the United Kingdom—R&D spending as percent of GNP rose.[2] Recent NSF data indicated the R&D/GNP ratio has increased slightly each year since 1978 and should reach 2.4 percent in 1982. However, there is considerable evidence that, from an economic point of view, the United States has been underinvesting in technology. Many firms protest that some environmental, health, and safety regulations unnecessarily deter innovation. In many cases, companies have had to apply part of their R&D expenditures to satisfying these requirements. A reversal of the negative trend in R&D spending is essential to the United States' international competitive position, and the recommendations contained in a 1980 AIA study on research and development in the United States deserve thoughtful, but expedient action.[3]

[2] *Science Resources Studies Highlights*, National Science Foundation, NSF 81-314, Washington, D.C., June 30, 1981.

[3] Aerospace Industries Association, *Research and Development: A Foundation for Innovation and Economic Growth*, (Washington, D.C., 1980).

TABLE 3

SHARES OF WORLD EXPORTS OF MANUFACTURES[a,b] OF U.S. AND LEADING INDUSTRIAL NATIONS 1970–Second Quarter 1980

Year	United States	France	West Germany	Italy	Netherlands	United Kingdom	Japan	Canada
1970	21.3	9.1	19.8	7.1	4.6	10.4	8.9	1.8
1971	19.7	9.3	20.2	7.3	4.9	10.9	9.9	1.4
1972	18.4	9.8	20.6	7.6	5.0	9.8	10.2	1.3
1973	18.0	9.8	21.8	6.8	5.3	9.0	10.4	1.1
1974	18.8	9.2	21.5	6.8	5.4	8.4	11.9	1.1
1975	19.2	10.2	20.1	7.3	5.1	8.9	11.4	1.1
1976	18.8	9.8	20.8	7.2	5.2	8.5	12.0	1.1
1977	17.3	9.9	20.9	7.7	4.9	9.2	12.6	1.0
1978	17.0	9.9	20.7	7.9	4.8	9.4	12.5	1.0
1979	17.4	10.7	20.8	8.3	4.9	9.5	10.8	1.0
1980(II)[c]	18.4	10.3	20.1	8.1	4.7	9.7	11.8	1.2

SOURCE: U.S. Department of Commerce, International Trade Administration, *International Economic Indicators* (various issues), as reported in "Study of U.S. Competitiveness," July 1980, Trade Policy Staff Committee, U.S. Department of Commerce.

a "World" is defined as the 14 major industrial countries
b Excluding exports to the United States
c Second quarter, 1980

While the export performance of U.S. industry in general has been less than outstanding, the commercial aircraft sector has made a strong contribution to trade balance. Since 1970, civil jet transport deliveries and sales of spare parts have resulted in a net surplus of exports over imports. By 1979, the industry was producing the largest trade surplus of any American manufacturing industry. In that year, and again in 1980, an aerospace firm was the nation's largest single exporter; in fact, five of the top exporting companies were aerospace firms. Over $7 billion in net exports were attributed to the commercial jet transport industry in 1979 and, in 1980, the net surplus was more than $9 billion. The benefits to the economy of the industry's positive export balance are widespread as, with each new program undertaken, individual airframe and engine manufacturers subcontract large portions of the end products to an extensive supplier network.

World Economic Outlook

The nations of the world are currently experiencing a reduction of economic growth rate. While recovery is expected for the industrialized nations in the next two years, the situation for less developed countries (LDCs) will likely worsen primarily because of their inability to service their increasing debt as a result of high inflation and large oil bills. In an effort to counter inflation, industrialized nations are pursuing more stringent monetary and fiscal policies. This would indicate a continuation of economic stagnation in the near term but, in the longer run, should improve the situation.

While improvements in the world economy should come about in the long term, it is nonetheless expected that world real GNP growth will be something less than has been experienced historically. The United States and Europe

FIGURE 2

REAL GROSS NATIONAL PRODUCT AND GNP ANNUAL GROWTH RATE FOR THE UNITED STATES, EUROPE, AND THE REST OF THE WORLD 1977–1990

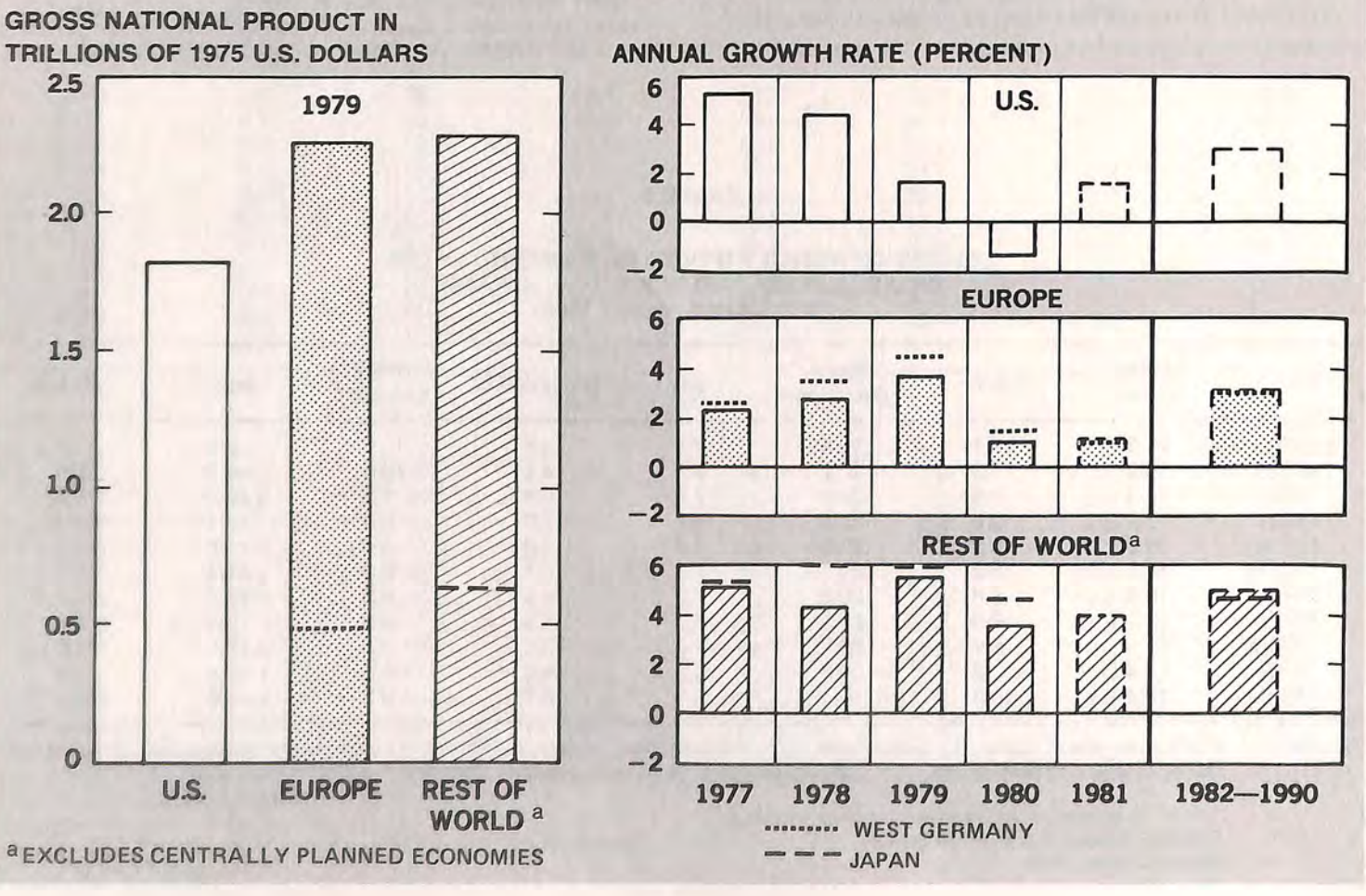
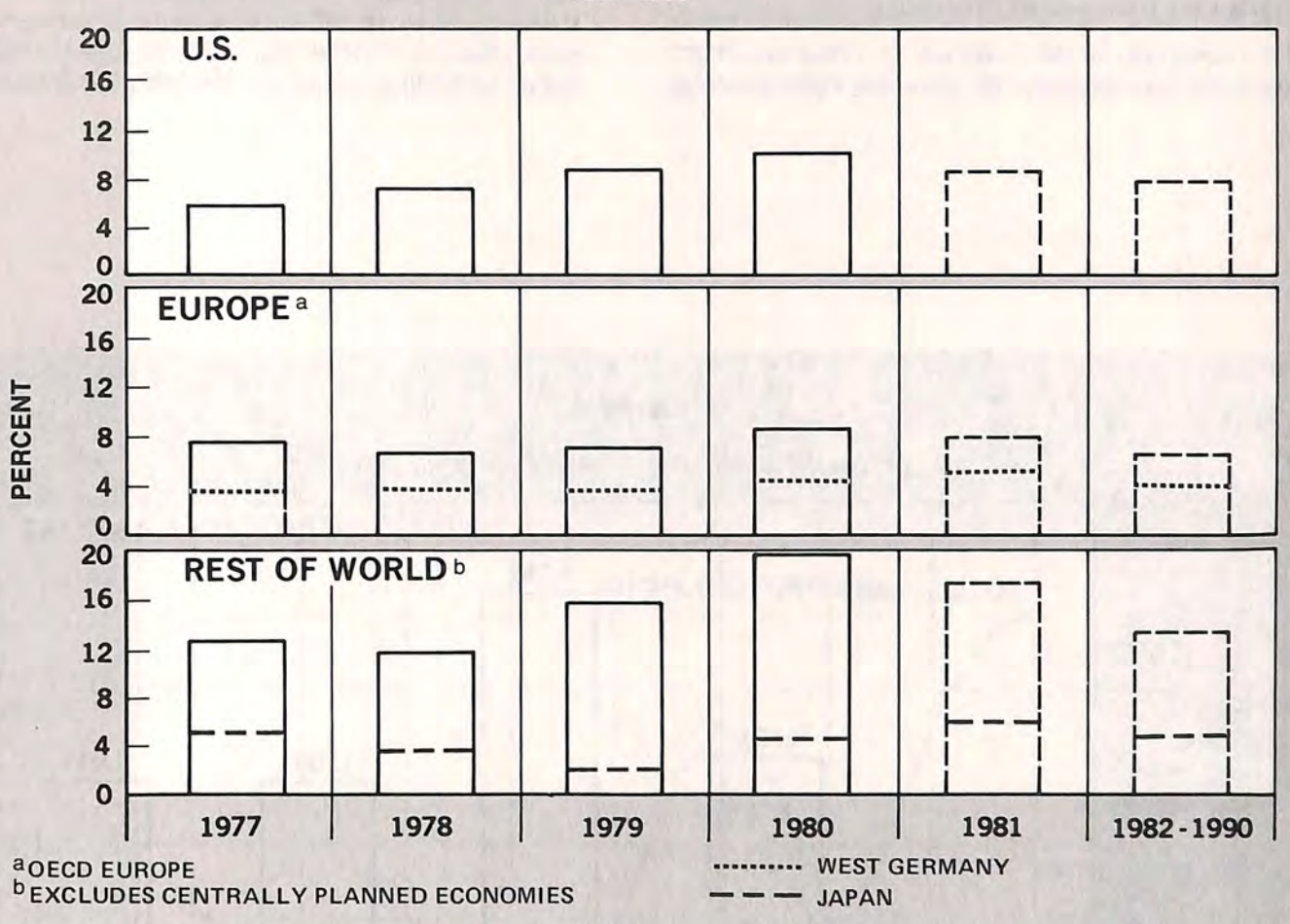


FIGURE 3

GROSS NATIONAL PRODUCT INFLATION
FOR THE UNITED STATES, EUROPE, AND THE REST OF THE WORLD
1977–1990



should average around 3 percent growth while the rest of the world may average closer to 5 percent (Figure 2). Modest improvement in inflation is expected worldwide but inflation is still likely to range around 7 percent annually in the industrial countries. Notable exceptions are Germany and Japan, where inflation should be in the range of 4 to 5 percent (Figure 3).

Fundamental to a long-term forecast for the world economy are the following assumptions:

- There will be periods of economic downturn in the next 10 years.
- The OPEC cartel will endure and surplus receipts from oil revenues will continue to be placed in financial assets or precious metals, causing strains on financial institutions. OPEC recycling of petro dollars in the form of purchased goods and services, however, will continue to slacken.
- The debt servicing capabilities of LDCs will continue to weaken, and further strain financial institutions.
- Average growth of oil prices will range about 3 percentage points above the rate of U.S. inflation. Implicit is the assumption that there will be fluctuations in price growth rates but no major oil supply disruptions as serious as those experienced in 1973 and 1979. This assumption is one of the most critical to aircraft manufacturing planners yet, because of the highly political nature of oil price-setting, it is one of the most tenuous assumptions.
- The energy picture will improve in the latter part of the decade, through energy conservation and new technology developments.
- U.S. productivity will improve as a result of favorable incentives to business, incentives for personal savings, and prudent government spending.

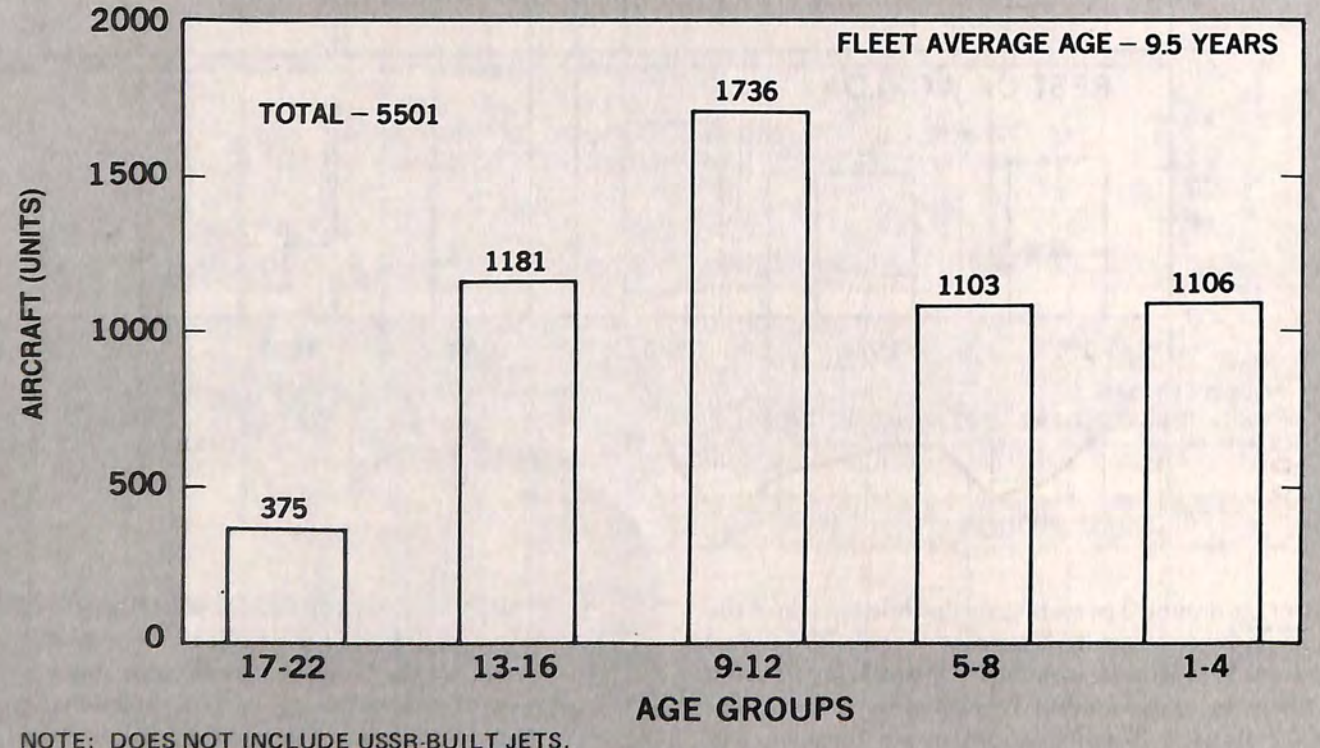
- In Europe, economic growth will be constrained by high wages and less opportunity for outside investment.
- Japan will continue to achieve a high rate of growth through its remarkable cooperation between government, labor and business.

The Market for Commercial Transports

Today, the airlines of the world are operating over 5,500 commercial jet transports and the world fleet has an average age of over 9 years (Figure 4). Over 1,700 transports are between 9 and 12 years old, and over 6 percent of the total fleet are between 17 and 20 years of age. The variety of aircraft in production is impressive, ranging from the 90-seat, 1000-nautical-mile BAC-111 to the Boeing B-747-200 capable of carrying over 400 passengers for up to 4,600 miles. However, many aircraft in service today are no longer in production (e.g., DC-8, Caravelle, Concorde). Just under half of the 5,500 airplanes now in service are obsolete by the

FIGURE 4

AGE DISTRIBUTION OF THE WORLD AIRLINES' JET FLEET



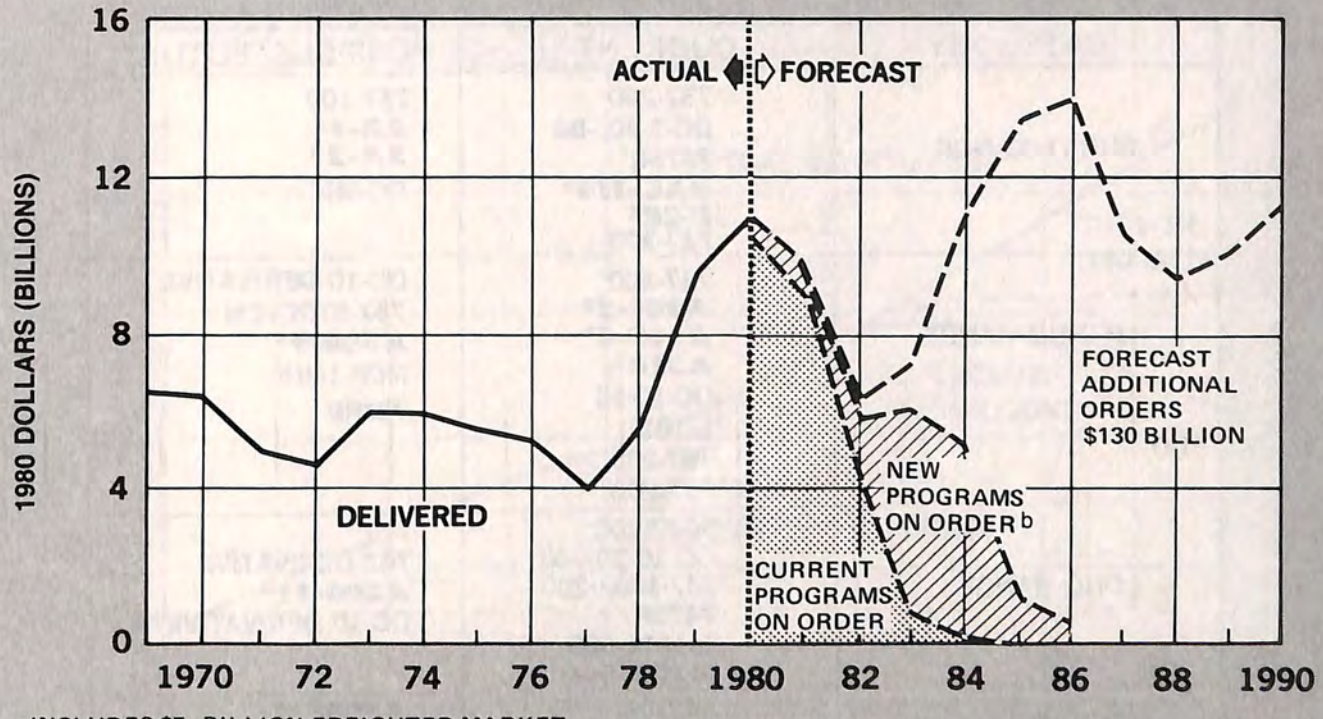
NOTE: DOES NOT INCLUDE USSR-BUILT JETS.
JET AIRCRAFT INVENTORY AS OF DECEMBER 31, 1979

operating standards of the 1980s. Noise constraints, fuel prices and fuel availability, and technological advancements will soon take their toll of today's airline capital equipment inventory.

Each major participant in the aircraft industry periodically assesses the market for both its current and potential products. Although each manufacturer's assessment of the market varies somewhat, the value of the aircraft to be delivered during the 1980s, in 1980 dollars, is expected to be between $110 and $140 billion (Figure 5). This forecast is based primarily on the foregoing economic assumptions. In constant dollars, that represents almost two-thirds of the value of all commercial aircraft sold over the last 30 years. Although the decade is just underway, approximately one-fifth of the airplanes to be delivered in the next 10 years have been ordered; some are just beginning to roll off production lines, reflecting years of design, development, testing, and initial

FIGURE 5

FORECAST OF 1980s COMMERCIAL JET AIRLINER MARKET [a]
ICAO COUNTRIES EXCLUDING USSR AND PEOPLE'S REPUBLIC OF CHINA



[a] INCLUDES $5-BILLION FREIGHTER MARKET

[b] DC-9 SUPER 80, 757, 767, A310

production tooling and material commitments. For the aircraft industry, competition is—and will continue to be—the intense pursuit of a finite number of replacement and growth-related sales opportunities. Again, while the manufacturer's assessments do vary, Figure 6 illustrates current and projected areas of strong jet transport foreign competition.

The jet transport capacity purchased in this decade will first replace existing available seat/ton miles as aircraft become obsolete and, second, will provide for traffic demand growth into the 1990s (Figure 7). Figure 8 shows that, from a demand for 750 billion revenue passenger miles (RPMs) in 1980, growth at only 5.6 to 7.5 percent will yield a market of between 1.1 and 1.4 trillion RPMs in 1990. This expected growth is approximately two-thirds as vigorous as in the decade of the seventies. Air freight demand, estimated at 22 billion revenue ton miles (RTMs) in 1980, could grow to 50 billion RTMs in 1990 (Figure 9).

FIGURE 6

CURRENT AND PROJECTED AREAS OF
STRONG JET TRANSPORT MARKET COMPETITION

CATEGORY	CURRENT	POSSIBLE FUTURE
SHORT-RANGE	737-200 DC-9-30, -80 747SR ***BAC-111***[a] ***F-28***[a] 737-300	757-100 ***SA-1***[a] ***SA-2***[a] DC-9RE
MEDIUM-RANGE	727-200 ***A300-2***[a] ***A300-4***[a] ***A310***[a] DC-10-10 L-1011 767-200 757-200	DC-10 DERIVATIVE 767 STRETCH ***A300-9***[a] MDF-100[b] 727RE
LONG-RANGE	707-320C DC-10-30/-40 747-100/-200 747SP L-1011-500 ***A300–600***	777 747 DERIVATIVE ***A300-11***[a] DC-10 DERIVATIVE
FREIGHTER	747F/C DC-10F/C	***A300F/C***[a] 757F 767F

[a] ***FOREIGN COMPETITION***

b Joint McDonnell Douglas-Fokker study

Foreign Competition in Commercial Transport Production

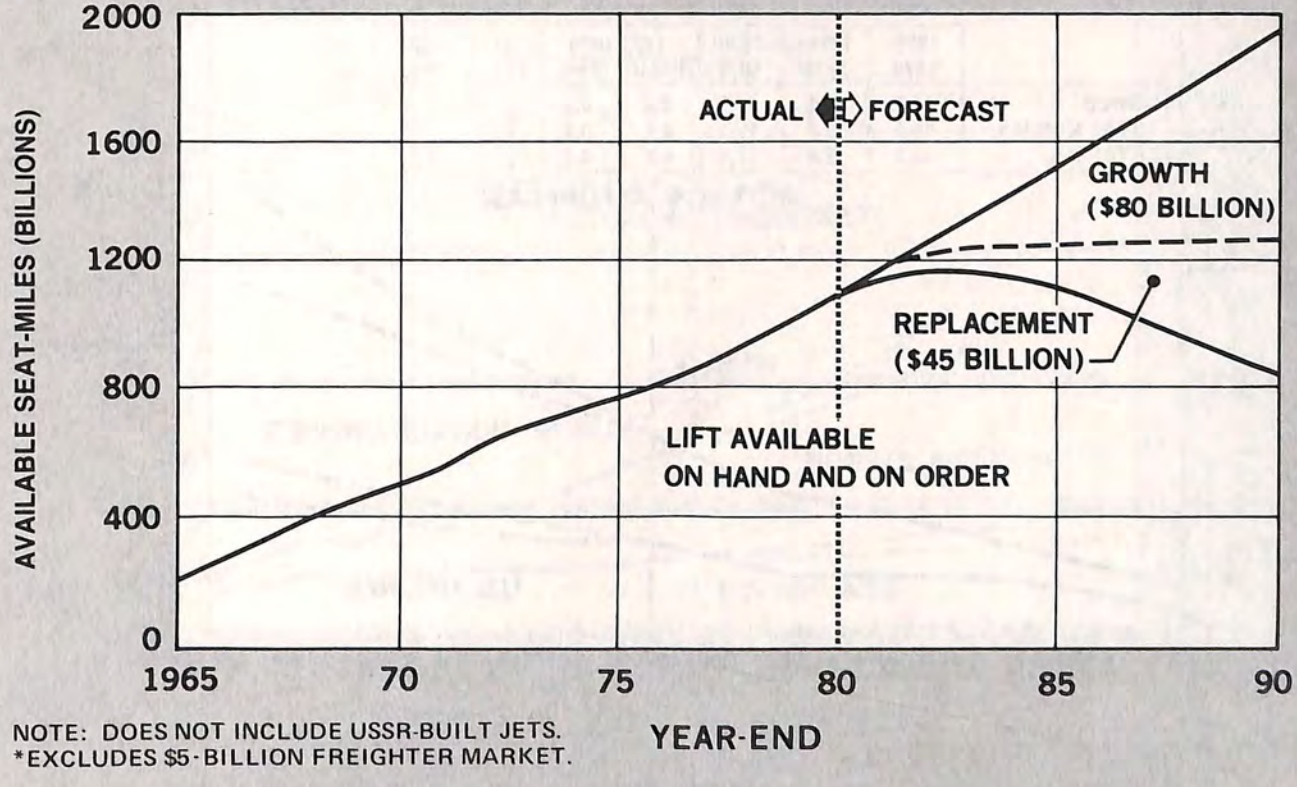
U.S. aircraft and engine manufacturers have dominated the world markets since the introduction of the jet transport, although the first jet transport was made in Europe. During the 15 years before 1979, U.S. aircraft makers captured nearly 90 percent of the market annually. With the emerging success of the European Airbus program, this sort of continued domination is unlikely. For example, in 1979, Airbus received more than 30 percent of wide-body orders placed during the year, a share equal to the combined orders of Lockheed and McDonnell Douglas. See Figure 10 for a summary of trends in the free world commercial jet airliner market.

There are a number of compelling reasons to anticipate the continued growth of non-U.S. jet transport manufacturing and marketing.

First, the market for jet transports is large and is growing rapidly even when inflation is taken into consideration. The

FIGURE 7

WORLD MARKET REQUIREMENTS FOR AIRCRAFT REPLACEMENT AND TRAFFIC GROWTH[a] 1980–1990



NOTE: DOES NOT INCLUDE USSR-BUILT JETS.
*EXCLUDES $5-BILLION FREIGHTER MARKET.

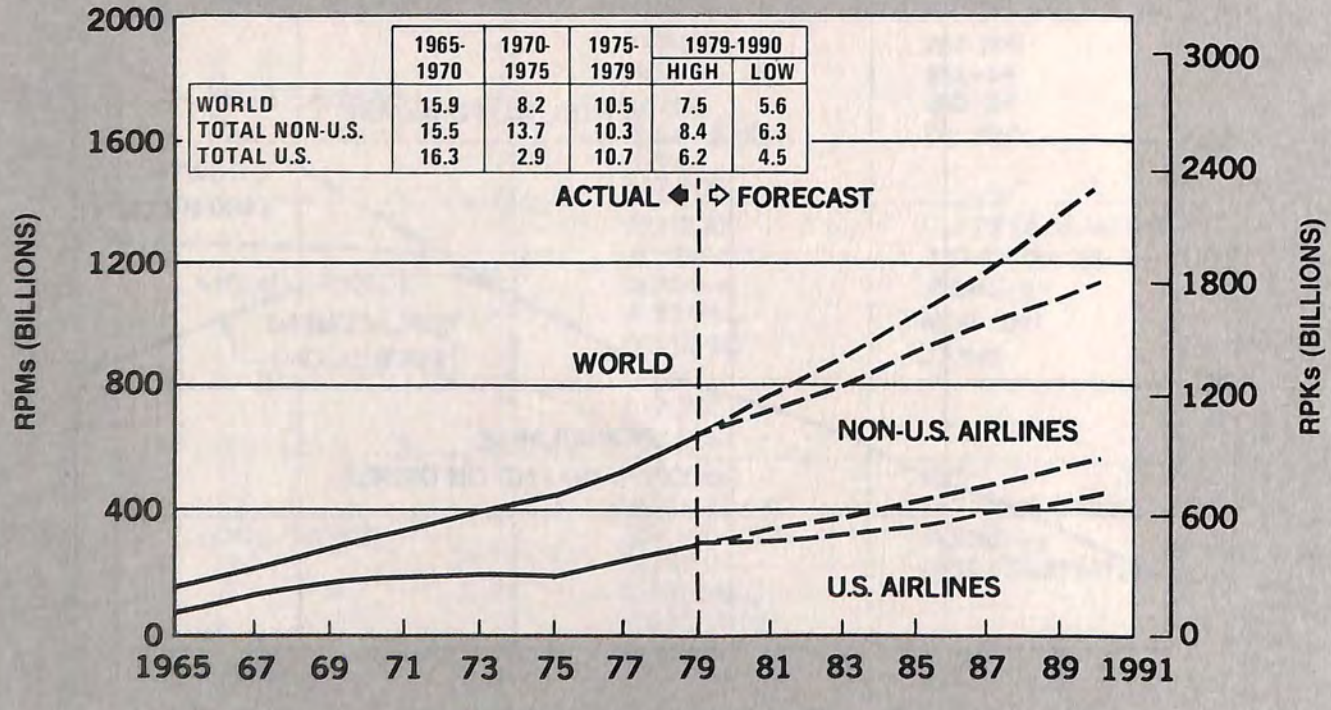
market can be expected to expand in the foreseeable future because there is no strategic competition on the horizon for jet transportation when it comes to moving people and material long distances over varied terrain and climate.

Second, from a technological standpoint, commercial transports are a natural area for expansion for the highly-developed nations. Commercial transport technology is complementary to military aircraft technology and military aircraft capability is already a requirement for many of the developed nations. Then, too, aircraft technology is readily accessible. Since 1940, technological advancements have been freely shared among the academic community and, more recently, between nations and private corporate interests. As indicated earlier, there is a trend as well for the developed nations to move into industries of higher technology as their traditional industries can no longer compete with those of emerging nations.

Third, a commercial transport industry is an excellent

FIGURE 8

WORLD REVENUE PASSENGER-MILES
FOR U.S. AND NON-U.S. AIRLINES
1965–1990



NOTE: EXCLUDES USSR, PEOPLE'S REPUBLIC OF CHINA, AND NON-ICAO NATIONS, BUT INCLUDES TAIWAN AND ALL-CHARTER CARRIERS

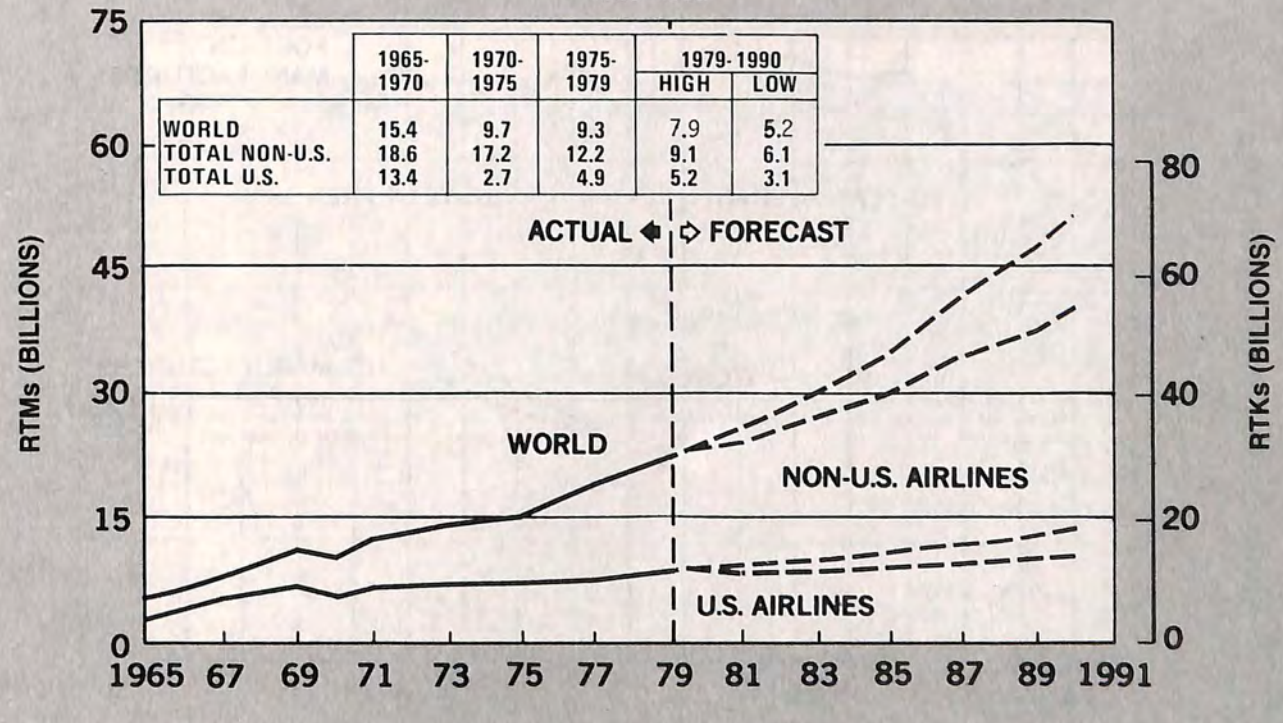
means of earning needed foreign exchange. All of the world's industrial nations have suffered merchandise trade deficits in recent years due to a burdensome dependence on imported oil, food supplies and non-fuel minerals. Increasingly, national priorities have become conscious reflections of the need to earn export credits to pay for these economic fundamentals.

Fourth, the largest growth in travel demand is outside the United States (Figures 11a and 11b) and it will become more difficult for U.S. manufacturers to remain dominant in these markets. The United States is the world's largest single market for jet travel and air shipping, as defined by geographical boundaries. Since the early 1970s, however, growth in demand for these services has been greater in other world markets; new carriers have emerged there and new air routes and fare structures have opened. Moreover, national presence in world capitals has become more prestigious and trade has become increasingly significant to the

FIGURE 9

WORLD REVENUE FREIGHT TON-MILES
FOR U.S. AND NON-U.S. AIRLINES
1965–1990

	1965-1970	1970-1975	1975-1979	1979-1990 HIGH	1979-1990 LOW
WORLD	15.4	9.7	9.3	7.9	5.2
TOTAL NON-U.S.	18.6	17.2	12.2	9.1	6.1
TOTAL U.S.	13.4	2.7	4.9	5.2	3.1



NOTE: EXCLUDES USSR, PEOPLE'S REPUBLIC OF CHINA, AND NON-ICAO NATIONS, BUT INCLUDES TAIWAN AND ALL-CHARTER CARRIERS

preservation of a strong national economy. Every reputable forecasting authority, both within and outside the aircraft industry, expects this trend to continue during the next decade. By the end of the decade, non-U.S. air travel will represent two-thirds of the world's travel market. It is only logical to expect that nations with strong international trade expertise will want to increase their share of that market.

Finally, an immeasurable but real bonus attached to the building of commercial transports is the benefit of prestige, of showing the flag, or gaining international preeminence. The supersonic Concorde, while economically a less-than-desirable product, has still afforded benefits to both France and the United Kingdom. The massive national subsidization of the Concorde program is sufficient witness to the real or imagined benefits derived by those nations. A successful commercial transport program, with commercial transports operating throughout the world, offers a significant measure of prestige and influence to any nation.

FIGURE 10

FREE WORLD COMMERCIAL JET AIRLINERS
COMPETITIVE MARKET PENETRATION SUMMARY
1960–1979
(Booked-Dollar Basis)

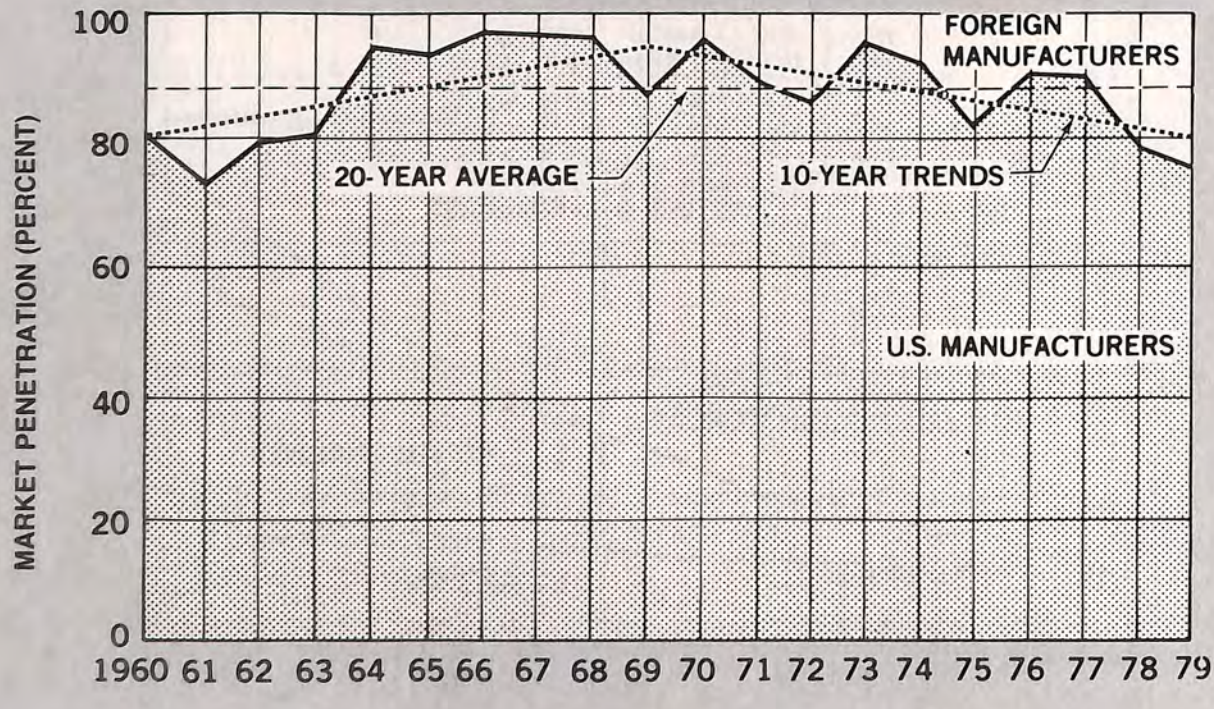
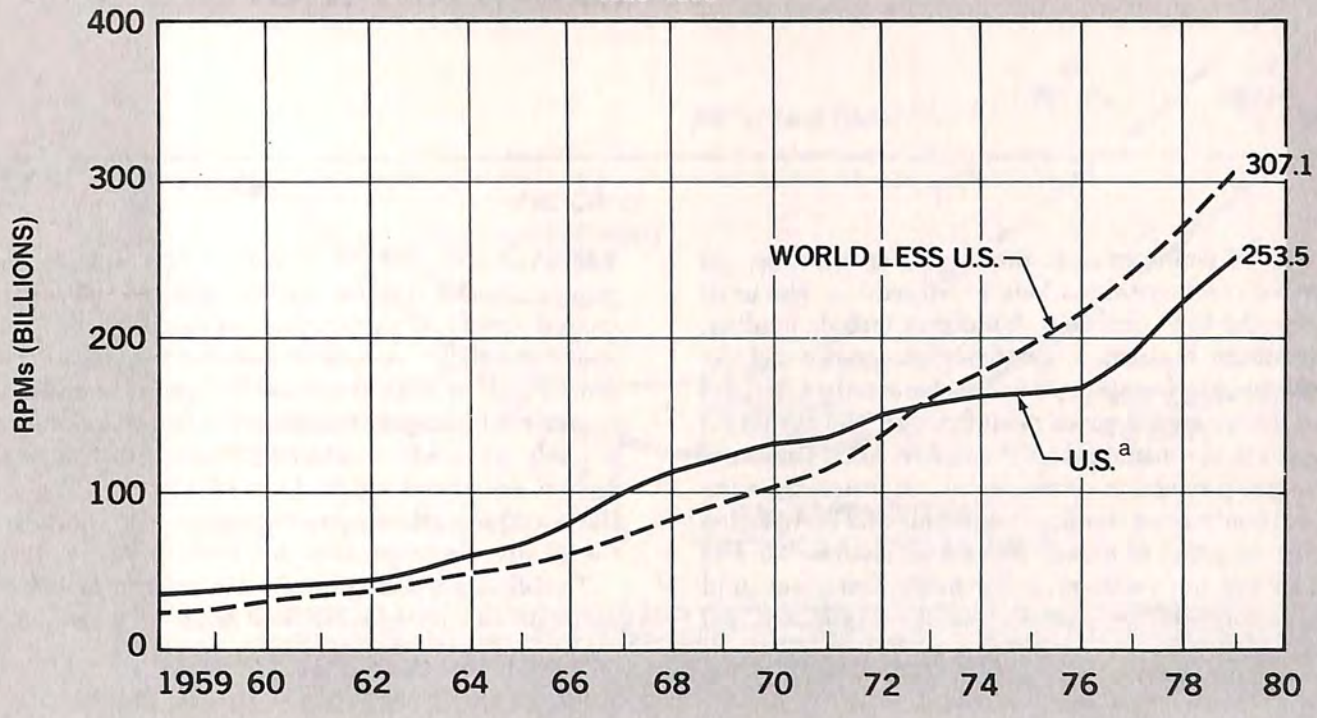


FIGURE 11a

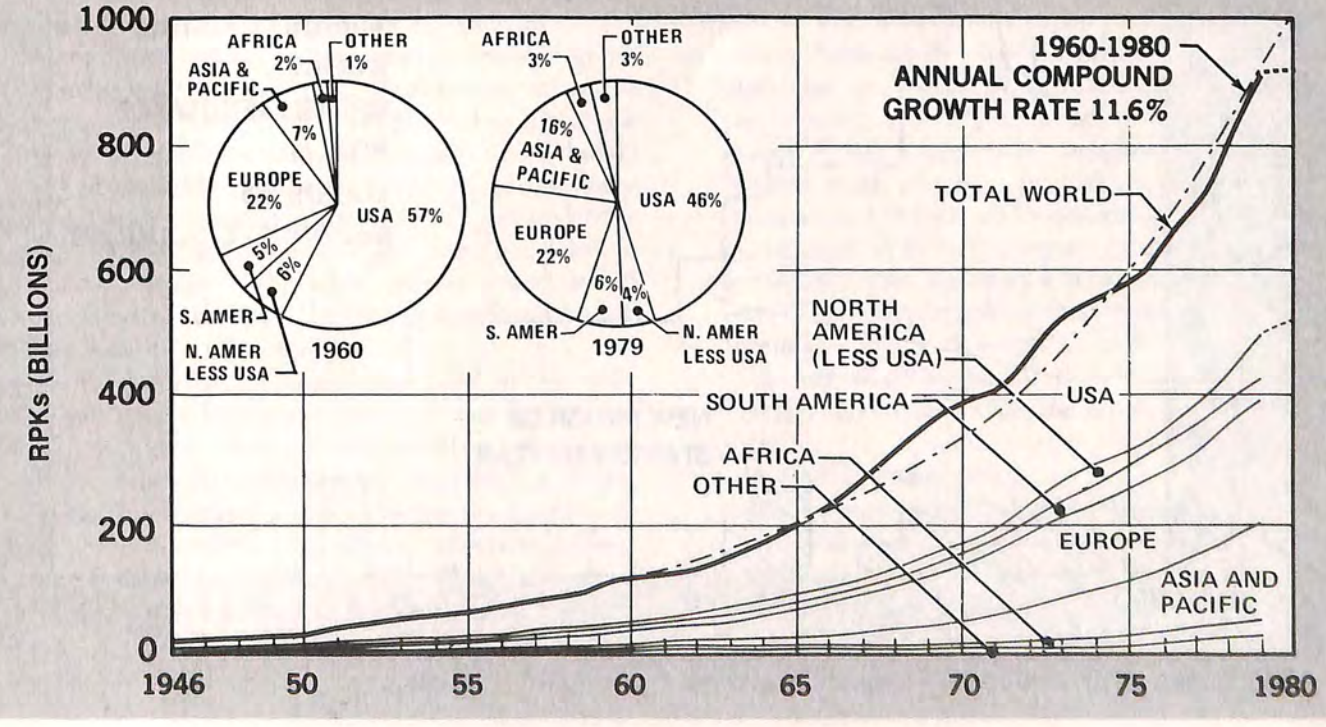
SCHEDULED U.S. AND NON-U.S.
REVENUE PASSENGER-MILE TRAFFIC GROWTH
1958–1980



[a] INCLUDES DOMESTIC TRUNK, INTERNATIONAL TRUNK, AND LOCAL SERVICE AIRLINES

FIGURE 11b

AVERAGE ANNUAL GROWTH IN SCHEDULED PASSENGER KILOMETERS
FOR WORLD AIRLINES BY REGION
1946–1980



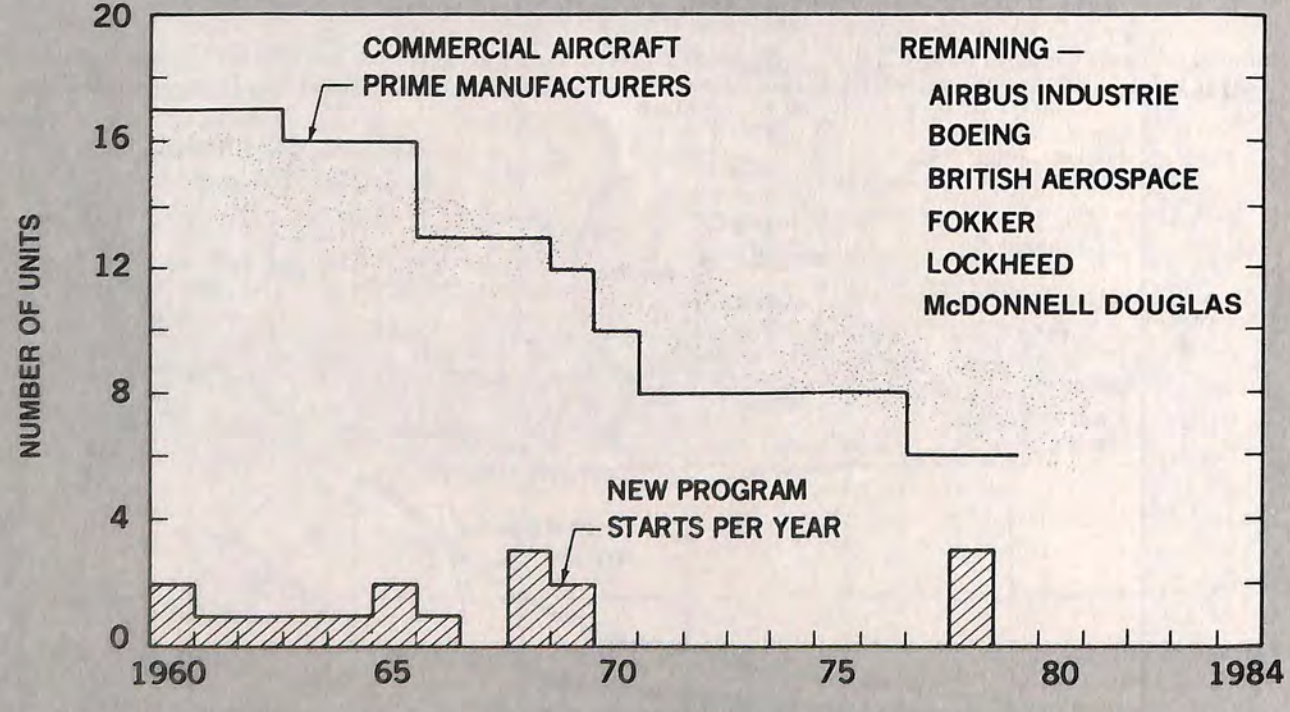
THE RISKS INVOLVED IN CIVIL AIRCRAFT PRODUCTION AND MARKETING

The risks of committing to production of a modern jet transport for commercial markets are increasing. The usual risks facing the U.S. civil aircraft industry include funding, future earnings, reputation, customer acceptance and design obsolescence, but these risks are characteristic of those accepted by any capital goods manufacturer. The significant difference is in the magnitude of the undertaking. Billions of dollars in pre-production commitments are common in the design, subcontracting, tooling, marketing and certification stages of production of today's jet aircraft models. Most of these costs are not recoverable for many years, not until hundreds of units of the product have been produced and sold. And few civil jet transports have sold in sufficient numbers in the dynamic markets of the last 25 years to have earned a profit for their makers or for the governments that sponsored them. A look at industry participation is itself illustrative. In 1960, there were 17 prime manufacturers of commercial transport aircraft in the free world; today, there are only six—Airbus Industrie, Boeing, British Aerospace, Fokker, Lockheed and McDonnell Douglas (Figure 12). In the last 20 years there were fewer new program starts than in the 10 years between 1950 and 1960.

The billions of dollars involved in program launch costs are only part of the risks assumed by aircraft manufacturers.

FIGURE 12

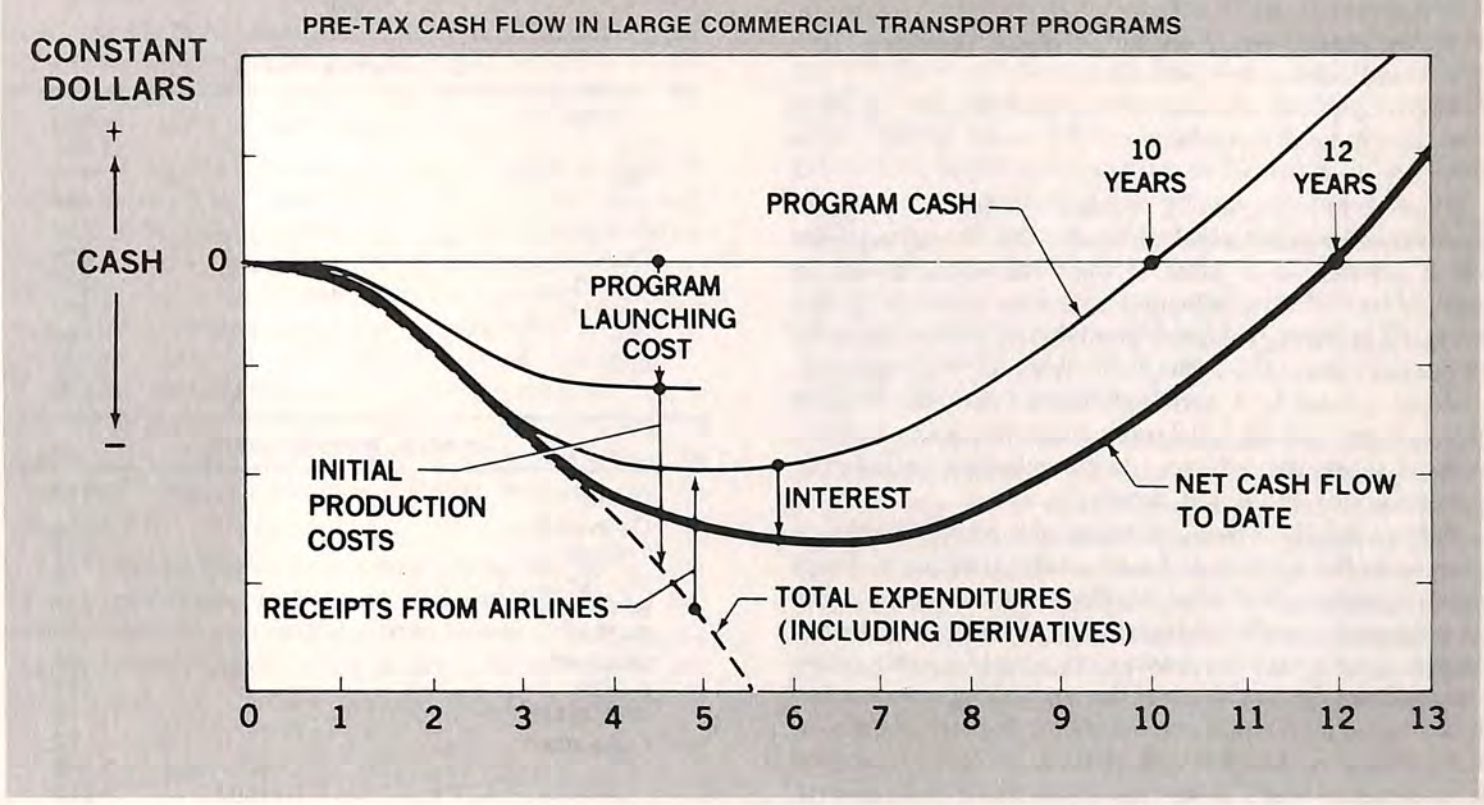
COMPETITION IN THE FREE WORLD COMMERCIAL TRANSPORT INDUSTRY[a]
1960–1980



[a]EXCLUDES DERIVATIVE AIRLINERS, COMMUTER AND EXECUTIVE AIRCRAFT

FIGURE 13

PRE-TAX CASH FLOW IN LARGE COMMERCIAL TRANSPORT PROGRAMS



Getting aircraft into the market-place as quickly as possible to achieve competitive advantage and initial cost recovery requires the commitment of large sums of capital to meet high initial rates of production. Equity capital is rarely available in sufficient amounts and large debt burdens are therefore assumed. Debt service costs mount quickly, heightening the cash flow crisis if initial sales are slow. Since the typical, competitive pricing scheme amortizes development costs over many units of production, the airframe and engine manufacturers and hundreds of suppliers become committed to an aircraft's success many years before breakeven—and profitability—are achievable. Moreover, since the introduction of jet transports in the late sixties, derivative versions of each aircraft model have been necessary to maintain a sales pace. With each derivative comes added development costs, extending the cash flow deficit over still more years and units of production.

One of the keys to continued presence in the marketplace—given a market for an aircraft model and its derivatives— is productivity. Each aircraft produced provides a learning experience for management, suppliers, and employees. This "learning curve" phenomenon results in a cash flow drain per unit until the out-of-pocket cost to produce is equal to, or less than, the selling price. With the positive cash flow which follows, eventually—with sufficient unit sales—breakeven and profitability can be achieved. Given the extreme competitiveness of the commercial transport business, it is not unusual to have to deliver 400 units of the initial model before breakeven is achieved. Each derivative thereof requires a further increase in unit sales to achieve breakeven.

The magnitude of the initial investment, which must be maintained over long periods and through economic cycles, varies widely and depends upon an array of factors. Principal among these are the size of the aircraft, initial sales acceptance and production rates, timing and extent of product improvements, inflation, individual program productivity, extent of risk assumed by suppliers, debt versus equity funding used, purchase payment provisions, and delivery uncertainties. Figure 13 shows how long term a venture the initiation of an aircraft program can be. Since jet transport technology was introduced into commercial service, the ratio of program launching costs-to-equity for the manufacturers has always exceeded 1.3 to 1.0.

Factors which create uncertainty in new aircraft introduction and significantly affect the return on initial commitment include:

- World market size
- Geographical distribution of the market
- Number of the product offered in the segment of the market for which the model is designed
- Competitive pricing
- Post-certification engineering costs (i.e., inservice problem solving)

- Performance of the product to a wide variety of customer requirements
- Continued new customer acceptance
- Follow-on sales
- Cost control under cyclical economic conditions
- World economic environment
- Timing of introduction of new models and derivatives
- Government involvement

Through 1980, a total of 20 commercial jet transport programs have been launched and over 7,000 aircraft manufactured and delivered (Table 4). Only ten of the 20 aircraft models are still in production and only a few are widely accepted as having achieved profitability. The common denominators among the successful ventures were (a) large-scale acceptance by a worldwide market early in the life of the program, and (b) initial production efficiencies, coupled with (c) substantial advances in computer-controlled manufacturing during the last decade.

Billions of dollars, then, are required to launch an airplane program in the eighties, and many years of continued design improvement or derivative development must pass before development costs are recovered. Why does it take so long to recover these costs? The reasons are many but, in summary, they include: the magnitude of the initial design investment, heavy initial production commitments, the size of the market and time-related demands of the airlines, technological advancements which create opportunities for derivative aircraft models, costs related to operating improvements, pricing imperatives, inflation, and unpredictable economic cycles. Manufacturers must be continually attuned to the air carrier industry which is struggling to produce a contemporary return on investment that will in turn generate sufficient capital to replace obsolete aircraft and to fund growth. If production volumes are too small, due in part to an excessive number of models being offered, this will not be possible.

The principal benefactors of aircraft programs continue to be the traveling and shipping public; the employees of the manufacturers, the airlines, and supplier industries; and the national economy. Aircraft industry profitability is less than the average profit for all U.S. corporations.

TABLE 4

COMMERCIAL JET AIRPLANE DELIVERIES THROUGH 1980

U.S. Manufacturers		
707/720		939
727		1,692
737		715
747		487
DC–8[a]		556
DC–9		955
DC–10		339
L–1011		195
880[a]		65
990[a]		37
	Sub-Total	5,980
Non-U.S. Manufacturers		
Comet[a]		112
Caravelle[a]		279
Trident[a]		117
VC–10[a]		54
BAC–111		227
F–28		158
Mercure[a]		10
A–300		121
VFW–614[a]		10
Concorde[a,b]		12
	Sub-Total	1,100
	Total	7,080

a No longer in production
b 15 Aircraft were produced but only 9 were delivered

Financing Aircraft Production and Marketing

Historically, over 80 percent of the world's commercial jet aircraft have been manufactured in the United States and marketed in an essentially free enterprise manner. While it is true that the number of competitors in the market has declined, it is also true that for many of the rising competitors some of the fundamental uncertainty of the enterprise has been reduced by government support.

The U.S. free enterprise system is financed in large measure by the flow of private capital to commercial ventures which have the potential to protect and multiply that capital. The alternatives to be weighed in determining the amount of capital which flows into a particular venture have increased in recent years. In addition, the factors of the marketplace have been distorted by inflation. Not only has the amount of risk capital required to launch an aircraft program become larger, but the cost rate of that investment has increased as well. Since a substantial portion of recent aircraft programs has been based on debt capital, as the debt burden grows larger the size of each program—in terms of units of production required to cover these costs—must be greater or unit cost could become prohibitive. The risks become increasingly greater as well.

In Europe, Airbus Industrie, Fokker and British Aerospace receive support in facing these risks from their respective national treasuries. This assistance is in response to European Economic Community policies of economic cooperation and regional security, as well as in accordance with national priorities (e.g. trade balance and employment), and a spirit of pride and independence.

Because of the fundamental differences between the U.S. economic system and the economic systems of its competitors, the means available to minimize the risks of an aircraft program undertaking are significantly different.

Capital Risks

The fears and fortunes of commercial aviation operators spring from the cyclical nature of individual national economies and the world economy. Because airlines have a propensity to commit their future earnings to equipment purchases at times when earnings are rising, there is a consequent effect on airframe manufacturers.

The relationship between earnings and orders for the U.S. airline industry is illustrated in Figure 14, and the high correlation between reported earnings and orders for future aircraft deliveries is evident. This demonstrates why it is so important that aircraft manufacturers introduce the right aircraft (range, capacity, technology, and performance) at the right time (business cycle, market demand, operating environment, fleet age, and so on). Timing is one of the largest risks facing manufacturers and requires early commitment of capital and a substantial cash flow to meet the demands of the uncertain business cycle over different programs and demand levels.

The constant dollar debt compiled by the three U.S. airframe manufacturers between 1965 and 1979 (Figure 15a) will illustrate the substantial debt financing undertaken in a typical aircraft manufacturing program. Some industry history further clarifies the capital risk involved. In 1965, four U.S. firms were developing and manufacturing commercial jet transports. In the years following, Convair (General Dynamics) dropped out of the market after substantial losses; Douglas Aircraft found it necessary to merge with McDonnell Aircraft after running into financial difficulty; Lockheed required a government guaranteed loan; and Boeing, at one point, carried over a billion dollars in debt. Today, in fact, Boeing's commitment to both the B-757 and B-767 programs represents multibillions of dollars in private equity and debt capital. Despite the size of the financial commitments to aircraft programs, profitability is far from assured. As we have seen, few aircraft programs to date could be said to have been profitable. Only time will tell how many of the other nine aircraft currently in production will reward their manufacturers for their investment.

While the U.S. industry was in difficulty during the early seventies, production was cut back and thousands of U.S. workers were laid off to hold down costs and reduce future risks. The employment levels of the 1966–68 period, in fact, have not been repeated in the U.S. aircraft industry. But a look at Europe's experience with the Concorde program will point up an important difference in the risk environment for private versus nationalized manufacturing enterprises.

FIGURE 14

AIRLINE NET EARNINGS VERSUS ORDERS
FOR NEW TRUNK CARRIER AIRCRAFT
1958–1980
(Millions of Current Dollars)

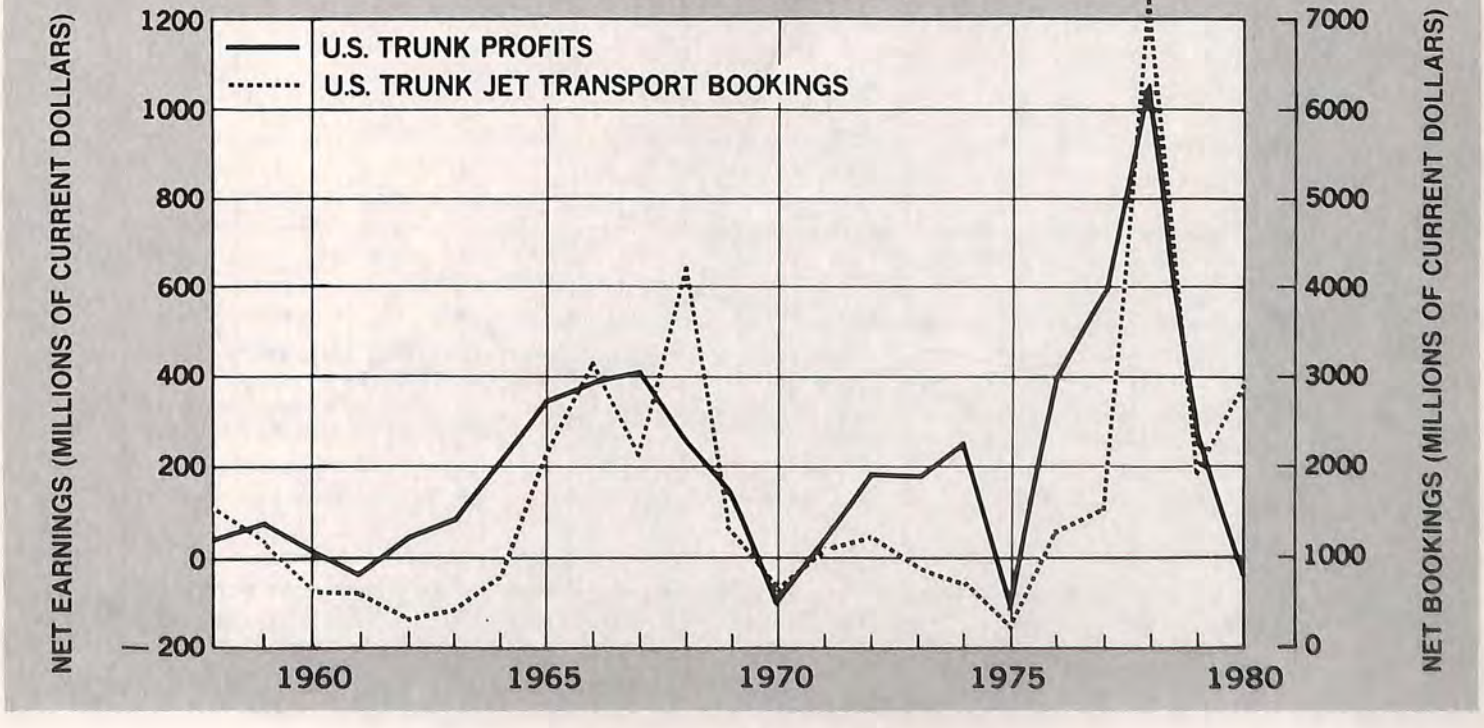
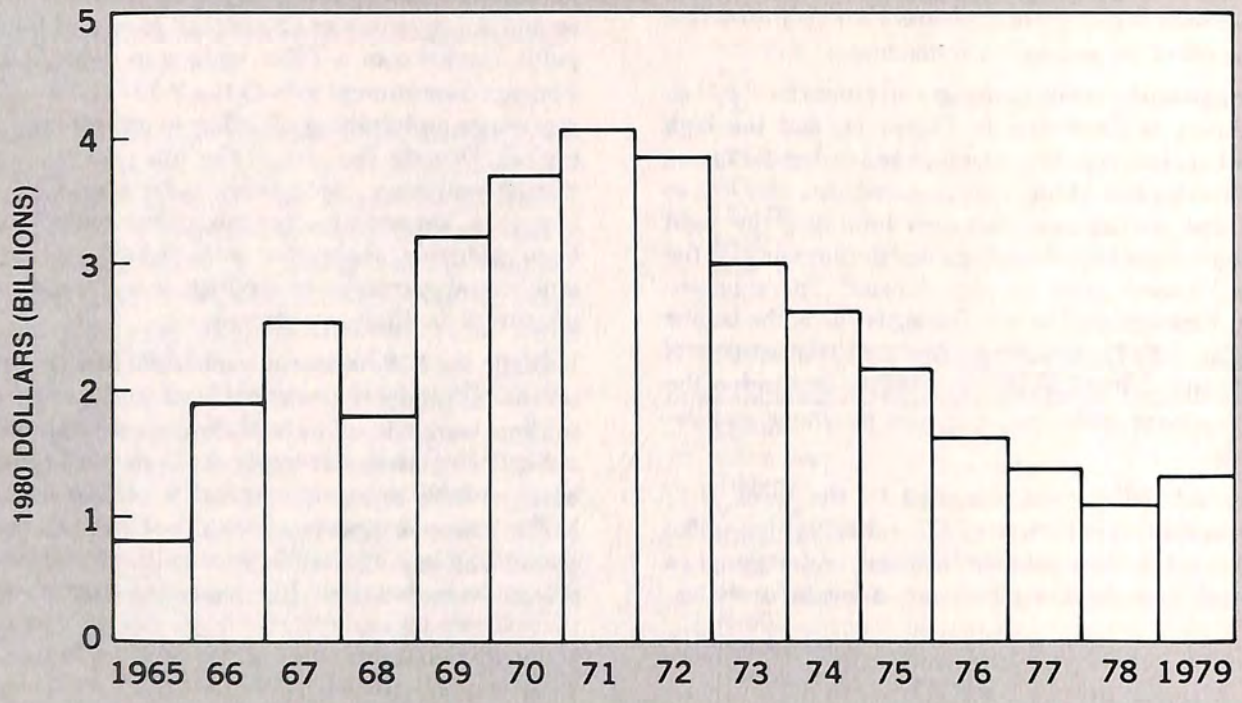


FIGURE 15a

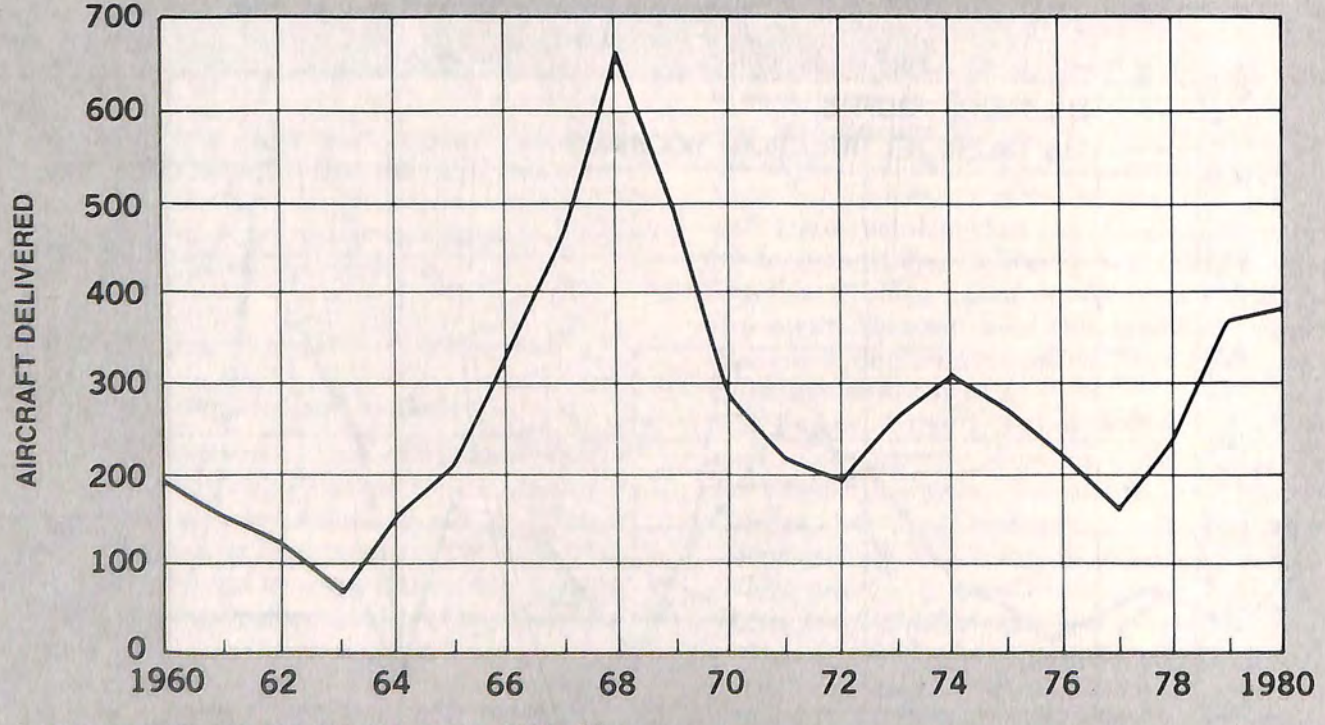
TOTAL DEBT OF U.S. COMMERCIAL AIRCRAFT MANUFACTURERS
1965–1979
(Billions of Dollars)



SOURCE: COMPILED FROM ANNUAL REPORTS OF BOEING, DOUGLAS, AND LOCKHEED, 1965-1979.

FIGURE 15b

U.S. MANUFACTURERS' COMMERCIAL JET DELIVERIES[a]
1960–1980



[a] INCLUDES 707, 720, 727, 737, 747, CV880, CV990, DC-8, DC-9, DC-10, and L-1011 (U.S. GOVERNMENT PURCHASES EXCLUDED)

When Europe's Aerospatiale terminated production of the Concorde Supersonic after selling only nine of 16 aircraft produced, the impact on the involved economies was quite different from that experienced in the United States during its aircraft industry difficulties. The French and British governments absorbed the Concorde losses and went on to participate in financing the Airbus consortium in 1971.

An understanding of the nature of aircraft production programs will help illuminate the cash flow problems and capital risk. Aircraft programs are characterized by high production rates during the first few years, generally followed by a drop in production as the airplanes are assimilated into the airline systems. Then, depending upon the economic/business cycle, production will later rise again as demand grows and sales are stimulated by model derivatives. Figure 15b demonstrates this characteristic of aircraft production programs over time with a look at the pattern of U.S. commercial jet deliveries. An important consideration for manufacturers is that multiple programs in various stages of production and demand help maintain more nearly constant total manpower requirements.

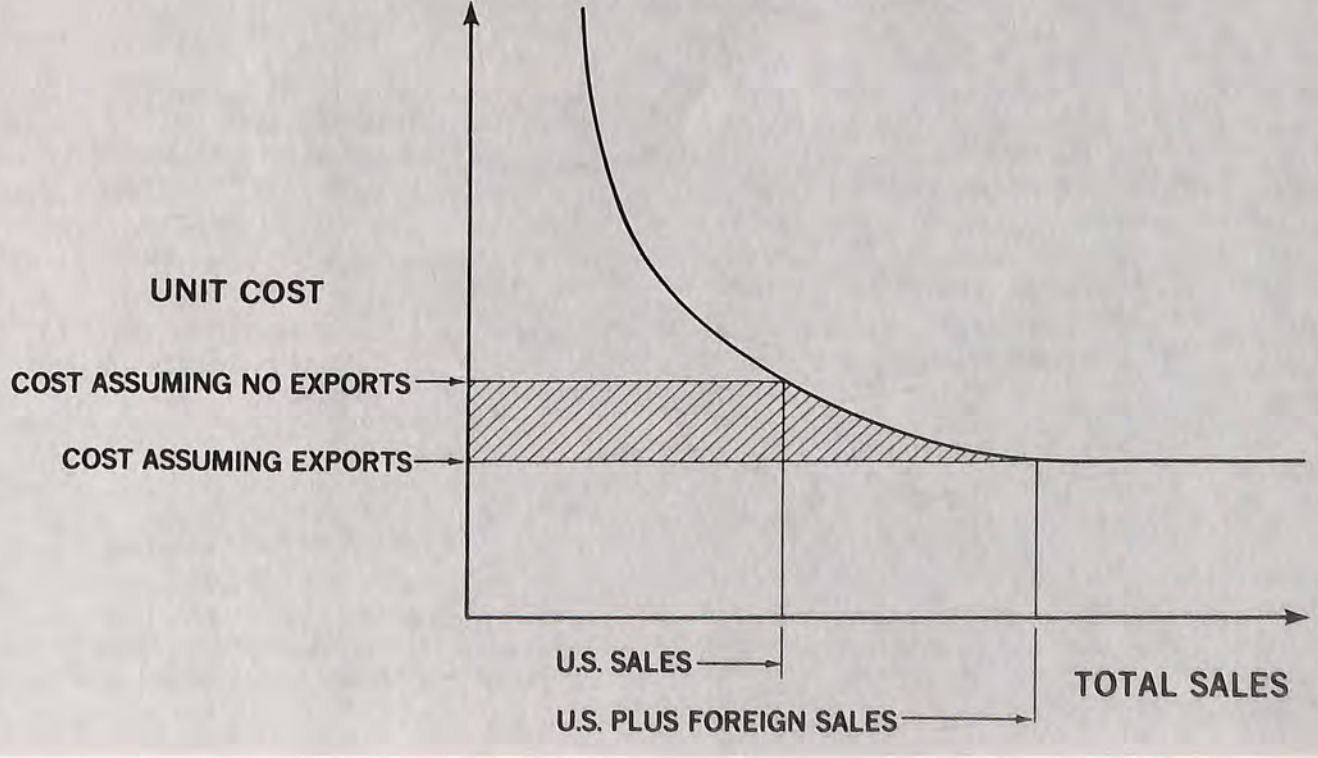
The pricing structure of the aircraft industry—as it relates to the high unit production costs of the first several hundred of an aircraft intensifies capital risk. Profitability generally requires improvement through time as the total number of units delivered increases and the initially higher per unit costs encountered at the beginning of the learning curve are reduced. Typically, however, airplanes are priced far below initial unit costs to facilitate market introduction. It does require a large market and continual engineering and operating improvements to sustain market interest, and capital funding to accomplish this adds further to the cash flow commitment necessary to remain in production. The larger the market, the more units over which this cost recovery can be spread and the lower the unit price for all customers, foreign and domestic (Figure 16). This points up one of the important benefits of aircraft sales abroad. A recent industry analysis found, for example, that the price per unit to U.S. airlines *without* export sales markets, would be 40 percent greater.

The peak investment for a commercial jet program can easily reach several billion dollars and may not be recovered for 10 to 15 years and then only if the program is successful. Recovery time for the basic program is often extended as additional investments are required for derivatives for product improvements to meet market requirements. Successful programs, then, must have long production runs spanning these long capital recovery periods.

The fundamental difference between the European/Asian and U.S. economic systems is clearly reflected in the sources of capital to finance these long-term recovery commercial jet transport programs. In the United States, manufacturers must rely upon retained earnings, equity investments and debt financing for capital investment—in a private enter-

FIGURE 16

EFFECT OF EXPORT SALES ON AIRCRAFT UNIT COSTS



prise environment characterized by open competition among alternative investment opportunities. Moreover, because of inflation, investment funds have been fewer and, when available, quite costly. European aircraft manufacturers function in a different environment where, in contrast, the national treasuries of the European Economic Community provide a large portion of the capital. The criterion for capital availability is not return on investment as it is in a private, market economy, nor is the cost of the capital always a function of the business/economic cycle. Rather, it is a matter of national policy to fund the development and perpetuation of a high-technology aircraft and aerospace industry.

Market Risks

Today, a new aircraft program must maintain its viability in the marketplace for 15 to 20 years. Because of the complexities of the market and changing technology, the initial choices of product characteristics and the time of launch are the biggest risks involved. The strength of these decisions will have to support the capital risks already described.

Four major factors influence the design of commercial jet transports: (1) economic efficiency, (2) validated technology, (3) airline marketplace, (4) airframe/engine compatibility and competition, and (5) regulatory requirements (e.g., with respect to environmental conditions). The successful product program must be responsive to the ever-changing dimension of these and other factors. No airplane program continues very long with the same product characteristics initially selected. Figure 17 illustrates important ways in which the initial design can be modified to meet changing airline requirements and improve its marketability over extended periods of time. Alternative gross weights, fuel capacities, cargo and passenger configurations, engine choices and operating standards, for example, are typical modifications to the payload/range design for the marketplace.

The selection of the "Basic Design Point" of a commercial jet program can take years of research, consultation with airlines and reviews of changing external forces (such as fuel price and availability, environmental constraints, financing). It involves engineering development and engine competition and requires millions of dollars for related research and development. Figure 18 presents the range of choices for basic design points up to this time. Only major derivatives to commercial jet programs are shown.

Before a Basic Design Point is chosen, the following factors must be identified:

- Worldwide airline service market
- Expected growth in demand (new and existing markets)
- Stage-length evolution
- Marketing practices and airline service objectives
- Investment costs per seat

FIGURE 17

POSSIBLE DESIGN MODIFICATIONS
TO MEET CHANGING AIRLINE REQUIREMENTS

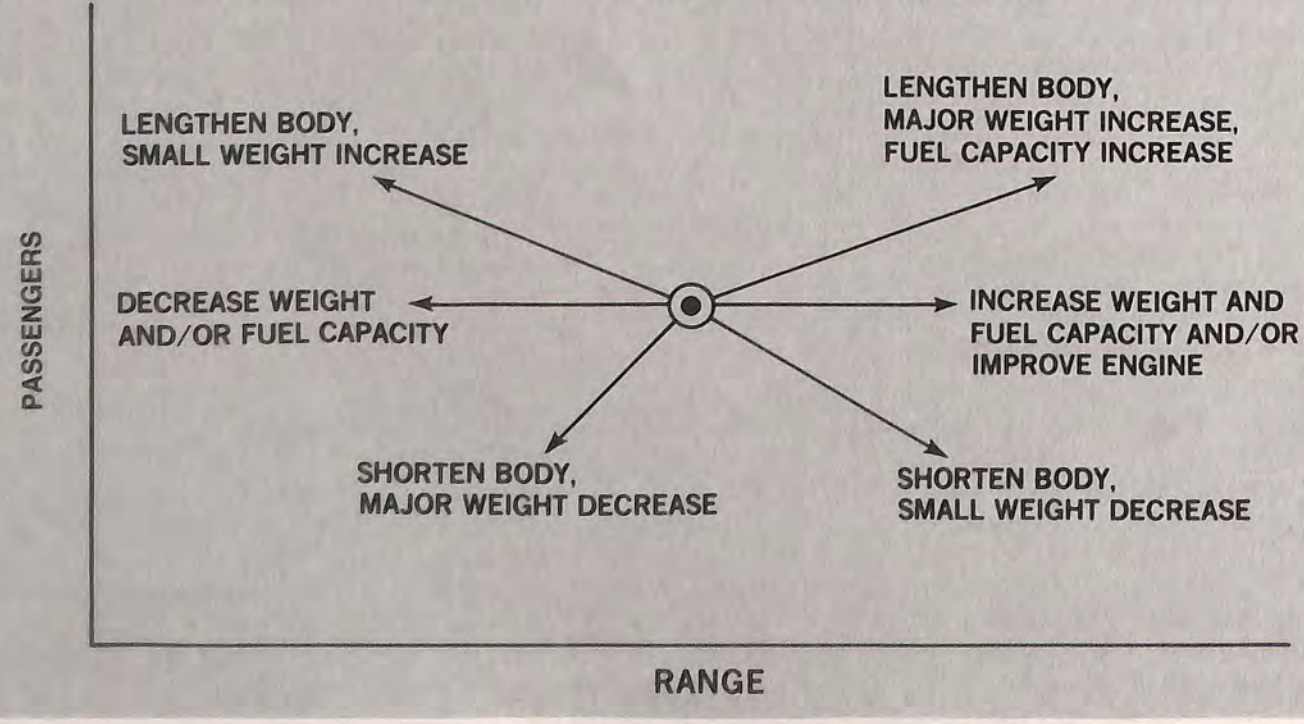
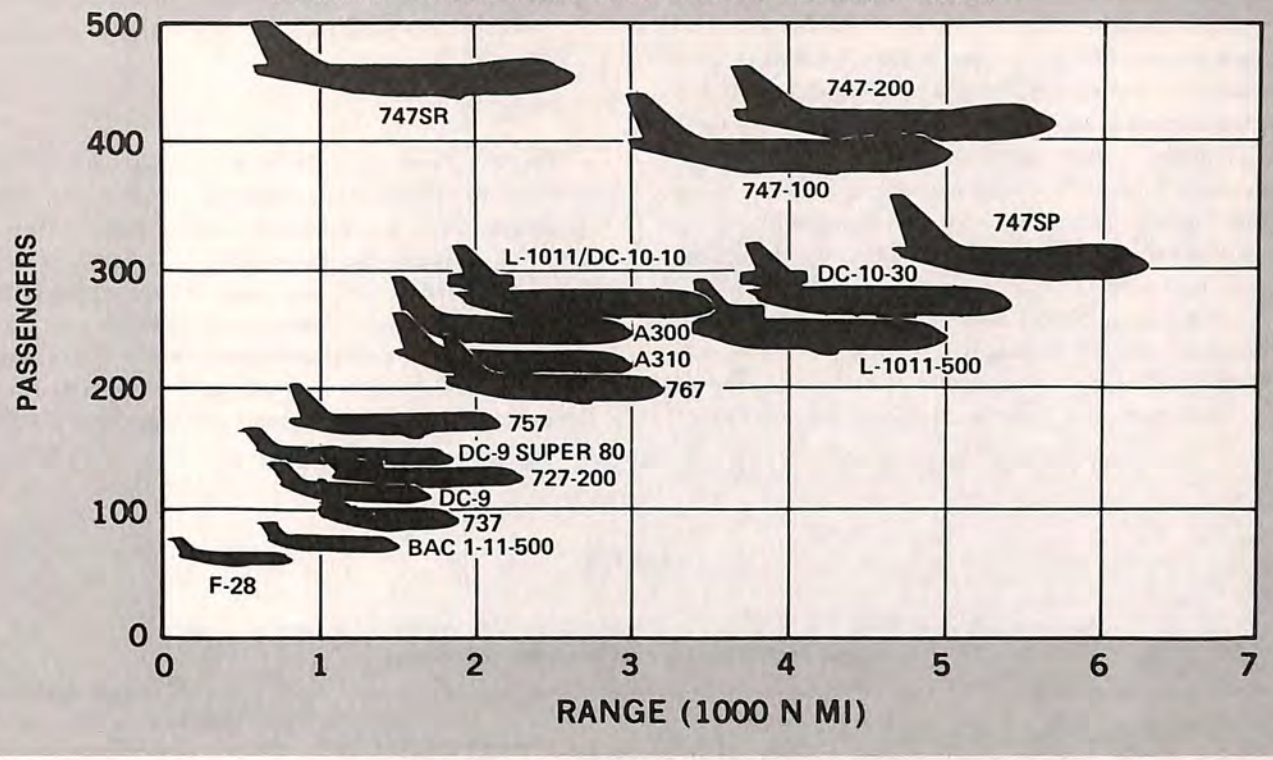


FIGURE 18

RANGE OF CHOICES FOR BASIC AIRCRAFT DESIGN POINTS



- Operating costs (per seat mile, per airplane mile)
- Available propulsion technology
- Operating performance (takeoff/landing)
- Compatibility with existing fleets
- Existing fleet age and condition
- Existing fleet reassignment possibilities
- Potential for profitability
- Emerging and/or validated materials and sub-system technology

Ultimately, the Basic Design Point is a carefully weighted compromise of rapidly emerging needs with emerging technology, and the least-cost opportunity available for initial and potential derivative models. A billion or so dollars must then be available to finance the venture in a manner that will not adversely affect the price offering, nor inhibit the necessary initial production rate. In recent years, the availability or capacity of the materials supply network to meet production rate demand has also become increasingly crucial as airframe manufacturers typically subcontract one-half the total manufacturing activity to industry suppliers.

The larger the marketplace, the more likely a program is to be successful. Any perturbations which diminish the size of the program or extend the time over which a model is actively in demand endanger its viability. Naturally, the wider the product line the greater the market for a particular manufacturer and the more flexibility available to meet planned and unplanned demand changes. The loss of any opportunity to compete in the market automatically increases the risk of the total program.

Initial sales of particular jet transport equipment to each single customer are critical. The outcome of the initial sales competition for a market model will have long-term effects upon the total industry. Because of compelling reasons—primarily the commonality of equipment, which helps hold down maintenance and crew costs and reduces scheduling problems—the loss of an initial sales opportunity to an airline will likely result in the loss of that carrier's market —for that size aircraft—for 15 to 20 years. Moreover, follow-on and spare parts sales always exceed the value of the initial order. Table 5 illustrates the cumulative effect from initial sales of several Boeing aircraft since 1959. In terms of both numbers of units sold and value, follow-on sales are nearly three times—or more—voluminous over the life of a program as that first order. The average follow-on export sale for Boeing, Douglas, and Lockheed aircraft between 1971–77 was three times greater than the initial export sale.

Initial sales success or failure with a particular airline in a region can influence the decisions of other carriers in that entire market. There is a demonstrated "domino effect" from initial carrier decisions. Because airlines within common regions can take advantage of the favorable economics associated with joint maintenance support and spares pooling agreements, the initial penetration of an airplane type results in most, if not all, airlines in that region acquiring the same airplane. A recent example is Airbus penetration of the Silk Route market which encompasses the Pacific Rim, Asian subcontinent, and Arabian Gulf. These regions are rich in manpower and resources and have experienced rapid growth

in GNP, trade, and air travel. The demand for commercial aircraft is increasing just as rapidly. The A300 team, including government representatives, has been working very effectively to tie together this regional airline market with the A300 (see Figure 19). As shown, A300 sales efforts were successful in only two countries (eight jets) through 1976, but the team's successes currently include 15 countries (105 jets). Major sales efforts in other nations are underway.

In economies in which major exporting industries are nationalized, such instances of the use of government clout have become increasingly prevalent—not only in aircraft trade but in non-aircraft-related trade as well. The 1979 General Agreement on Tariffs and Trade (GATT) addressed some of the problems and contained a separate code for trade in civil aircraft. While it was signed initially by only 14 countries, the signatories include all the major producers. The Aircraft Agreement has served to point the way to correcting certain inequities which have emerged in recent years. As a result, future purchase decisions should be premised more on performance, quality, price and service.

Political Risks

Political risks are closely identified with differences in national priorities. As mentioned earlier, the European and Japanese national priorities include financial support to industries designated as important to the future of the country. The U.S. government also supports industries of significant importance but in a crisis intervention manner. The foreign governments provide their support in the planning, development, initial production and market testing phases. The financial terms of this support are significantly different as

TABLE 5

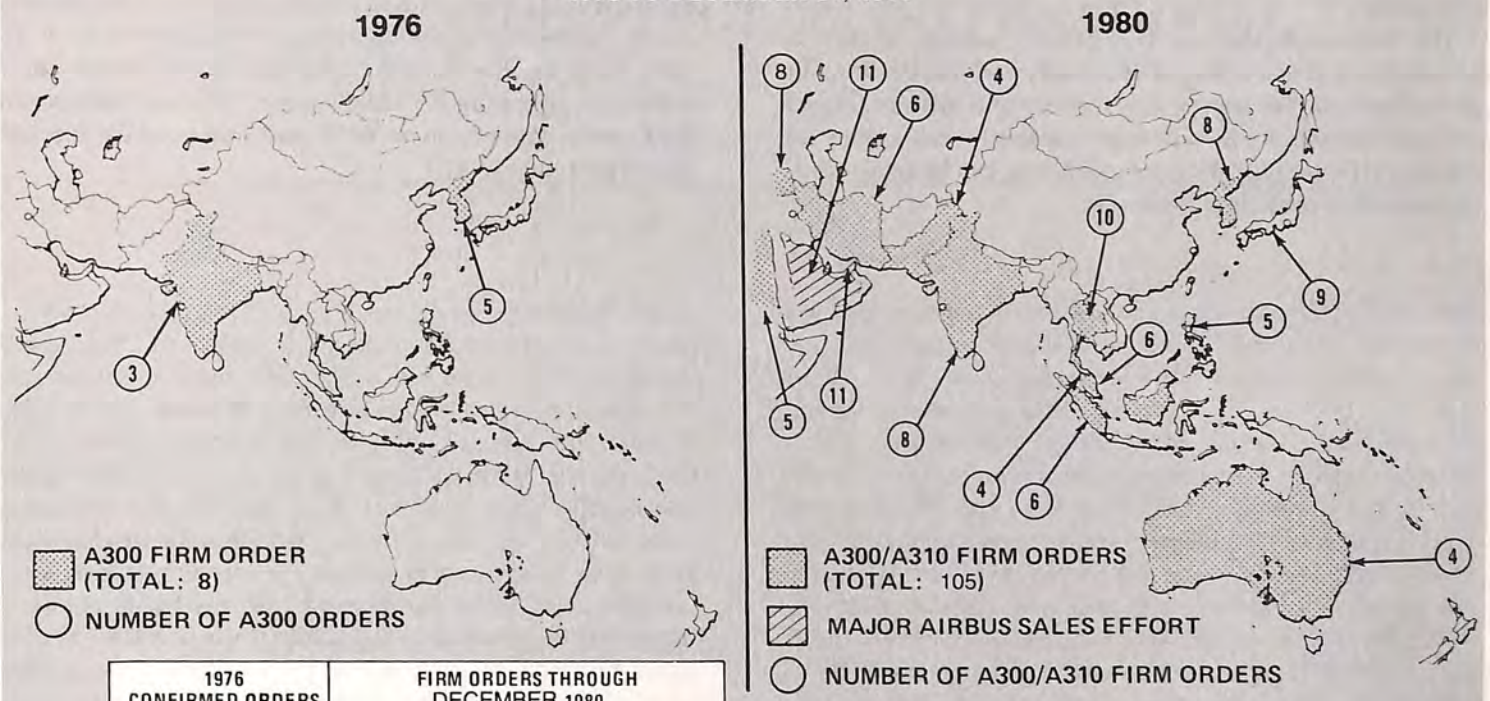
CUMULATIVE EFFECT FROM INITIAL SALES OF U.S. AIRCRAFT SINCE 1959
(Number of Aircraft and Millions of Dollars)

	1959–1963	1964–1968	1969–1973	1974–1978	Totals			
					Units		Value	
					Initial	Follow-On	Initial	Follow-On
Air Canada								
DC–8	6[a] + 9	14	13	—	6	36	$ 33.4	$ 300.8
DC–9	—	6 + 31	11	2	6	44	18.8	174.7
B–727	—	—	—	5 + 9	5	9	39.0	74.7
B–747	—	—	3 + 1	2	3	3	67.2	84.3
L–1011	—	—	6 + 0	4 + 0	10	0	190.0	0
SwissAir								
DC–8	2 + 2	4	3	—	2	9	11.0	69.7
DC–9	—	10 + 8	7	10	10	25	35.6	141.2
DC–10	—	—	3 + 0	3 + 2	6	3	127.8	76.0
Lufthansa								
707	4 + 3	13	3	—	4	19	20.6	132.2
727	—	12 + 15	8	26	12	49	50.2	351.9
747	—	—	3 + 5	10	3	15	55.7	563.0
DC–10	—	—	1 + 0	3 + 7	4	7	81.9	161.7
Japan Air Lines								
DC–8	4 + 7	16	18	—	4	37	22.5	314.2
727	—	6 + 5	1	—	6	6	26.4	27.6
747	—	—	3 + 13	21	3	34	55.8	554.2
DC–10	—	—	—	6 + 1	6	1	176.4	36.2
British Airways								
707	15 + 4	5	5	—	15	4	77.6	105.9
747	—	—	6 + 9	10	6	9	111.9	498.5
L–1011	—	—	6 + 3	8	6	3	118.2	289.8
Air France								
707	10 + 15	12	1	—	10	28	51.5	176.2
727	—	4	13	—	4	13	20.3	75.0
747	—	—	4 + 7	11	4	18	73.7	446.9
					135	380	$1,465.5	$4,654.7
					26%	74%	24%	76%

a Underline denotes number of aircraft in initial sale

FIGURE 19

A300/A310 SILK ROUTE MARKET PENETRATION
1976 TO DECEMBER 31, 1980



1976 CONFIRMED ORDERS	FIRM ORDERS THROUGH DECEMBER 1980		
INDIA KOREA	EGYPT GREECE INDIA INDONESIA KUWAIT IRAN	JAPAN KOREA MALAYSIA AUSTRALIA PAKISTAN	PHILIPPINES SINGAPORE THAILAND SAUDI ARABIA

well. Many countries continue their support as the commitment grows and the economy becomes increasingly dependent on the industry for employment. In contrast with the business-government adversary relationship in the United States, foreign governments and foreign commercial enterprises tend to be more cooperative.

In the United States, trade restraints to promote foreign policy objectives are increasingly common but these objectives are often not supported by the other developed nations of the world. Such foreign policy restraints have become burdensome to the U.S. aircraft manufacturers. In 1979 and 1980, for example, export licenses for almost half a billion dollars in exports were denied one U.S. manufacturer. No comparable restraints are placed upon the Airbus consortium.

While financing terms have become a pivotal item in sales to non-U.S. air carriers in recent years, domestic inflation has placed U.S. financial institutions at a disadvantage in offering competitive terms. Bilateral negotiations to minimize the differences in export financing terms have met with failure. Limitations on private U.S. banking institutions and funding constraints placed on the U.S. Export-Import Bank are denying U.S. exporters competitive equality, given the national treasury support from the European Economic Community.

The difference in approach toward exports between the governments of other nations and that of the United States has increased the risk for U.S. commercial aircraft manufacturers. They must finance massive aircraft program investments in a free enterprise manner while the nations of the European Economic Community, for example, are concerned less with return on investment from a company point of view than on overall national return such as employment, and perpetuation of a high-technology aircraft and aerospace industry. Foreign aircraft are priced to be competitive, as are U.S.-made commercial transports. However, the demands for cost recovery are fewer from national governments than from private financial institutions which face more immediate constraints as a result of inflation and concerns over monetary stability.

The erosion of the U.S. share of world trade continues. Fears that this trend is the result of the transfer of technology to foreign manufacturers by U.S. firms has prompted political constraint of certain high-technology ex-

ports. While it is true that high-technology items are the core of U.S. manufactured goods exports, technological advances by other developed nations can be attributed to indigenous capability which does not depend upon U.S. technology.

The Airbus consortium is a prime example of the co-production and marketing of a mutually endorsed venture by several nations. Moreover, the state-owned airlines cooperate in the development of new jet transports and, as they are controlled by participating governments, can be more easily persuaded to provide a demand.

During the GATT negotiations some haunting political issues were addressed and the final civil aircraft agreement was a major step forward in achieving market competition for aircraft sales. At this point, enforcement of the agreement is essential, and as competition grows more intense the need to insure fulfillment of the agreement will also increase. To date, however, the United States has fallen behind other nations in preparing for enforcement. (For information on the General Agreement on Tariffs and Trade and the Aircraft Agreement, see p. 47.)

BUSINESS-GOVERNMENT FRAMEWORK: ITS EFFECT ON INTERNATIONAL TRADE

The success, or failure, of a nation's commercial jet transport industry is inextricably linked to that country's domestic and foreign policies. The nature and extent of this relationship, and the fruits of government-industry interaction, will vary according to these policies. The relative importance of the product or service supply capability of the industry, both nationally and internationally, is central to the relationship. National and international security agreements further influence and complicate a situation of potentially conflicting strategic objectives, for the government-industry relationship is rooted in the technological capability of the aircraft industry and its inevitable position in national defense. As air power is essential to national security, the greater the commercial success of the industry, the more defense capability the nation can support at a given price to the taxpaying public. Despite the inevitability of a close government-industry relationship, there are nonetheless substantial differences between the United States and other countries in their approach to that relationship, where certain domestic and international policy objectives are concerned. These differences form the context for much of this chapter's attention.

U.S. International Trade—The Aircraft Industry's Important Role

In mid-1975, the U.S. balance of all merchandise trade began a 33-month decline. From an annual surplus of well over $9 billion, the U.S. trade balance dropped to a $31.8 billion annual deficit in 1978. Since then, quarterly deficits have stabilized around an average of $7.5 to $8 billion. The rapidly escalating price of imported oil and an economy plagued by inflation are most often charged as root-causes for this turn of events. At the same time, income from overseas investments has made substantial gains and there have been some net gains in the balance of services income. The expectation for 1981 is a surplus of $6 billion in the "current account"—the sum of net balances from merchandise and investment income, military travel, and transportation receipts, along with other services. In 1981, exports and imports grew at approximately the same rate over 1970—30 percent. The rising exchange rate value given to the deutsche mark, yen and franc—prior to the dollar's rise in 1981—has helped make U.S. products more competitive in world markets. Figure 20 and Tables 6 and 7 provide a perspective on the U.S. trade patterns of the seventies vis-a-vis the current accounts of other nations.

Although the U.S. share of the world's exports has declined, volume growth in exports, up 79 percent between 1970 and 1979, has been good. This growth was higher than the 75 percent increase experienced by seven other major industrial countries during the same period. Those seven countries, in aggregate, also experienced a comparable decline in share of world export trade. The reasons are the same for all: higher priced petroleum exports by OPEC countries and very strong growth in exports by some of the developing countries. In 1979, the United States enjoyed a trade surplus of $9.3 billion with the European Economic Community, of $3.4 billion with the other developed countries of the world, of $0.8 billion with non-OPEC developing countries, and of $4.9 billion with communist nations.

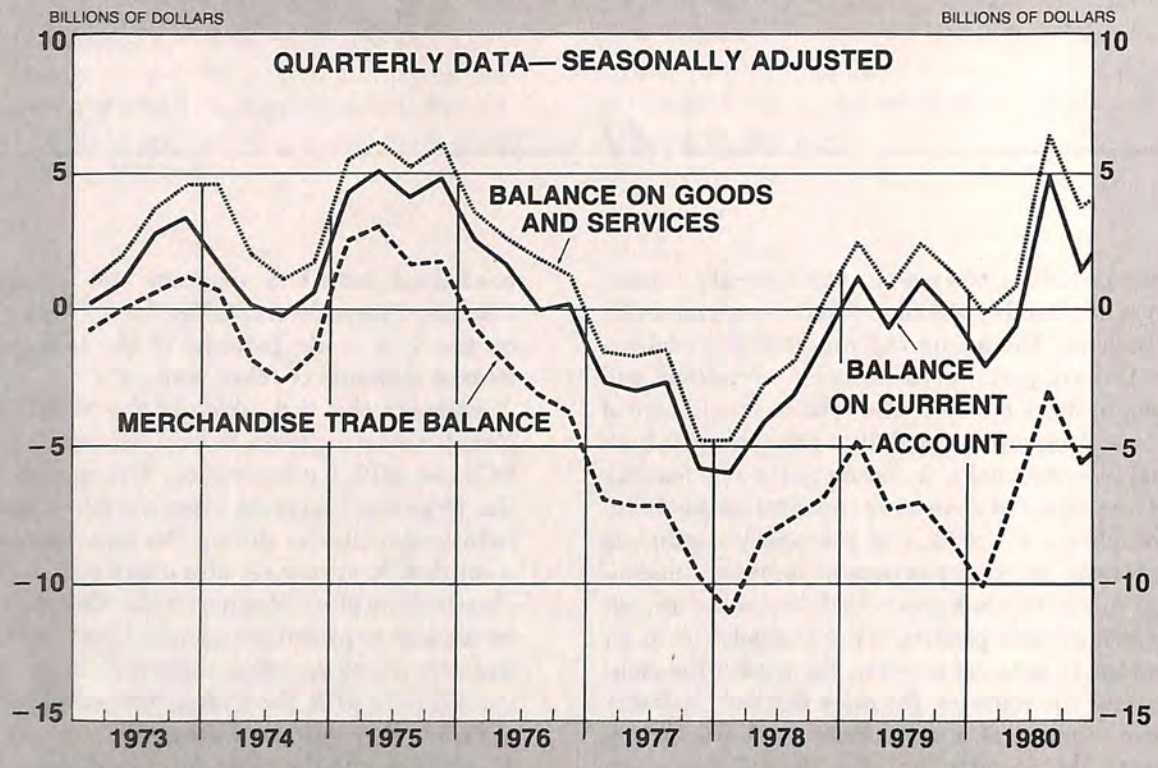
In 1980, exports of manufactured goods accounted for 65 percent of total U.S. exports and generated a surplus of $1.6 billion. The largest single manufacturing industry contributing to this surplus was the U.S. commercial jet transport sector. Boeing, Lockheed, and McDonnell Douglas combined exported $6.7 billion of U.S.-manufactured jet aircraft. Exports of engines, avionics, spare parts and services from within the industry, plus used aircraft and a wide array of accessories, brought that total to $10 billion. After deducting $900 million in imports, the net trade surplus was $9.1 billion. The Boeing Company was identified by *Fortune* magazine as the nation's number one exporter (almost $4 billion).

It should be noted, however, that in the midst of the U.S. industry's excellent 1979 performance, Europe's Airbus Industrie captured what was, at that point, its largest share of world jet transport orders for future delivery—31 percent. In 1980, Airbus achieved 32 percent of wide-body orders and, as of September 30, 1981, held 43 percent of the world wide-body backlog.

The commercial jet transport is one of a waning number of examples of U.S. technological leadership. Suffice it to say, the industry makes a substantial positive difference for the United States in world trade. The industry's net export surpluses in both 1979 and 1980 were sufficient to pay for one

FIGURE 20

U.S. INTERNATIONAL TRANSACTIONS
1972–1980



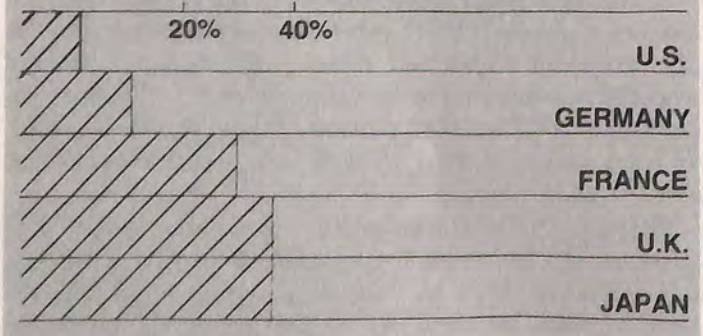
SOURCE: DEPARTMENT OF COMMERCE

day of every week's demand for imported petroleum. Moreover, the industry's products form a solid base for continued exports: follow-on sales, spare parts, accessories and service contracts.

The critical need to export in order to pay for vital imports has led European and Japanese policy makers to recognize the importance of the commercial aircraft as well as other high technology industry sectors. They have acted upon this recognition with financial support for major exporting industries. During 1979, for example, the major industrialized EEC countries and Japan all provided more financial support to exports than did the United States (Figure 21).

FIGURE 21

PERCENTAGE OF TOTAL EXPORTS
BACKED BY GOVERNMENTS
1979



SOURCE: U.S. COMPTROLLER GENERAL

Comparative Government Support of Aircraft Exports

The national promotion of exports, in a variety of forms, has emerged as a significant factor in world market competition. Export credit financing and insurance, tax avoidance or reduction incentives, direct promotion, bilateral agreement negotiations (barter trade), and direct financial assistance are increasingly common. A Business International Corporation study recently compared export incentives and concluded that, among 10 major countries, Brazil provides the most complete package of incentives.[1] The 10 countries in descending order, ranked as follows:

1. Brazil
2. South Korea

[1] Business International Corporation, Corporate Policy Division, *International Export Incentives: A Comparison and Analysis of Ten Key Countries* (New York, New York, 1979)

TABLE 6

U.S. INTERNATIONAL TRANSACTIONS
1973–1980
(Millions of Dollars)

Period	Merchandise[a,b]			Investment Income[c]			Net Military Transactions	Net Travel and Transportation Receipts	Other Services Net[c]	Balance on Goods and Services[a]	Remittances, Pensions and other Unilateral Transfers	Balance on Current Account[a]
	Exports	Imports	Net Balance	Receipts	Payments	Net						
1973	71,410	−70,499	911	21,808	−9,655	12,153	−2,070	−3,158	3,184	11,021	−3,881	7,140
1974	98,306	−103,649	−5,343	27,587	−12,084	15,503	−1,653		3,986	9,309	−7,186	2,124
1975	107,088	−98,041	9,047	25,351	−12,564	12,787	−746	−2,792	4,598	22,893	−4,613	18,280
1976	114,745	−124,051	−9,306	29,286	−13,311	15,975	559	−2,558	4,711	9,382	−4,998	4,384
1977	120,816	−151,689	−30,873	32,179	−14,217	17,962	1,528	−3,293	5,182	−9,493	−4,617	−14,110
1978	142,054	−175,813	−33,759	43,265	−21,865	21,400	738	−3,178	5,792	−9,008	−5,067	−14,075
1979	184,473	−211,819	−27,346	66,699	−33,236	33,463	−1,947	−2,622	5,460	7,008	−5,593	1,414
1980	223,966	−249,308	−25,342	75,936	−43,174	32,762	−2,515	−798	6,674	10,779	−7,056	3,723

SOURCE: Department of Commerce, Bureau of Economic Analysis.

a Excludes military grants.
b Adjusted from Census data for differences in timing and coverage.
c Fees and royalties from U.S. direct investments abroad or from foreign direct investments in the United States are excluded from investment income and included in other services, net.

TABLE 7

U.S. CURRENT ACCOUNT BALANCES
BY AREA AND COUNTRY
1979–1980
(Millions of Dollars)

	1979	1980p	1979–1980 Change
Surpluses			
Western Europe	14,303	20,261	5,958
Eastern Europe	4,300	3,103	1,197
Canada	8,788	7,262	1,526
Latin America & Other Western Hemisphere	7,526	14,451	6,923
Australia, New Zealand and South Africa	2,189	3,432	1,243
Subtotal	37,106	48,509	13,592
Deficits			
Other Countries in Asia and Africa (Includes OPEC)	−24,410	−33,224	−8,814
Japan	−8,583	−8,749	−66
International Organizations and Unallocated	−2,598	−2,814	−216
Subtotal	−35,691	−44,787	−9,096
BALANCE ON CURRENT ACCOUNT	1,414	3,723	2,309

SOURCE: U.S. Department of Commerce, *Survey of Current Business,* June 1981
NOTE: Figures may not add due to rounding

TABLE 8

GOVERNMENT AND PRIVATE SECTOR SUPPORT OF COMMERCIAL JET PROGRAMS IN EUROPE AND THE UNITED STATES

			Europe	U.S.
Government Support	Direct Capital Infusion	R&D Funds	●[a]	○[b]
		Developmental Grants		
		—New Programs	●	○
		—Major Derivatives	●	
		Developmental Loans (Low/No Interest)	●	
		Capital Funds for Facilities/Equipment	●	
		Lease or Use of Government Facilities	●	○
		Infusion of Equity Capital into Government-Owned Companies	●	
		Marketing Support and Subsidies	●	
		Exchange (Currency) Subsidies	●	
	Indirect Financial Support	Technology Transfer From Military to Commercial Aircraft Work	○	○
		Government Guarantees for Bank Loans—New Program	●	○
		Government Guarantees for Bank Loans—Company Rescue	●	●
		Tax Credits	●	●
		Airline Financing of New Aircraft		
		—Domestic (Airlines of Producers Countries)	●	
		—Export	●	●
		Training Funds and Support	●	○
		Government-Aided Marketing	●	○
Private Sector Funding		Earned Venture Capital	○	●
		Bank Loans (Not Government Guaranteed)		
		—Developmental Funds	○	●
		—Inventory Financing	○	●
		Company-Financed Research	○	●
		Company-Backed Airline Financing		●

a ● Significant
b ○ Minimal

3. France
4. Taiwan
5. United Kingdom
6. Japan
7. Italy
8. United States
9. Canada
10. West Germany

The commercial jet transport industry has become a high priority for export support among the industrialized nations—so much so that, until a recent interim agreement was concluded, a virtual export credit war was underway. The 1976 Organization for Economic Cooperation and Development (OECD) "Standstill Agreement" on terms of export financing had become a casualty of changing economic conditions, and attempts to revise the Agreement in 1980 to reflect current financial market conditions were thwarted, particularly by the French. The role of the European and Japanese governments in their jet transport manufacturing industries helps to explain why concluding a new agreement is so essential. Table 8 illustrates the differences between U.S. and European government involvement in commercial jet programs.

The European commercial aircraft industry is essentially consolidated in Airbus Industrie, a consortium of predominantly government-owned or controlled enterprises consisting of companies from France (37.9 percent), Germany (37.9 percent), the United Kingdom (20 percent), and Spain (4.1 percent) as full partners, with Belgium and The Netherlands as associates. (The French and Spanish companies involved are essentially government-owned, the German and Belgian companies about 50 percent government-owned—as is British Aerospace since its recent denationalization—while Fokker of The Netherlands is a privately-owned company.) Gov-

ernment financial support is provided these companies through a variety of means not available to U.S. firms. As a result, the prices of aircraft for Airbus Industrie programs (A300 and A310) probably do not reflect the full economic costs that would have to be accounted for and recovered under the U.S. private enterprise system.

In addition to providing financial assistance, the governments involved in Airbus Industrie play an active role in the marketing function. Initial sales of the Airbus A300 were extremely slow; only 57 airplanes were ordered during the first seven years, a situation which would probably have forced a U.S. firm to abandon the project. The initial sales were almost certainly directed procurements to "buy national;" French Finance Minister Jean-Pierre Fourcade reportedly put such pressure on Air France in January, 1975. Other sales resulting from government pressure included Lufthansa, Iberia and, more recently, Sabena. Once an aircraft model is established in a fleet, however, there is no further need for such pressure; a carrier then has an economic incentive to buy additional units (and derivative models) because of the previous investment in spares, training, specialized ground support equipment, crew familiarity with the equipment, and so forth.

Political leverage is another important factor in the sale of European-produced aircraft. Events have provided some evidence of a continuing involvement by the governments of Airbus participants to induce aircraft sales by associating them to political agreements such as: (a) trade agreements; (b) route awards/landing rights/frequency rules adjustments (e.g., Korean landing rights in Paris, Iberia frequency agreement in European routes, Swissair traffic rights with France, the United Kingdom, West Germany); and (c) military weapons support (e.g., atomic power plants to Iran, a petrochemical plant and Paris real estate joint venture to Kuwait). An interesting twist in political leverage was Australia's use of the Trans Australian Airline's purchase of A300s as leverage to encourage the European Economic Community to buy more Australian mutton.

Another approach used by government-backed European aircraft producers to induce sales is the provision of special terms that exceed the bounds of normal commercial practice. The Airbus sales to Eastern Airlines, for example, included a "Deferred Seat Plan" in which 12 of 23 airplanes will be paid for as if they had only 71 percent of the 240 seats for up to four years, or until load factors exceed a certain level.[2] Although seats will eventually be paid for, the deferral is interest-free. Eastern also had use of four A300s for a six-month trial period without lease cost.

The Japanese Government, through the Ministry of International Trade and Industry (MITI), has stated its intent to promote development of its commercial aircraft industry through international cooperation. Although Japanese aircraft companies are not government-owned, they receive support in new aircraft development programs through government loans. This applies both to Japanese programs and to Japanese participation in international cooperative programs. These loans are repaid with interest if and when the project turns a profit. This has not occurred in Japanese programs to date. Unlike European policy, Japanese government policy excludes funding assistance for production and marketing functions.

The level of Japanese funding assistance typically amounts to 50 percent of the Japanese share of development costs for aircraft programs. In the case of the RJ500 engine, which is a joint program between Japanese companies and Rolls-Royce of the United Kingdom, the government is expected to fund over two-thirds of the Japanese share of the development costs.

Prior to the Agreement on Trade in Civil Aircraft, which went into effect January 1, 1980, directed procurements by the governments of Airbus Industrie participants were practiced, establishing the pattern for follow-on sales by the carriers involved. Signatory governments have now agreed that aircraft prices should be based on a reasonable expectation of recoupment of all costs. While there is no requirement that each particular aircraft program must break even, production and marketing programs should be planned so that, with a reasonable production run, the aircraft program will cover all of its nonrecurring—such as production, finance, and marketing—costs. The total costs involved include the "identifiable and pro-rated" costs of military-funded development of civil aircraft and of components which are subsequently incorporated in civil aircraft. Such a provision is consistent with existing U.S. Government policies on recoupment for government-funded research to the extent it benefits a commercial enterprise.

The agreement also states that signatories shall not require, nor exert unreasonable pressure on, airlines, aircraft manufacturers or other entities engaged in the purchase of civil aircraft, to procure civil aircraft from any particular source. It is nonetheless true that the governments of Airbus Industrie participants still have a wider range of marketing opportunities available to them, due to the close relationship in those countries of political and commercial interests.

In the past, U.S. commercial jet manufacturers, competing solely against one another for an airline order, have only rarely sought or received assistance from U.S. diplomatic personnel abroad. The government's rigid adherence to a position of neutrality with respect to U.S. competitors and the exporters' natural reluctance to disclose their game plans tended to appreciably reduce the value of any such cooperation. Now that sales competition in many instances is not only between individual U.S. manufacturers but between U.S. producers and foreign manufacturers backed and supported by their governments, such assistance and cooperation will undoubtedly be increasingly sought by U.S. exporters. As this happens, it will be essential that the U.S. government give full support to its aircraft exporters, if the United States is to remain the world's foremost supplier of commercial aircraft.

[2] *Air Transport World*, July 1978, p. 25, and Hearings Before the Subcommittee on Trade, House Ways and Means Committee, July 14, 1978 (Report 95–101).

On a number of occasions, the U.S. Trade Representative has interceded with foreign counterparts in attempts to assure compliance with the Agreement on Trade in Civil Aircraft. The U.S. government provides other, albeit limited, assistance to U.S. jet transport manufacturers, which is discussed later in this chapter.

The Role of Research and Development

U.S. commercial jet transport manufacturers are working exceedingly hard to maintain their competitive position in the world market. They have committed billions to introduce new and improved, fuel-efficient models in several market areas. The McDonnell Douglas DC-9-80 represents a significantly improved aircraft that had its initial airline delivery in 1980. The Lockheed L-1011-500 has become the first civil program to utilize some new advances in control system efficiencies. The Boeing-757 and 767 each represent new multi-billion-dollar programs with initial airline deliveries scheduled for 1982 and 1983. The Pratt and Whitney PW 2037, JT9D-7R4 and the General Electric CF6-80 engines are similar commitments in the aircraft engine business.

The aircraft manufacturers represent a bright spot in U.S. industrial productivity as they have been able to modernize and expand production capabilities. As a result, the U.S. commercial transport aircraft is still a sound competitor in fuel efficiency and price when price reflects real cost.

From a near-term technological perspective as well, the U.S. commercial transport aircraft is still a sound competitor. Nonetheless, the expansion of foreign R&D capabilities—much of it funded by the governments involved—is challenging U.S. leadership. In some cases, foreign developments are outpacing U.S. programs. Because of this challenge to its technological leadership, the U.S. industry's competitiveness has become much more sensitive to export financing and other aspects of government policy.

Foreign near-term market successes and increasing production are combining with their building block research in a surge that seriously threatens the U.S. industry's future. The problem is not one of U.S. industry inaction; it is one of a more aggressive level of foreign action derived from government policies highly supportive to industrial aerospace objectives.

In the United States, basic research toward important technology developments (e.g., improvement of fuel efficiency) is funded by industry, the National Aeronautics and Space Administration and the Department of Commerce. However, before aircraft can incorporate such improvements, very extensive validation programs are necessary. Industry has urged an increase in NASA aeronautics R&D programs, particularly those applicable to civil transports, leaving application developments to be funded entirely by industry.

The historical preeminence of the U.S. aircraft industry has rested upon three pillars: (1) technology leadership, (2) manufacturing and supplier capabilities, and (3) a large domestic sales base. At the present time, the first of these is in danger of being eroded away. In the words of former Treasury Secretary Blumenthal: "Our technological superiority is not mandated by heaven. Unless we pay close attention to it and invest in it, it will disappear." The aerospace industry's research and development budgets, in common with those of other industrial sectors, have been adversely affected by high tax rates, runaway inflation, and uncertainties associated with the present economic environment and federal policies. While the industry has introduced new technology aircraft it is also true that, in constant dollar terms, the aerospace industry reduced its R&D budgets by nearly 30 percent from the late sixties to 1979, in constant dollar terms. Although budgets were higher in the late seventies than they were mid-decade, they have never again reached the levels of the sixties. In large measure, the high level of R&D spending during the sixties led to the large export sales in the seventies and, on this basis, the reduction in spending during the last decade is a grim omen for the eighties. The United States aerospace industry is in serious danger of surrendering its superiority to overseas competitors and of repeating the experience of the steel and automotive sectors.

From the previous chapter it is worth noting that the development of new aircraft is a uniquely risky venture involving high initial R&D and tooling costs and lengthy payback periods. Financial success for U.S. manufacturers today requires the production of more than 400 aircraft of a single type. Escalating launch costs have resulted in financial risks greater than the net worth of even the largest aerospace companies. Further, the sales rates of individual models are difficult to predict and may be affected by poor timing of introduction (DC-7 and Convair 880), an unfortunate series of accidents (Lockheed Electra), or the bankruptcy of a major supplier (Rolls Royce, the L-1011). Indeed, of three wide-bodied aircraft initiated in the sixties only one has thus far proved financially successful.

Foreign governments are providing substantially greater incentives to their R&D establishments than the United States although funding is not greater in absolute terms. Nonetheless, as percentage of total government funding to increase industrial productivity, the European countries have been spending on about the same level as the United States in aeronautics and space.[3] And while the relative level of expenditures in the United States on aeronautics and space steadily decreased through the seventies, other nations were applying more R&D funding to specific civil projects (e.g., A300-A310 development). Incentives offered by other nations include West Germany's tax-free grants for up to 7.5 percent of the investment in R&D facilities and tax allowances of up to 50 percent for assets used for research. Japan provides low-interest loans to targeted industries and a 25 percent first-year depreciation allowance for new R&D

[3] Aerospace Industries Association, *Research and Development: A Foundation for Innovation and Economic Growth*, (Washington, D.C., 1980), pp. 31–32.

equipment. The terms of the loan stipulate no repayments until the profitability of the venture is assured. Both Britain and Canada have instituted extensive programs to spur R&D spending, including immediate write-offs of new equipment investments.

Although it is crucial for the future health and development of the U.S. economy, the United States unfortunately has no long-range policy for R&D, innovation and technology. The United States appears to be years behind its principal competitors in embracing the national goals of innovation and productivity and recognizing the concept of a business-government partnership in R&D. In a recent study, the Aerospace Industries Association found that industries that perform federally-funded R&D excell over other sectors of the economy in worldwide trade.[4] R&D incentives to industry, then, are an investment in the U.S. economy's performance in future world trade competition.

U.S. Export Incentives

U.S. Government export expansion incentives fall into four main categories: (1) promotional programs, (2) assistance to small and minority-owned firms, (3) the improvement of trading opportunities through international trade agreements, and (4) financial incentives. Commercial jet transport and related supplier marketers can find assistance only in the last two categories. Each has particular long- and short-range significance to the industry.

International trade agreements—U.S. negotiators, backed by assistance from the civil aircraft industry, were particularly aggressive during the last round, the Tokyo Round, of negotiations on the General Agreement on Tariffs and Trade (GATT). The fruit of their efforts was an agreement among 14 nations on a Civil Aircraft Trade Code. All 99 participating countries were invited to sign, but to date only the United States, Canada, the nine nations of the European Economic Community, Switzerland, Japan, Norway, Sweden, Czechoslovakia, and Romania have elected to do so. The Aircraft Agreement eliminates import duties on civil aircraft and related parts in the signatory countries, as well as a variety of non-tariff barriers to free and competitive trading opportunities. The agreement was reached in April 1979, became U.S. law in July and went into effect January 1, 1980.

The Aircraft Agreement is complex and covers all aircraft (other than military) and flight simulators but excludes aircraft-related ground equipment. The focus of attention when the agreement was drafted was eliminating non-tariff barriers to equal competitive opportunities. Specifically, the Agreement covers:

1. *Technical standards*—Designed to discourage discriminatory manipulation of product standards, testing, and certification.
2. *Government-directed procurements*—Designed to prevent government influence in local procurement decisions by directives, conditional procurements, offering of inducements, or threats of sanctions.
3. *Foreign purchase inducements*—Designed to prevent manufacturer-based governments from offering or threatening non-aircraft-related action to/upon foreign governments which might influence competitive equality.
4. *Trade restrictions*—Designed to preclude use of quotas or restrictive licensing practices.
5. *Subsidies and countervailing duties*—Adopted the current GATT Agreement on the subject and included a statement of intent on civil aircraft pricing methodology.
6. *Annual review and dispute settlements*—Designed to promote communication among the signatories and establish a mechanism—the Committee on Trade in Civil Aircraft—for generating rulings and recommendations.
7. *Acceptance, accession, withdrawal and amendment procedures*—Adopted standard GATT provisions.

The Aircraft Agreement represents a compromise among differing and competing interests. The United States immediately eliminated a 5 percent duty on all aircraft-related imports as a visible demonstration of intent. Concessions by other signatories were all related to non-tariff issues, and the U.S. aircraft industry anticipates some substantive difficulties may arise over unresolved issues, as well as questions of interpretation with the Agreement as signed. Eighteen months, for example, were required to resolve United States-Japanese differences of interpretation over the Government Procurement Code. The stumbling block was a potential $3.3 billion telecommunications procurement planned by Nippon Telephone and Telegraph Company. The U.S. government is now watching carefully the manner in which the procurement is handled as an indication of whether the Japanese are serious about opening up their markets for high-technology products to foreign competition. With assertive enforcement of the Agreement and U.S. manufacturer vigilance of the market, this opportunity could have been lost.

Foreign government involvement in the civil aircraft industry is a sensitive issue with U.S. manufacturers. The fulfillment of the spirit and letter of the agreement by behind-the-scenes resolution of problems is essential if the agreement is to be truly effective within a reasonable length of time. In addition, amendments to the agreement are inevitable in order to meet changing world trade conditions and other trade-related bilateral and multilateral agreements which may occur. For example, the existing Aircraft Agreement could be affected by OECD negotiations over aircraft financing terms (pages 44 and 48).

The modification of procedures and administration for handling the customs duty changes agreed to in Tokyo are now underway. The need to speed delivery of spare parts through customs operations is not being met, as intended by

[4] Ibid.

the agreement, due to delays in administration in many parts of the world. Similar situations exist with respect to the standards, trade restrictions, and subsidy areas of the agreement. There is also a need to expand the agreement's coverage of spare parts. The time and dedication necessary to resolve such problems are not expected to be forthcoming without some urging by the U.S. government.

While much, then, was accomplished by the GATT Agreement, it is but a foundation upon which to build operating systems. In order to insure the benefits which can and will accrue to the industry from this agreement, vigorous government and industry enforcement is essential. Industry Sector Advisory Committees (ISACs) have been established to provide the U.S. government with data, and analytical and policy recommendations. The U.S. government, however, is moving very slowly to respond.

Financial incentives—U.S. government financial incentives to expand export marketing, which assist the civil aircraft industry, are limited to the very politically controversial DISCs (Domestic International Sales Corporations), Export-Import Bank financing, and some funding of basic research and development. DISCs have been subject to attack from U.S. and foreign interests since 1975 and, as a result, a reduction in the scope of eligibility has been implemented. The future of the DISC as an export incentive is in doubt due to Congressional criticism of the allowed deferral of taxes on foreign sales income, and a concerted effort by EEC countries through the GATT to eliminate DISC benefits.

The Export-Import Bank (Eximbank) was chartered by Congress in 1934 and has operated ever since as a self-sustaining, wholly-owned government corporation. The U.S. Treasury provided the bank with $1 billion in capital. By 1980, profits from Eximbank operations had allowed it to pay back to the Treasury in excess of $1 billion in the form of dividends and built-up contingency reserves of some $2 billion.

The Eximbank facilitates U.S. civil aircraft exports by providing direct loans, loan guarantees and political risk insurance. Foreign countries have similar institutions such as HERMES (Germany), COFACE (France) and the Export Credit Guarantee Department (ECGD) in the United Kingdom. The Eximbank is charged by Congress to meet competitive financing offerings, but it is also expected to be profitable. Currently those objectives cannot be attained, and the Eximbank is in operating deficit for the first time in its history.

The small differences in operating costs between aircraft can often be offset by attractive financing. To avoid a self-defeating export credit war, the aircraft-exporting nations entered into the "Standstill Agreement" in 1975, which limited officially supported export credits to 90 percent of the purchase price with repayment term set at 10 years (12 years for leases). The Standstill Agreement is silent on interest rates. A recently concluded interim arrangement covering Airbus and U.S. aircraft established minimum interest rates (U.S. dollar—12 percent; French franc—11.4 percent; German deutsche mark—10 percent) and limited the cover to 42.5 percent for Eximbank type credits, 62.5 percent for European credits. (Average term of loan is equivalent because of different repayment requirements.) Participation in excess of the 42.5 percent on Eximbank financing would be limited to guarantees. This interim agreement, like the Standstill, continues the repayment term at 10 years.

Since all countries that manufacture aircraft currently subsidize the financing of their aircraft exports, such subsidies provide no advantage to any exporter and are an unnecessary drain on national treasuries. Eliminating subsidies as part of an international agreement would permit governments to reallocate their resources to priority domestic needs.

The political justifications and economic rationale advanced by many countries for subsidizing exports are discussed elsewhere. The best and probably only alternative to a credit war, however, is an international agreement between all aircraft and aircraft-engine exporting countries to eliminate financing as a competitive element in aircraft sales.

A final agreement on export financing based on the current interim agreement must involve private sector financial institutions worldwide. These capital/money markets are fully capable of providing the financing required to support both U.S. and foreign aircraft exports in any currency desired by the prospective borrower. They can also provide financing more commensurate with the expected useful life of the aircraft, which is 18 to 20 years or more. Access to, and terms of, such financing must be available to support all exports on a non-discriminatory basis.

As a practical matter, it could cost a non-U.S. manufacturer more to access the U.S. capital/money market than it would a U.S. manufacturer. Conversely, U.S. manufacturers could face similar cost differentials in accessing capital/money markets in other countries. Therefore, to achieve non-discriminating long-term financing, official export credit agencies may need to neutralize the cost differential caused by accessing off-shore funds. Neutralizing such cost differences should not be construed as an unfair trade subsidy since its only purpose would be to rectify market imperfections and ensure parity of financing terms to prospective borrowers. The final agreement on export financing should result in longer-term, private sector funding with equal access, free mobility and full parity for all aircraft manufacturers. In the interim, however, it is most important that all competitive financing offers be met so that equipment is selected on the merits of the product.

U.S. aircraft export sales have relied heavily upon Eximbank financing in recent years. A small fraction of a percentage difference in export financing offered by the United States against that offered by the multinational European consortium of banks, led by the French, can make a significant difference in the total operating cost of a jet transport over the period of the loan. U.S. capital costs have been rising over the last 30 years, and the increase in the last several years has been precipitous. As a result, U.S. manufacturers have been at a serious disadvantage when competitive foreign export financing programs, which provide fixed

rates,have been compared to U.S. export financing programs, which include commercial bank fluctuating rates combined with Eximbank fixed rates. The U.S. "blended" rate has been significantly higher than equivalent foreign competitive offers resulting in substantially different capital costs. For example, with the prime rate above 15 percent, the difference between a foreign competitive fixed rate offer at 8¾ percent and a U.S. blended rate could range between 300 and 400 basis points. For a 10-year loan this translates into additional capital costs of between $15.8 to $26.3 million for each $100 million of financing. (See Table 9).

U.S. civil aircraft manufacturers offer very competitive products with respect to performance, price, economic efficiency in operation, and airline passenger appeal. But in the course of shopping for future fleets, customer airlines are looking at total operating costs, including debt financing and its service costs. U.S. jet transport manufacturers have been economically disadvantaged in an otherwise open competition unless export financing comparable to foreign government offerings was available from Eximbank. Even recent agreements on minimum interest rates do not guarantee parity to U.S. firms.

TABLE 9

CAPITAL COST DIFFERENCE BETWEEN U.S. BLENDED AND FOREIGN FIXED RATES 1980 ($100 Million, 10-Year Term, Semi-annual Payments)

Interest Differential Percent	Cost	Present Value of Cost at 10 Percent Discount
1	$ 5,250,000	$ 3,768,895
2	10,500,000	7,537,790
3	15,750,000	11,306,685
4	21,000,000	15,075,580
5	26,250,000	18,844,475

U.S. Export Disincentives

Despite declarations to the contrary, the U.S. government has over the years persisted in its view of export business as a privilege granted at the pleasure of the government, and removed at its displeasure with a buyer nation. Additionally, export promotion and market development through government programs have been oriented toward small to medium-sized enterprises. These policies indicate that our government has overlooked the fact that large export businesses offer substantial export markets to thousands of small and medium-sized suppliers. Without these markets, the economy will lose sales, profits, future capital, employment, tax revenues, and export earnings.

Today the United States is involved in an economic struggle. Foreign competition for traditional U.S. manufacturer markets is becoming more intense both at home and abroad. The United States is no longer a monopolistic influence in world trade; other markets are nearly as large, other sources of supply offer comparable quality, performance, price, and service in a wide range of products. Over the last 30 years, U.S. foreign assistance has helped developing nations attain economic independence. Many prosper under the growing trend of interdependent economies and all of our trading partners regard exporting as a necessity of economic good health.

In the fall of 1978, President Carter called for export expansion via assistance to business to encourage aggressive competition. ". . . Equally important," he said, "will be the reduction of government-imposed disincentives and barriers which unnecessarily inhibit our firms from selling abroad . . ."

These disincentives include:

Administrative delays—U.S. corporate executives have ranked administrative delays and regulatory impediments first among U.S. disincentives that impact international business.[5] Delays and uncertainty relating to procedures and regulations produce discouragement and higher costs, damaging both the inventiveness and competitiveness of U.S. products and services.

Unilateral controls and impediments—When the United States is the only nation applying controls or erecting impediments to exports, it gives away sales opportunities to foreign suppliers.

Foreign policy restraints—Foreign policy restraints, which amount to economic sanctions—a form of boycotting—without the cooperation of other nations, have also taken their toll of export growth.

The United States Congress has chosen to take a strong stand against the propagation of international terrorism and the denial of basic human rights and the campaign for human rights has become institutionalized in several pieces of legislation. History has shown, however, that unilateral sanctions have failed to achieve their objectives, even when foreign availability of substitute products was much more limited than is now often the case. Over the last five years, the effectiveness of human rights considerations in granting economic assistance, military aid, export loans and investment guarantees, and in exporting some agricultural products and providing Peace Corps services has been mixed, at best. Further, foreign nations view U.S. human rights legislation as fundamentally naive and bordering on violation of international law.

Ironically, the use of economic sanctions may well worsen conditions for those it is intended to benefit. A study of boycott/embargoes imposed since 1940[6] indicates that these

[5] International Management and Development Institute, *Keeping Competitive in the U.S. and World Market Place* (June, 1979).

[6] Henry Benson and Robert Gilpin, *Evaluation of the Use of Economic Sanctions to Promote Foreign Policy Objectives* (April, 1979).

sanctions tend to harden the resolve of the opposition. The loss of economic aid from the United States usually strikes at the poor and disadvantaged, rather than at the ruling body of a country. And at home, when export sales are denied, job opportunities are inevitably reduced; again, the first and hardest hit are the economically disadvantaged.

The Export Administration Act of 1979 reflected Congressional concern for limiting the use of unilateral sanctions in foreign policy differences to those occasions where greater success would be more likely than before. The Act prescribed criteria for imposing, extending or expanding foreign policy export restraints. Additionally, it stated that consideration must be given to the foreign availability of comparable products, the likely effect of the sanctions upon U.S. competitiveness, the perception of faltering supplier reliability likely to be engendered, and the national economy. The likelihood of a sanction achieving its intended purpose, given the availability of comparable foreign products and technology must also be considered. Department of Commerce regulations initially issued January 1, 1980, failed to reflect these criteria where commercial aircraft and helicopters are concerned. Instead the regulations went beyond the law to specify the dollar value of export transactions to be reviewed. Meanwhile, from the time deliberations over the legislation began in 1978 through 1980—some eighteen months—licenses for $500 million in exports of commercial aircraft, engines, and spare parts were denied or postponed.

While the products of U.S. commercial jet aircraft manufacturers can compete very effectively in terms of efficiency, performance, quality, service and price—if price reflects real cost—valuable markets can be lost due to foreign policy export restraints, and the reputation of an unreliable supplier is spreading in world markets for many U.S. products and services because of prior experience with restraints.

Antitrust legislation—While some 30 countries have antitrust laws, the U.S. legislation is the oldest and most vigorously enforced. Domestically, these laws have been very effective in promoting competition; their application in international business, however, has set the United States apart from most of its trading partners, and disadvantaged U.S. business in competing for export markets.

While the impact of antitrust legislation on the aerospace industry may be minimal, many U.S. businessmen perceive the extraterritorial application of these laws as a major export disincentive. It is alleged that no other government restricts its commercial enterprises to such an extent in setting up joint ventures, making consortium bids, dealing with state trading companies, or negotiating with commodity cartels as does the U.S. government. No other government provides so few guidelines for what constitutes acceptable business conduct abroad or is so eager to pursue antitrust enforcement. No other government works to prevent mergers and cartels in overseas sales and investment ventures as does the United States. The 97th Congress is, however, considering changes in the current anti-trust laws.

The Webb-Pomerene Amendment to the Sherman Antitrust Act does allow firms to join together for bidding and cost sharing if the activity does not adversely affect competition in this country. Large firms have made the greatest use of Webb-Pomerene provisions, but have been increasingly loathe to be aggressive in this effort, due to an uncertainty created by recently changing interpretations of criteria for corporate behavior overseas. The Export Trading Company legislation before the 97th Congress is designed to help counteract this situation and broaden incentives for participation in export trade organizations. Antitrust laws are not themselves credited with many lost export opportunities but when the uncertainty caused by their interpretation and application is combined with the burden of anti-boycott strictures and the Foreign Corrupt Practices Act, an export venture may seem hardly worth the trouble. On balance, it would seem that any restrictions on U.S. firms' activities not equally shared by the foreign competition would tend to disadvantage U.S. exporters.

The Reagan Administration has indicated an understanding of the problems which now handicap U.S. exporters and has issued a statement on trade policy setting forth these fundamental objectives:

- Restoration of strong non-inflationary growth to facilitate adjustment to changing domestic and international market conditions.
- Reduction of self-imposed export disincentives, and better management of government export promotion programs.
- Effective enforcement of U.S. trade laws and international agreements.
- Effective approach to industrial adjustment problems.
- Reduction in government barriers to the flow of trade and investment among nations, with strong emphasis upon improvement and extension of international trade rules.[7]

At this time, the role of the government in the commercial jet transport industry is undergoing change. It is to be hoped that this leads to a restoration of U.S. world market competitiveness, as afforded in the terms of the GATT agreement.

[7] Statement of Ambassador William E. Brock, U.S. Trade Representative, before a Joint Oversight Hearing of the Senate Committee on Finance and the Senate Committee on Banking, Housing and Urban Affairs, July 8, 1981.

EMERGING INTERNATIONAL COLLABORATION

In the last few years, with the restructuring of competition in the aircraft market, changes in the world marketplace and increases in program costs, some U.S. aerospace companies have entered new relationships with foreign companies. These U.S. firms have made collaborative agreements with foreign firms to gain market share and decrease financial risk. In fact, it must be noted that 30 to 35 percent of the Airbus A300 is of U.S. manufacturing content. A look at recent history will place the issue in better perspective, providing insight into the imperatives that have developed and what lies ahead. Specifically, it is appropriate to consider what has happened to U.S. military aerospace sales over the last 20 years, a period during which the European aerospace industry has revived, grown and become aggressively competitive. Recognizing that the geopolitical environment of Europe is sensitive to many and varying factors, the European market will remain sizable and significant and its military aerospace sales trends should provide a reasonable lead-indicator of what could happen to commercial aircraft sales.

In the United States, military aerospace export sales as a percentage of total exports have remained relatively constant over the last 20 years (Table 10). However, total U.S. exports as a portion of the total free world export market have declined from 31 percent in 1960 to 22 percent in 1979 (Table 11). Another view of this same situation can be seen in Figure 22. Total U.S. aircraft sales show that the military aircraft export segment has remained relatively constant at an average 10 percent over the last thirty years. In the same time period, however, civil aircraft export sales have increased from less than five percent to 40 percent of total U.S.-manufactured aircraft sales. Both sets of data clearly indicate that military export aircraft sales have not expanded significantly in the last twenty years. Although a much more detailed analysis would be required to identify all of the factors involved, the most obvious has been the purchase of "home built" aircraft by European countries, coupled with U.S. government export restrictions. In spite of the more than 300 F-16s ordered by NATO countries from the United States in the mid-seventies, the 800 Panavia Tornadoes, 400 Alpha Jets and 400 SEPECAT Jaguars on order or delivered represent the reality of indigenous European competition altering the trend of historic sales curves. It is probable that this trend will be continued with the advent of the proposed Eurofighter.

What has happened with respect to military export sales may be a precursor of events in the commercial arena. Although worldwide sales of U.S. commercial aircraft are still strong, Airbus Industrie competition has caused U.S. market share to decline. There is a high probability that this trend will continue through the next decade.

Factors Influencing Joint Ventures

The military and commercial objectives of some foreign nations—which include increased industrial development and the creation, stabilization or increase of employment—have led these nations to develop advanced technological capabilities. Their efforts have encouraged the formation of joint venture agreements with major aerospace companies,

TABLE 10

U.S. EXPORTS
TOTAL AND MILITARY AEROSPACE
1960–1979
(Billions of Dollars)

	1960	1970	1976	1977	1978	1979
Total Exports	$20.6	$42.7	$115.1	$121.2	$143.6	$181.6
Military Aerospace Exports	$ 0.6	$ 0.9	$ 2.2	$ 2.5	$ 4.0	$ 4.1
Military Aerospace as Percentage of Total	2.9%	2.1%	1.9%	2.1%	2.8%	2.3%

TABLE 11

TOTAL EXPORTS AND EXPORTS AS PERCENTAGE OF TOTAL FREE WORLD EXPORT MARKET FOR THE UNITED STATES AND MAJOR INDUSTRIAL NATIONS
1960–1979
(Billions of Dollars)

Year	United States	France	West Germany	Italy	Netherlands	United Kingdom	Japan	Canada
1960	20.6	7.2	11.4	3.6	4.0	10.4	4.1	5.4
1970	42.7	18.1	34.2	13.2	11.9	19.6	19.3	16.1
1979	181.6	100.6	171.7	72.2	63.6	86.3	103.0	55.8
PERCENTAGE OF TOTAL FREE WORLD EXPORTS								
1960	30.9%	10.8%	17.1%	5.4%	6.0%	15.6%	6.1%	8.1%
1970	24.4	10.3	19.5	7.5	6.8	11.2	11.0	9.2
1979	21.8	12.1	20.6	8.6	7.6	10.3	12.3	6.7

SOURCE: National Aeronautics and Space Administration, Government/Industry Affairs Division, *The General Economy and the Aerospace Industry* (Washington, D.C., July 1980).

FIGURE 22

CIVIL AND MILITARY AIRCRAFT EXPORT SALES
AS PERCENTAGE OF TOTAL AIRCRAFT EXPORT SALES OF U.S. MANUFACTURERS
1950–1979

both U.S. and foreign. An interesting facet of the success of European-produced military aircraft is that all three aircraft mentioned above are products of multinational joint ventures: Panavia, which produced the Tornado, is composed of British Aerospace, Messerschmitt-Boelkow-Blohm and Aeritalia; SEPECAT, which created the Jaguar, is a joint venture of British Aerospace and Dassault-Breguet; and Dassault-Breguet and Dornier build the Alpha Jet.

Japan has also encouraged transnational partnerships. A prime example is the linking of Ishikawajima-Harima Heavy Industries, Kawasaki Heavy Industries and Mitsubishi Heavy Industries with Rolls Royce to develop the RJ500 engine. This venture is a fifty-fifty partnership. Japan's MITI (Ministry of International Trade and Industry) is reportedly loaning approximately three-fourths of the nonrecurring costs in the early stages of development. MITI's contribution will be reduced to two-thirds once the engine is committed to production. Then, until the engine begins to return a profit, MITI will continue to provide half of all Japanese costs. MITI loans will be repaid only when the engine is profitable.[1]

This financial arrangement illustrates one of the factors that makes foreign cooperation so attractive and, at the same time, makes foreign competition a major concern for U.S. companies. Interest-free, deferred-payment loans for development programs, and indigenous markets (armed forces or nationalized airlines) offer major advantages and risk reduction that enhance cooperative associations among countries.

Another consideration affecting development of collaborative agreements is the relative condition of the companies that may be involved. There are, basically, two categories of companies that pursue such ventures. The first consists of companies that, of political or economic necessity, are eager to form transborder partnerships: those that want to acquire advanced technology capabilities and those that must join a cash-rich partner in order to survive. The Japanese are an example of the former. The McDonnell and Douglas Aircraft union in the late sixties, was an example of one entity surviving by joining a strong partner. This survival syndrome will most probably be a continuing factor for some U.S. and European companies within the foreseeable future. In a second category of candidates for collaborative agreements are larger and stronger companies that initiate relationships to gain market share and/or reduce risk.

A powerful influence in favor of cooperative ventures has also emerged from the requirements of security within the Western Alliance, with the support and encouragement of the trend by the United States government. The United States, particularly the Department of Defense (DOD), has created and continues to create situations in which manufacturers are channeled into international agreements. Influencing these ventures are the need for hardware commonality, most often within NATO, and for cost reductions of sophisticated military hardware through volume production. As a result, there have been an increasing number of collaborative military projects in Europe and Japan while, in the United States, the Department of Defense has also pushed for NATO RSI (Rationalization, Standardization and Interoperability) or, more simply, for weapons collaboration.

U.S. companies have come to realize that in order to participate in this international defense market they must increasingly collaborate with foreign companies, many of which are either owned or strongly influenced by their governments. For U.S. manufacturers, "offset" required by foreign governments has frequently become an integral part of selling efforts. Offsets consist not only of the seller's buying foreign products to partially offset his sales—and, therefore, to offset the balance of trade gains—but may also involve the manufacture, under license, of part or all of a seller's product within the foreign buyer's country. Such arrangements force a cooperative relationship between U.S. and foreign manufacturers who, normally, would be in competition.

While the U.S. government has set the stage for collaborative manufacturing arrangements, still other factors have tended to encourage transborder partnerships:

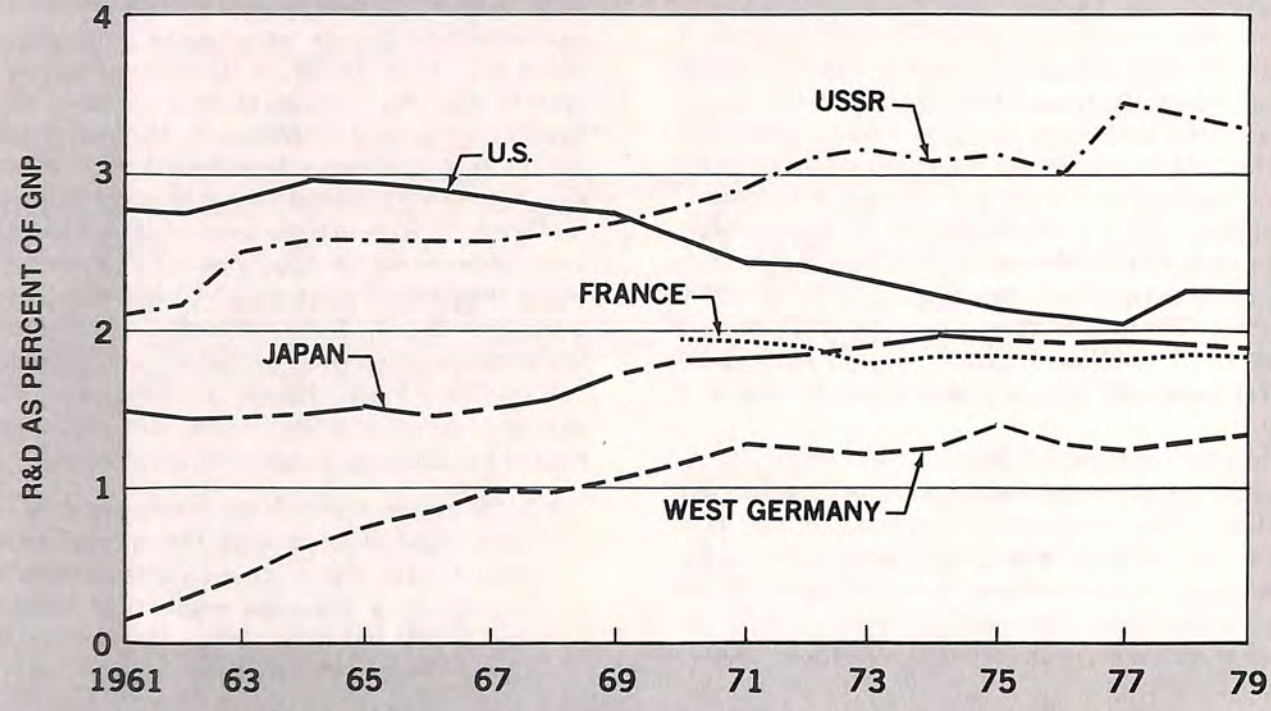
- Some foreign countries are developing their own aerospace capabilities through the conscious strategy of joining either with more advanced partners to absorb technology, or with other countries to create a synergism. The Airbus consortium is the best and most successful example of the latter approach to date and the RJ500 partnership between Japan and England's Rolls Royce could well be the next. Such strategies create a competitive atmosphere in which it becomes more difficult for weak/small companies to survive. At the same time, they set a standard and a pattern for others to follow.
- The sharing of costs of reseach and development, of launching engine and airframe programs, and of supporting and expanding production facilities is another major advantage of collaborative/risk sharing arrangements. Insofar as R&D is concerned, Figure 23 shows graphically that France, West Germany and Japan, as well as the USSR, all have maintained or increased spending on R&D as a percent of GNP while the United States has decreased spending. Even if the United States spends more in absolute terms than, for example, West Germany the trend is discomforting and reflects the decline in the federally-suported share of R&D from 56 percent in 1970 to under 50 percent in 1979. If this trend continues, and more R&D costs are borne by private firms, prices will increase and technological leadership will erode causing U.S. products to be less competitive. The possibility of sharing costs for expensive and risky R&D is a strong argument in favor of cooperative ventures with other countries.

  With either engine or airframe development costs ranging between one and two billion dollars, cost sharing has tremendous appeal. In some cases, the oppor-

[1] *The Aeroplane Makers*, The Economist, (August 30, 1980), p. 5, Survey Section.

FIGURE 23

RESEARCH AND DEVELOPMENT EXPENDITURES
AS A PERCENTAGE OF GROSS NATIONAL PRODUCT
FOR THE U.S. AND LEADING INDUSTRIAL NATIONS
1961–1979



tunity to share expenses has undoubtedly made the difference between launching a program or not.

Recognizing the variability of U.S. aerospace production figures, it is clear that the decision to expand production capacity can be critical—particularly in view of the range and variety of jetliner programs currently in production or planned (Table 12). Companies face the difficulty of matching near-term increases in facilities requirements with long-term uncertainties and cyclic demand. One solution is the utilization of the existing production facilities of foreign partners in order to satisfy current expanded requirements.

- Cooperative ventures provide improved access to markets which previously may have been unavailable or restricted. Through joint marketing organizations, third world nations and markets with unilateral orientations toward specific foreign suppliers are potentially available to the previously excluded partner.

- Many foreign airlines are controlled by military officers influenced by the military regimes of their country. The United States has already lost a significant segment of its military export sales—much of it to foreign products. By inference, what is happening in the military area can be carried over to the commercial area when foreign airlines are under government control. Somewhat in this same vein, political risk is another element in export sales to foreign nations. In both of these cases, trade becomes a tool and, in certain situations, joint ventures can minimize risk and allow a unique marketing advantage.

- The trend toward collaboration is being given impetus by attitudes, policies and laws of the United States that, combined with inconsistent and unfavorable interpretation of policies, serve as export disincentives. A more complete discussion of this issue was presented in the preceding chapter.

Trend Toward International Cooperation

Risk sharing is a relatively recent phenomenon caused by huge development costs coupled with the inability of the marketplace—the airlines—to support the number of manufacturers that existed in the fifties and sixties. Today the development costs of new engines and new aircraft are measured in terms of *billions* of dollars. Payback periods for companies that develop new products exceed 10 years and

TABLE 12

CURRENT/NEAR TERM AND PLANNED PRODUCTION WORLD COMMERCIAL JETLINER PROGRAMS

Range	Type	Source	Model	Typical Number of Seats (Mixed)	Range (Miles)	Number & Mfg. of Engines	Initial Version Date Into Service
Current/Near Term Production							
Long Range	Wide-body	USA	747-200B	442	6000	(4)P&WA,[a] GE[b] or RR[c]	1970
			747SP	321	5800	(4)P&WA, GE or RR	1976
			747SUD*	486	6200	(4)P&WA, GE or RR	1984
			L-1011-500	246	5000	(3)RR	1979
			DC-10-30/-40	277	5400	(3)GE or P&WA	1972
		USSR	Il-86	234		(4)Kuznetsov	1980
	Standard body	USA	707-320B	147	5800	(4)P&WA	1958
			DC-8-71	220	4600	(4)CFMI[a]	1982
		USSR	Il-62M	140	5500	(4)Soloviev	1968
	SST	USSR	TU-144	140	4000	(4)Kuznetsov	1975
Medium Range	Wide-body	USA	L-1011-1	256	3900	(3)RR	1972
			DC-10-10/-15	277	4000	(3)GE	1971
			747SR	500	3000	(4)P&WA or GE	1973
			767	208	3400	(2)GE or P&WA	1982
		Europe	A300B4	251	3100	(2)GE or P&WA	1972
			A310	212	3100	(2)GE or P&WA	1983
			A300-600	263	3700	(2)GE or P&WA	
	Standard body	USA	727-200	145	2500	(3)P&WA	1964
			757	178	3500	(2)RR or P&WA	1983
			DC-9-80	137	2300	(2)P&WA	1980
		USSR	TU-154	146	3300	(3)Kuznetsov	1974
Short Range	Standard body	USA	737-200	100	2200	(2)P&WA	1967
			737-300	120	2400	(2)CFMI	1984
			DC-9-30	93	2000	(2)P&WA	1965
		Europe	F-28	85	900	(2)RR	1969
		USSR	YAK-42	120	900	(3)Lotarer	1977
Planned/Potential Production							
Long Range	Wide-body	USA	747 Stretch	500+	5500	(4)P&WA, GE or RR	Mid-1980s
			DC-10-Super 30	327	5300	(3)GE or P&WA	Mid-1980s
		Europe	TA-11	226	6100	(4)P&WA	Mid-1980s
			TA-12	226	5120	(2)GE or P&WA	Mid-1980s
Medium Range	Wide-body	USA	DC-10 Super 10	277	4500	(3)P&WA, GE or RR	Mid-1980s
		Europe	TA-9	325	3200	(2)GE or P&WA	Mid-1980s
	Standard body	USA	7-7	150	1500	(2)CFMI, RR or P&WA	Late 1980s
			MDF-100	150	2200	(2)CFMI, RR or P&WA	Mid-1980s
		Europe	A320	150	1800	(2)CFMI, RR or P&WA	Mid-1980s
Short Range	Standard body	USA	DC-9 Derivative	110-120	2100	(2)CFMI or P&WA	Mid-1980s

* Stretched upper deck
a Pratt and Whitney
b General Electric
c Rolls Royce
d General Electric and SNECMA

the risk involved in each new venture is, in effect, the net worth of the company. Many of the major aerospace companies active in the fifties and sixties have had to retrench or reorient their businesses to adjust to market demand. This trend is expected to continue in the future and result in a probable reduction of the industry to even fewer companies.

Thus, the natural forces of the marketplace are directing some companies toward some form of collaboration, e.g., subcontracting or risk sharing/license/joint venture agreements.

An additional element tending to create cooperation, as mentioned earlier, has been the demands of foreign coun-

tries for offset or shared production as a requirement for military purchases. With NATO defense requirements and procurement arrangements forcing companies to collaborate, the tendency to extrapolate from the military experience to civil programs is an additional pressure that creates a favorable atmosphere, if not encouragement, for joint relationships.

Given these factors, it is easier to understand the trend toward transnational cooperative ventures, beginning with the multiple inter-European companies created in the sixties and seventies to produce the Concorde, Tornado, Jaguar, Alpha Jet and Airbus aircraft. These ventures established the standard for multinational collaboration.

In the early seventies, Pratt and Whitney courted Rolls Royce in an aborted attempt to jointly develop the JT10D engine currently designated the PW2037. Pratt and Whitney later continued the successful JT10D development with MTU of Germany and Fiat of Italy. Pratt and Whitney also entered into extensive offset arrangements with European countries to secure the NATO sales of the F100 engine in the F-16 fighter aircraft. Although the JT10D bond with Rolls Royce was not consummated, there was an agreement in 1980 for collaboration on the military engine for the Harrier V/STOL aircraft (which, in turn, would be built under license by McDonnell Douglas in the United States).

Also in the early seventies, General Electric recognized the benefits, both in dollars and in marketing, for risk sharing programs and joined with SNECMA of France in the development of the CFM56 engine. This joint venture agreement between GE and SNECMA was followed by co-production on the part of SNECMA of the larger CF6 engine for the European-produced Airbus A300/A310 aircraft.

The aircraft manufacturers have also established relationships with foreign companies:

- Recently, Fairchild Industries and SAAB of Sweden, as well as CASA of Spain and Nuritano of Indonesia, announced the joint development of commuter-sized aircraft.
- If funded, McDonnell Douglas will build the Advanced Harrier (AV-8B) under license for the United Kingdom's Hawker Siddeley.
- Douglas Aircraft subcontracts the manufacture of subsections for the DC-9 and DC-10 to foreign suppliers.
- At the current time, the Lockheed L1011 aircraft is offered only with Rolls Royce RB211 engines.
- In 1978, Boeing signed a program participation agreement with the Italians and the Japanese for design work and production on the 767.
- In 1981, McDonnell Douglas and Fokker of the Netherlands announced an agreement to explore co-production of a 150-seat transport, the MDF-100.

In considering the trend toward international collaboration, there is a need for caution regarding inferences about the nature of the aerospace export market. It must be fully appreciated, for example, that the agreements of today and those of tomorrow will not necessarily involve the same partners. A look at the history of the many consortia formed and dissolved in Europe over the last twenty years makes it reasonable to expect that the relationships existing in 1980 will not be the same as those of 1985. In addition, not all major U.S. aerospace companies are involved in foreign partnerships to the same degree. Foreign competition, then, remains an important issue for an industry in which rival firms and nations risk very high stakes for a limited number of commercial aircraft sales.

Technology Transfer

Possibly one of the areas of greatest controversy concerning collaborative arrangements with foreign partners is the consideration of technology transfer. This can best be addressed by looking at two alternative approaches to the issue. One is the complete control of technology transfer by the U.S. Government. Essentially, this is the current arrangement with cognizant government agencies directing when, and what, specific information can be transmitted to foreign countries and companies. A second approach would eliminate most of the bureaucratic burden involved in the current process. It would establish a modified free enterprise system: The government would establish a general policy or criteria for a specific application, and the applicant would present the impact of the technology transfer for an identified critical timeframe.

The obvious rationale for the first system is national security, with an implied attitude that industry is driven only by the shortsighted perspective of near-term profits. The second approach is based on the tenet that long-term survival and growth are the primary drivers for U.S. industry. It then follows that technology transfer by individual companies can be controlled and directed by their sense of responsibility—not only to their industry but, most importantly, to themselves. Few corporations do not realize and appreciate the long-term danger of providing advantage to an aggressive competitor.

The factor of critical timeframe deserves careful attention. Even if it takes longer than one normal innovation cycle for a foreign competitor to use transferred technology to its advantage—and this creates no threat to the company or industry that provided the technology—the reorientation of that technology from one foreign industry to another, or from one application to another, remains a significant consideration. But even under a system of total government control, all possible combinations of technology utilization cannot be foreseen.

In the late fifties, for example, a U.S. aerospace firm established a licensing agreement with a Japanese company, Kawasaki, for a production package which included tooling designs. Within 10 years, Kawasaki was competing successfully in an entirely different product line—but one which depended upon machine tooling—against American companies. It is only possible to guess at the contribution of the initial licensing agreement to Kawasaki's success. More importantly for the aerospace industry, however, this same Japanese company is currently a partner with Rolls Royce in developing the RJ 500 turbofan engine. It is most probable

that the development of the Japanese firm's technical production capability was evolutionary, but the question remains: Did the original technology transfer accelerate the process, and to what extent?

The issue of technology transfer obviously involves many subtleties and complexities. Among them is the benefit of two-way technical communication. Although an innovational process has historically characterized the U.S. aerospace industry and resulted in a continuing stream of new developments, products and services, it is not inevitable that the pattern will continue. It is important to remember that much current, advanced aerospace technology including the supercritical airfoil, the helicopter, jet engine and swept wing was not invented in the United States. Within logical limits, it is possible to argue that if the transfer of today's technology results in the eventual superiority of a foreign company, then the transfer probably only accelerated the inevitable. As T.A. Wilson, Chairman of the Boeing Company, has commented: "Technology transfer, in fact, has always been a two-way street and we can hardly afford to stop technical communication."

Another interesting twist to the technology transfer issue develops from the fact that current U.S. policy dictates no technology equal or superior to available military technology be exported. Because of the reductions in military R&D and procurement funding that took place over the past decade, however, there are many instances in which civil technology is superior to comparable military technology. The readily evident examples are navigation systems, the application of composite material in airframe components, and the use of active flight controls on the Lockheed L-1011. The fact that civil use precedes or supersedes military applications, should not preclude the exportation of these technologies. Obviously, industry has the obligation to exercise constraint in transferring developmental and production capabilities in these areas, but the exportation of civil manufactured products should be unconstrained by the government.

Recognizing that controls will be retained in any case, there is one element of transferrable technology from which all constraints should be removed and that is safety-related technology. There should be no restraints on freely providing this type of capability to other countries. It is the humane course of action; moreover, if advanced safety equipment is available to every airline then overall air safety is improved for both U.S. airline operators in foreign countries and foreign operators in the United States.

In much of the controversy concerning technology transfer, emotion and prejudice play a major role in forming opinions and biasing viewpoints. It is clear that timeframes and cross-industry applications have to be carefully assessed, if possible, in evaluating the effects of a technology transfer. There is, however, a fundamental, overriding question to be answered: If a foreign competitor is provided a technology it does not have but can use effectively in a relatively short time, will the transfer give it the ability to successfully compete against the U.S. companies? If the answer is yes, then, without mitigating circumstances, there should be no transfer. Still, as in most interactions, there are aspects that modify otherwise straight-forward perceptions. Was, for example, the licensed production of the F-104 in Europe a primary cause of the European aeronautical industry's redevelopment in the sixties—or did it merely accelerate evolution of a capability that had begun prior to World War II, was almost destroyed by the war, but which would have ultimately re-emerged in any event? In this case, politically encouraged technology transfer did not cause the re-emergence of a powerful competitor; it contributed to an inevitable development. (Interestingly, Lockheed Corporation, which participated in the resurgence of the European aeronautical industry, is licensee for the Alpha Jet in the United States, if it is selected as the U.S. trainer.)

The critical cause and effect criteria by which the issue of technology transfer must be judged often has to be applied with convoluted logic. For example, could an individual U.S. company have prevented the development of the Airbus Industrie's A300? Foregoing an extended point and counterpoint analysis, and weighing the role of predatory pricing policies and directed nationalistic buying, it is most probable that the A300 could not have been prevented. The requirement to succeed on the part of Airbus and the parent countries was stronger than the desire to prevent it. Given that Airbus could not have been prevented from achieving the market success that it has, what follows? What about the competition for second-tier items such as electronics and powerplants? If a U.S. company cannot successfully exclude foreign competitors, is it not justified in participating in a foreign program in order to minimize further competitive losses? The same logic can be applied to the provision of equipment, services, and technology.

It must be remembered that, with few exceptions, equivalent alternatives to U.S. products and services are available from foreign sources.

THE UNITED STATES AERONAUTICAL INDUSTRY

The Airline Industry

The U.S. commercial airline industry is a major customer for the air transport industry, although trends in passenger travel and air freight shipment have placed foreign sales ahead of domestic sales as a source of earnings. In 1979, U.S. scheduled airlines enplaned 317 million passengers, up from 172 million passengers in 1969—an increase of over 84 percent. These airlines had operating revenues of $27.2 billion and about 341,000 employees, an indication of the size, scope and impact of the industry.

In 1980, the domestic U.S. airline industry experienced a downturn in traffic due primarily to the recession. After strong growth of 17.7 percent in 1978 and 12 percent in 1979, 1980 traffic declined 4.7 percent. Following this worst historical drop in airline traffic, the industry is expected to experience an average annual growth rate of 4.5 to 5.5 percent through 1994 (Figure 24).

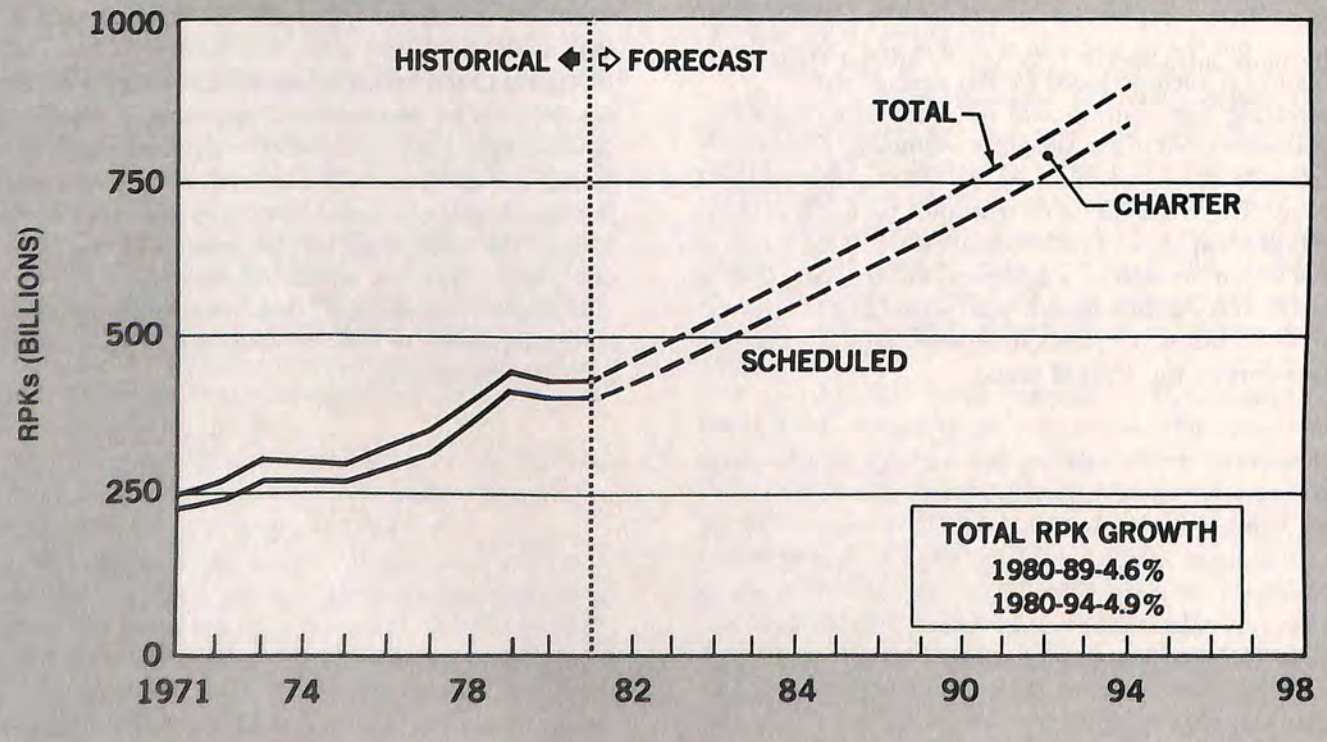
Deregulation—The legislated decrease of the Civil Aviation Board's (CAB) control of carriers, combined with CAB's own liberal attitude on competition, has created a new climate in the domestic airline industry.

Airline deregulation has caused new carriers to enter the market and established carriers to explore new routes. As a result, despite escalating fuel prices, fare discounting remains widespread. Orders for new aircraft remained relatively high in the first half of 1980, but fell off sharply after June, due mainly to the recession and falling traffic.

The short-term effects of deregulation may be highly chaotic for the airlines, and may result in an increasing number

FIGURE 24

U.S. PASSENGER TRAFFIC—AN ANALYSIS OF 36 AIRLINES
1971–1994



of mergers, as well as some airline failures. In the longer term, the effect upon traffic should be minimal, however, since people will continue to travel by air. Deviations may occur as some airline programs stimulate traffic and, conversely, as sharply increased fares due to high fuel and labor costs may dampen growth.

There are a few other possible results of deregulation:

- Continued intensive airline competition could lead to greater localized domestic capacity for some communities. As an example of the possible trend, Eastern, World, Pan Am and Capitol have joined American, TWA and United on the Los Angeles-New York run.
- Competition may create more direct service. The number of new routes certificated by the CAB under deregulation has been very large (2,500 by July 1979, according to an International Air Transport Association study). Obviously, most of these new routes have not been serviced; it is known, however, that trunk carriers added service on 336 domestic city-pairs between July 1978 and July 1979. In addition, some smaller U.S. cities have realized increased frequency of service since deregulation. In Bakersfield, California, for example, seven daily flights to and from Los Angeles and San Francisco increased to 19 following deregulation. This fragmentation of the market could lead to a demand for a smaller capacity aircraft.
- A reduction in competition during the period of adjustment to deregulation might not result in a need for additional aircraft, but lead rather to reduction of frequencies, elimination of discount fares, and fewer available seat miles.
- Efforts to alleviate airport congestion by auctioning slots or using differential fees could favor wide-body aircraft. The greater the cost to land at a popular time, the more attractive it becomes to spread these costs over a large passenger load.

It is very difficult to predict the longer-term effects of deregulation on the airline industry. While deregulation has led to overcompetition (and price cutting) and overexpansion of some routes (and lower load factors), it is not the only factor involved in the airline's current financial problems: The 1980 recession cut traffic, and escalating fuel costs contributed to a sharp increase in costs. However, deregulation and the airlines' reactions to it have been major contributors to loss of profits. Table 13 presents the financial standing of the trunk carriers in 1979 and 1980 and the difference between the two periods.

Obviously, the airlines cannot continue in this fashion. The end of the recession, renewed growth in traffic (and load factors) will reduce these losses. In fact, the 1981 air traffic controllers strike may to some extent enable the airlines to recoup through improved load factors generated by flight cutbacks. In the end, however, the airlines must learn to live with deregulation. This may involve further mergers but most certainly it means a deemphasis of cutthroat competition, and higher ticket prices for the consumer.

TABLE 13

U.S. TRUNK AIRLINES OPERATING PROFIT AND LOSS
1979 and 1980
(Millions of Dollars)

Airlines	1980	1979	1980 Better (Worse) than 1979
American	$(85)	$ 5	$(90)
Braniff	(107)	(38)	(69)
Continental	(46)	(8)	(38)
Delta	164	124	40
Eastern	2	111	(109)
Northwest	(24)	56	(80)
Pan Am/National	(130)	48	(178)
TWA	(18)	(44)	26
United	(66)	(235)[a]	169
Western	(46)	18	(64)
Airline Total	(356)	37	(393)

SOURCE: *Aviation Daily; Aviation Week*

a Result of strike

It must be pointed out, nonetheless, that some believe deregulation is a blessing and that, without it, the airlines would be in still worse shape.

"Evidence is strong that airlines would have been a lot worse off in this year (1980) of soaring fuel costs and falling traffic had they not been deregulated. I'm not sure we could have handled it," according to Neil M. Effman, Vice President for Airline Planning at Trans World Airlines, Inc.

Senator Howard W. Cannon (D-Nev.), sponsor of the Airline Deregulation Act, said: "The system as a whole has gotten more efficient because airlines can put their equipment where it can be used best. Efficiency is what deregulation is all about."[1]

Time will tell which viewpoint of deregulation is correct. At the present, all routes will become open December 31, 1981 and all fare controls will expire January 1, 1983. The Civil Aeronautics Board will go out of existence on January 1, 1985. If during this period the airline industry remains in a turmoil and does not generate an adequate financial return, a shake-out in the industry could result in a reduced number of surviving companies. If the industry does not stabilize, a remote possibility is a return to some form of regulation.

Equipment plans—The U.S. airlines are going through a transitional phase brought about by deregulation and heightened by the 1980 recession. The recession may ebb in the near future and it must be assumed that the airlines will learn to live with deregulation or that some form of regulation will be reimposed. Future equipment plans, therefore, will be triggered by traffic growth, noise legislation, operating costs, financing costs, and the availability of capital.

[1] "Flying a Risky New Route for United," *Business Week*, No. 2650, August 19, 1980, pp. 78–82.

Traffic growth—As mentioned earlier, U.S. airline traffic, after dipping slightly in 1980, will average 4.5 to 5 percent growth through 1990, and slightly higher thereafter. This growth creates a "capacity gap" that the airlines must fill with additional equipment. A Boeing study indicates that U.S. airlines will have to purchase approximately $35 billion worth of new equipment (in constant 1981 dollars) through 1990 merely to satisfy increased traffic growth. The $35 billion figure, it must be emphasized, covers growth only, no replacement. In this 10-year period (1980–1990) traffic growth will dictate an average annual investment of almost $3.5 billion for new equipment. It will also place a great strain upon the airlines to generate the profits necessary to pay for this capital equipment.

Noise regulations—In an effort to curtail noise levels, Congress passed a law on February 29, 1980, setting schedules for the retirement or modification of aircraft that do not meet specified noise requirements. The first stage of aircraft compliance must be accomplished by January 1, 1985.

Table 14 indicates the number of U.S. aircraft that did not meet noise regulations as of January 1, 1981. The table also shows that four years earlier there were over 500 more aircraft that did not meet the noise specifications.

Not all of the 1,283 aircraft listed as non-compliant in 1981 will be phased out in order to comply with the Congressional mandate on noise. Most of the DC-8-61s and -63s, for example, will be re-engined; many of the later versions of the B-727, B-737 and DC-9 will be modified. Many of the 1,283 aircraft are candidates to be phased out, however. It must be assumed that, in preparing to meet the noise regulations, airlines kept early 1980 aircraft sales up despite the recession and resultant drop in traffic. In many cases, the noise regulations have accelerated the normal retirement cycle of the airlines. Therefore, the combination of retirement of aircraft due to economics and the noise requirement results in an anticipated U.S. aircraft replacement market of $17 billion (1980–1990) or about $1.5 billion per year.

Fuel economy—There is a strong analogy between the autos Americans drove in the early seventies and the commercial aircraft built and flown up to that time; in neither instance was fuel efficiency a major consideration. That changed, however, with the fuel embargo of 1973 and escalating prices since that time have ushered in a new era. The current trend toward more fuel-efficient vehicles and the scrapping of older, less fuel-efficient models in the auto industry is also occurring within the airlines. Many aircraft which have not reached the end of their normal life, or which could be utilized until 1985 and still meet noise regulations, are being retired because they are not fuel efficient. Figure 25a indicates how fuel has now become the major portion of direct operating costs. Figure 25b shows the increases in fuel costs since 1973 from 12.5 to 86.5 cents a gallon. Decontrol of oil in early 1981 will further accelerate airline fuel costs in the short run with the average annual price rising to an estimated $1.04 for the year.

Capital requirements—U.S. airlines have and will continue to have large capital requirements spurred by traffic growth,

TABLE 14

NOISE COMPLIANCE STATUS OF AIRCRAFT IN THE U.S. AIRLINES FLEET

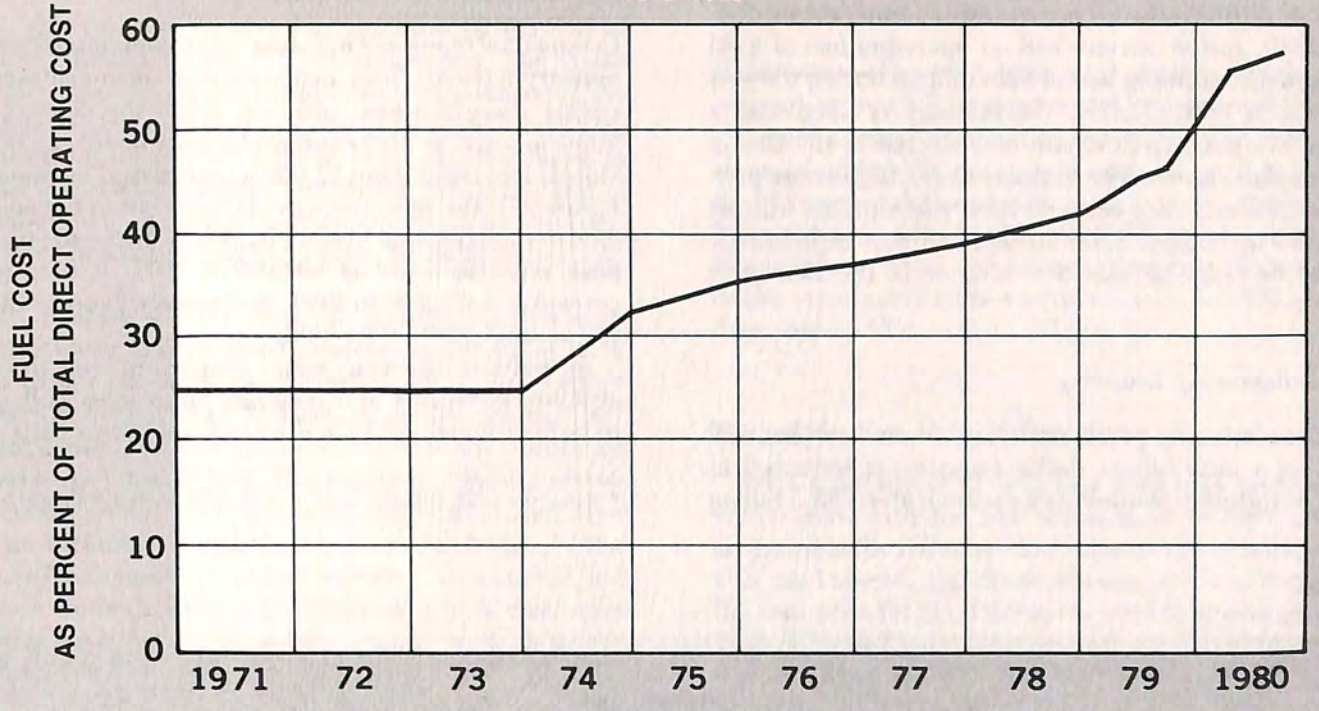
Company	Aircraft[a] Type	January 1, 1977 Compliant	January 1, 1977 Noncompliant	January 1, 1977 Percent	January 1, 1981 Compliant	January 1, 1981 Noncompliant	January 1, 1981 Percent
Boeing	B–707/720	—	298	0	—	159	0
	B–727	189	656	22.4	645	431	56.9
	B–737	7	143	4.7	79	146	35.1
	B–747	32	77	29.3	134	12	91.8
	Sub-total	228	1,174	16.3	858	748	53.4
Douglas	DC–8	—	224	0	—	161	0
	DC–9	32	335	8.7	83	316	20.8
	Sub-total	32	559	5.4	83	477	14.8
All Other	CV–880	—	25	0	—	8	0
	BAC–111	—	33	0	—	44	0
	Caravelle	—	0	0	—	6	0
	Sub-total	—	58	—	—	58	0
	GRAND TOTAL	260	1,791	11.2	941	1,283	42.3

SOURCE: Federal Aviation Administration data

a All DC–10s and L–1011s in the U.S. fleet are compliant

FIGURE 25a

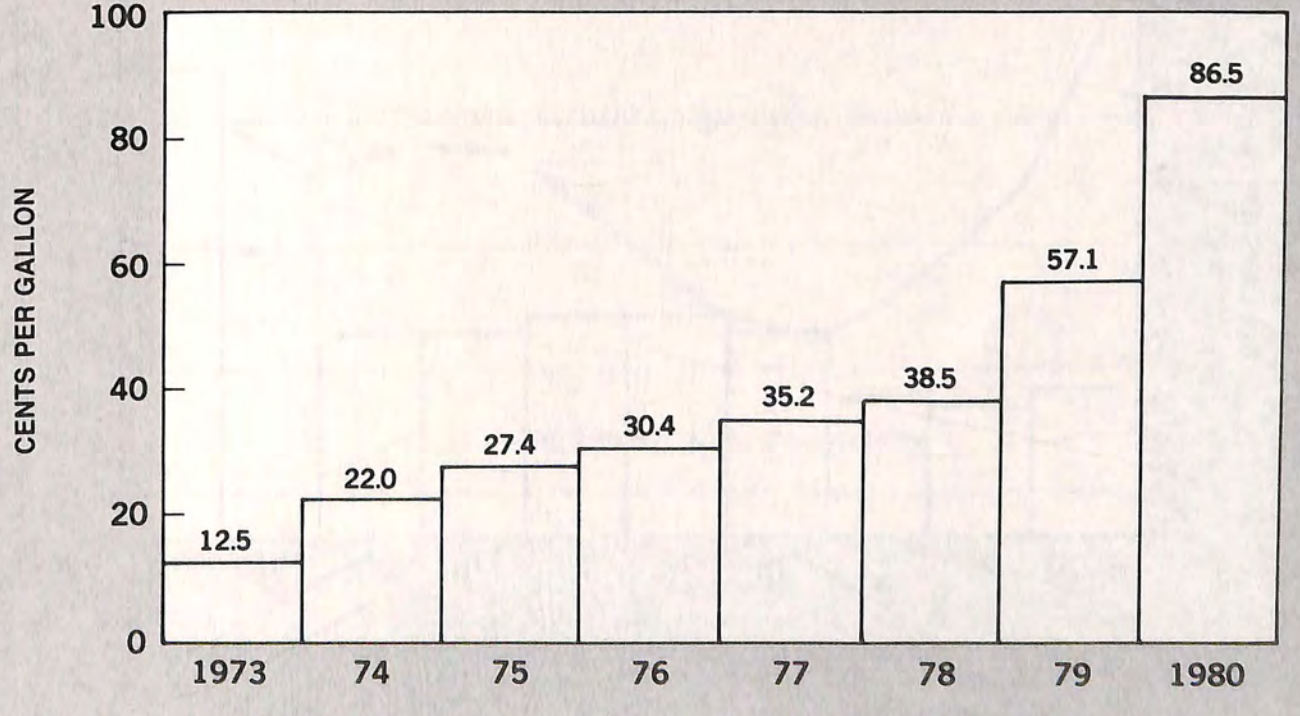
FUEL COST AS PERCENT OF DIRECT OPERATING COST
FOR U.S. TRUNK AIRLINES ON DOMESTIC SERVICE ROUTES
1970–1980



SOURCE: CAB FORM 41

FIGURE 25b

AVERAGE ANNUAL FUEL COSTS
FOR U.S. TRUNK AIRLINES ON DOMESTIC SERVICE ROUTES
1973–1980



SOURCE: CIVIL AERONAUTICS BOARD
NOTE: INTERNATIONAL PRICES VARY ABOUT 16 CENTS PER GALLON ABOVE U.S. DOMESTIC PRICES

obsolete aircraft, noise legislation and the need for more fuel-efficient aircraft. The ability to finance these capital requirements is a complex one dependent not only upon the airline but also upon the state of the financial community and the attitude of the government.

The U.S. airline industry is currently running strong deficits. In 1980, major carriers had an operating loss of $285 million and a continuing loss of $124 million during the first six months of 1981. Clearly, the industry is faced with a dilemma: the need to purchase new aircraft in the face of record-breaking losses. The industry needs to generate profits but even if this does occur in 1981, these profits will not offset the losses of 1980. Some airlines may have to go heavily into debt in order to buy new aircraft in the 1980–1990 timeframe.

The Manufacturing Industry

The manufacturing portion of the U.S. civil aeronautical industry is a multibillion dollar industry as indicated in Figure 26. Industry shipments grew from about $3.5 billion in 1970 to $13.1 billion in 1980. Even accounting for inflation, sales nearly doubled in this period.*

The civil aircraft industry is made up of three sectors with commercial transport aircraft being the major component, followed by general aviation and helicopters.

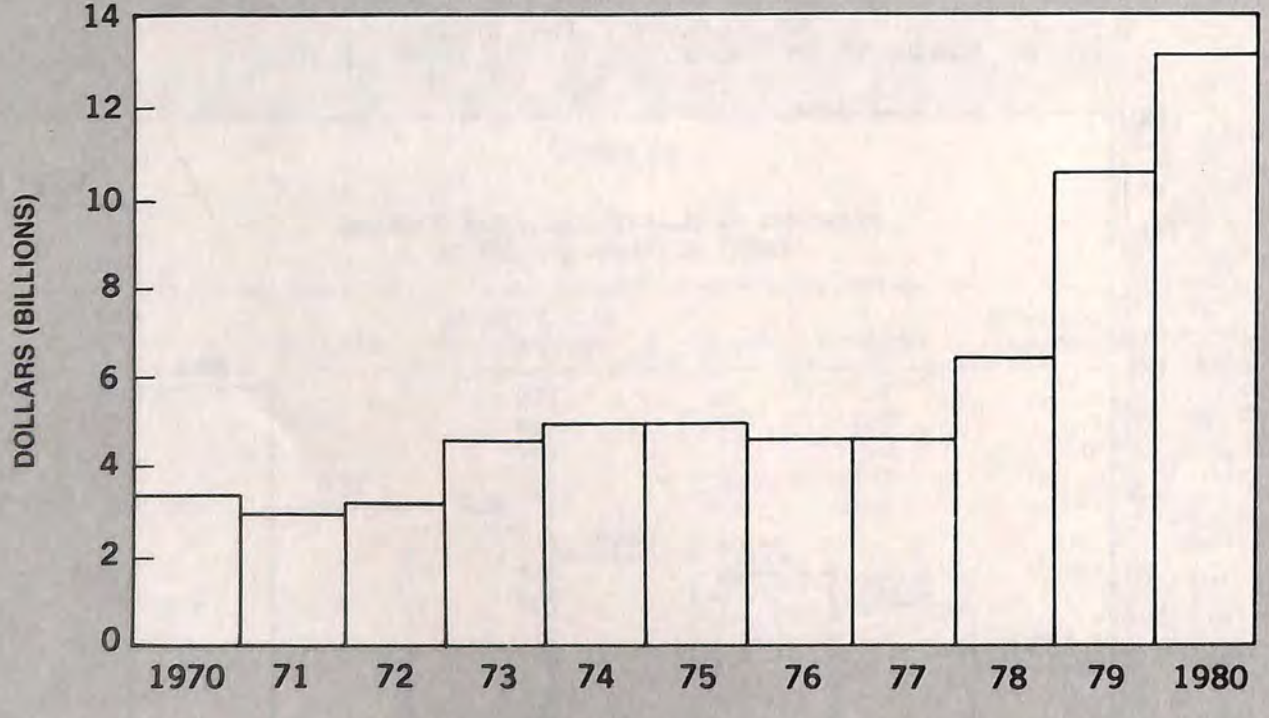
Commercial transport industry—The commercial transport industry includes three major airframe manufacturers, two engine manufacturers, and over 3,000 suppliers. The airframe industry in 1980 employed approximately 92,000 individuals including about 12,000 scientists and engineers (see Figure 27). The seventies saw employment in the aerospace industry overall drop from 1,403,000 in 1968—the industry's peak year—to a low of 894,000 in 1977; it then rose 36 percent to 1,218,000 in 1980. Preliminary figures indicate it will reach 1,229,000 for 1981.

In addition to being major employers, the three civil airframe producers also generate large sales dollars. The industry shipped $8 billion in civil aircraft in 1979, nearly

* Using the GNP Deflater, 1972 = 100; 1970 = 91.5 and 1980 = 177.4

FIGURE 26

U.S. CIVIL AIRCRAFT SHIPMENTS
1970–1980



SOURCE: AEROSPACE INDUSTRIES ASSOCIATION AND
GENERAL AVIATION MANUFACTURERS ASSOCIATION

doubling the $4.3 billion shipped in 1978. In 1980, shipments totaled nearly $10 billion. The 1970–1980 history of commercial transport shipments is shown in Figure 28. U.S. Department of Commerce data indicate that $6.7 billion of 1980 shipments were exported. Over the past five year period, the value of exports has averaged 69 percent of transport shipments from U.S. manufacturers. The dominance of the foreign market has also been pronounced in the backlog of orders, with data as of the end of 1980 showing 58 percent of the value of all unfilled orders for transports to have been placed by foreign customers. As of the end of September 1981, however, foreign orders no longer comprised over half of the backlog, having fallen to 46 percent.

General Aviation—In the seventies, general aviation manufacturers more than doubled production. While, in 1970, slightly over 7,000 units were shipped, by 1979 this figure had risen to over 17,000. In 1980, recession and high fuel costs took their toll on general aviation and shipments dropped to less than 12,000. This segment of the industry is also increasingly subject to increased competition from other countries including Brazil, Israel, France and Canada. The Embraer Bandeirante produced by Brazil, for example, is a 12–20 seat commuter in the inventory of six U.S. commuter airlines.

In 1980, general aviation shipments were $2.5 billion, up from slightly over $0.3 billion in 1970. In real terms, the industry has nearly tripled its dollar shipments in this period (Figure 29).

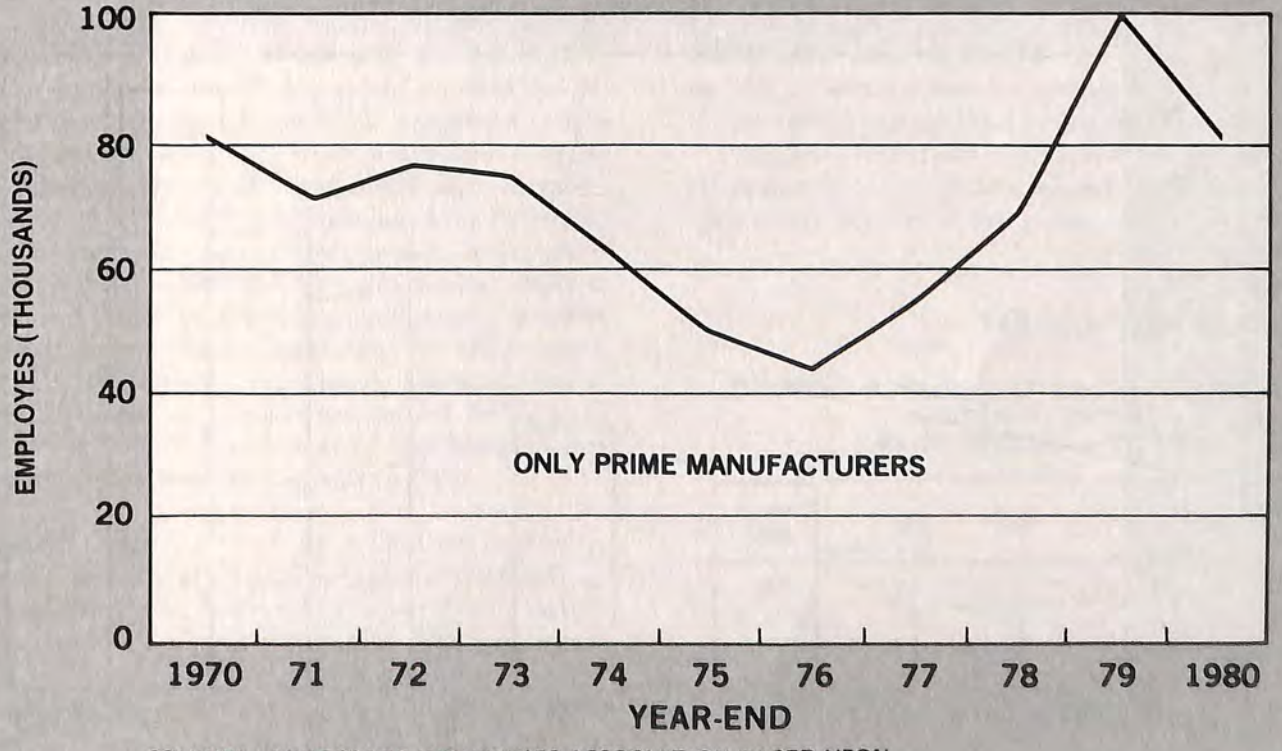
Helicopters—The civil helicopter market, while small in comparison to civil transports and general aviation, is nevertheless a significant and growing industry. The industry almost doubled the number of units shipped in the seventies. In current dollars the increase was almost tenfold (from $49 million to $403 million in 1979) indicating that, even allowing for inflation and the near doubling of units shipped, larger, more costly units were being sold. In 1980, shipments then rose to $656 million (Figure 30).

Outlook for the Aircraft Industry

With a decade of growth as a backdrop, and with shipments going over the $10 billion mark in 1980, one would assume that the industry was buoyant and optimistic. In fact, U.S. civil aircraft manufacturers are highly uncertain about the near-term future. Due to the economic downturn in the United States plus increased fuel prices, worldwide traffic

FIGURE 27

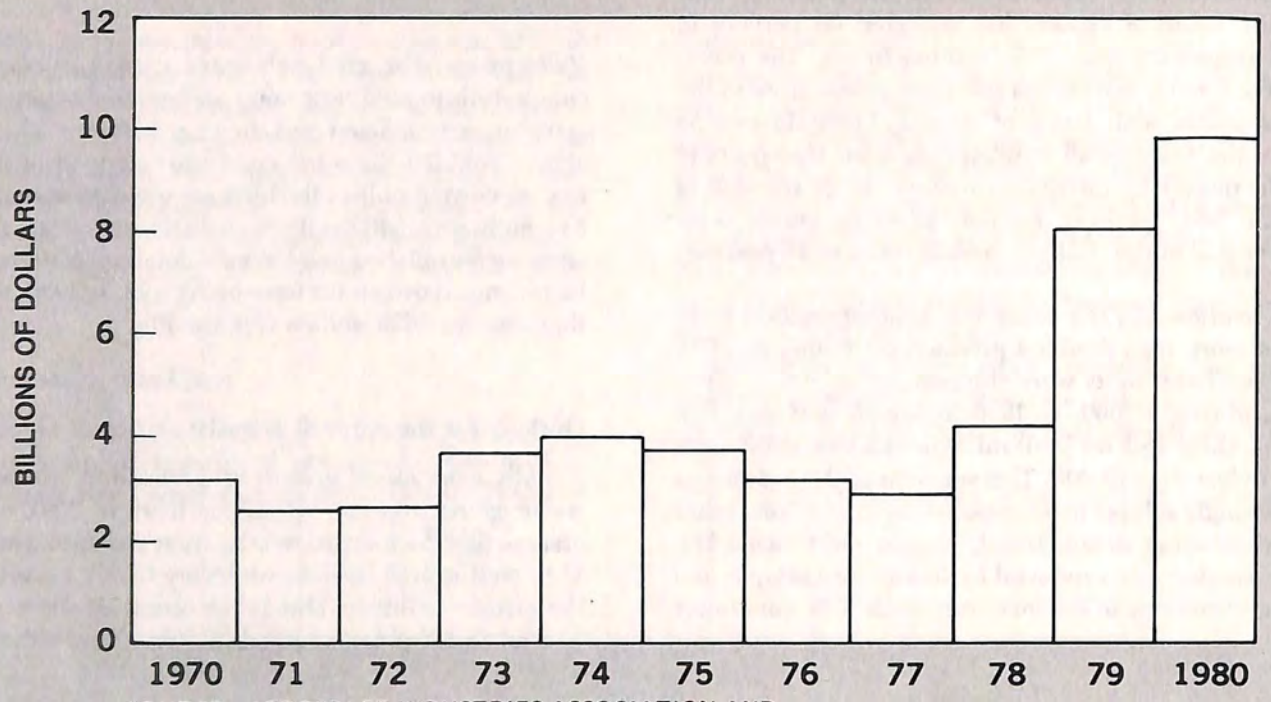
U.S. COMMERCIAL TRANSPORT AIRCRAFT MANUFACTURING EMPLOYMENT
1970–1980



SOURCE: AEROSPACE INDUSTRIES ASSOCIATION BASED UPON
U.S. DEPARTMENT OF LABOR STATISTICAL DATA

FIGURE 28

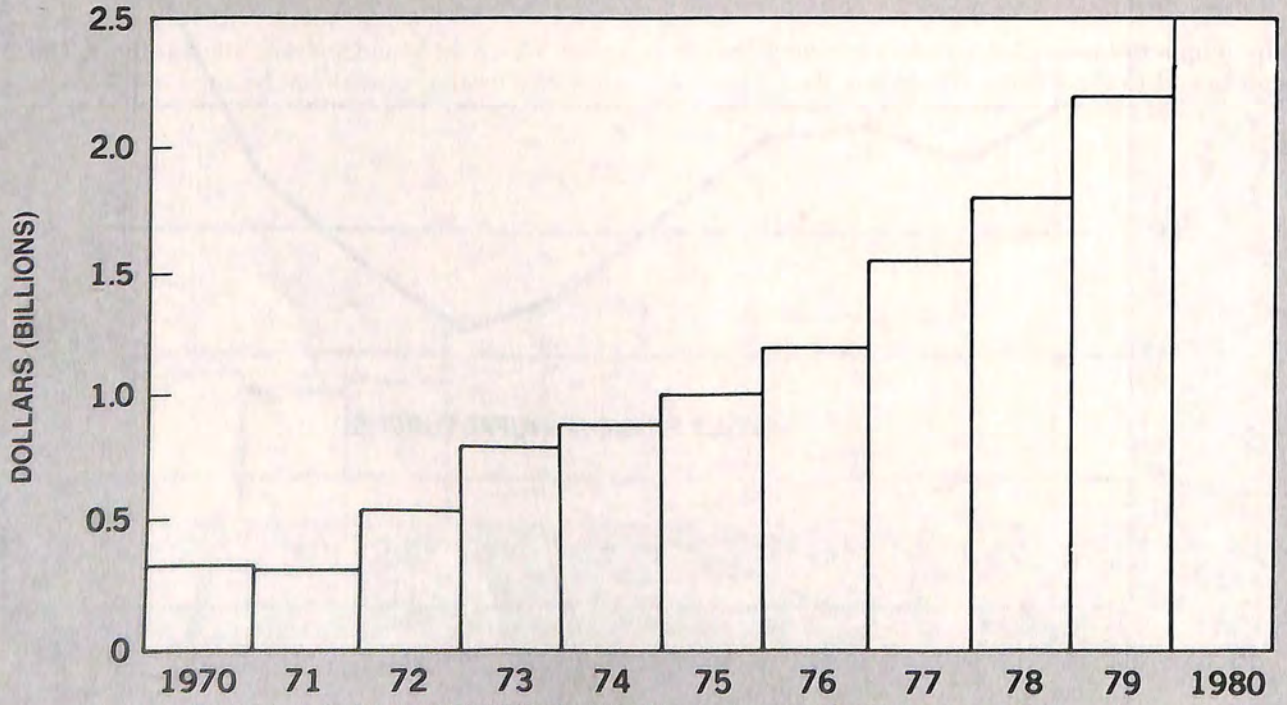
U.S. COMMERCIAL TRANSPORT AIRCRAFT SHIPMENTS
1970–1980



SOURCE: AEROSPACE INDUSTRIES ASSOCIATION AND
GENERAL AVIATION MANUFACTURERS ASSOCIATION

FIGURE 29

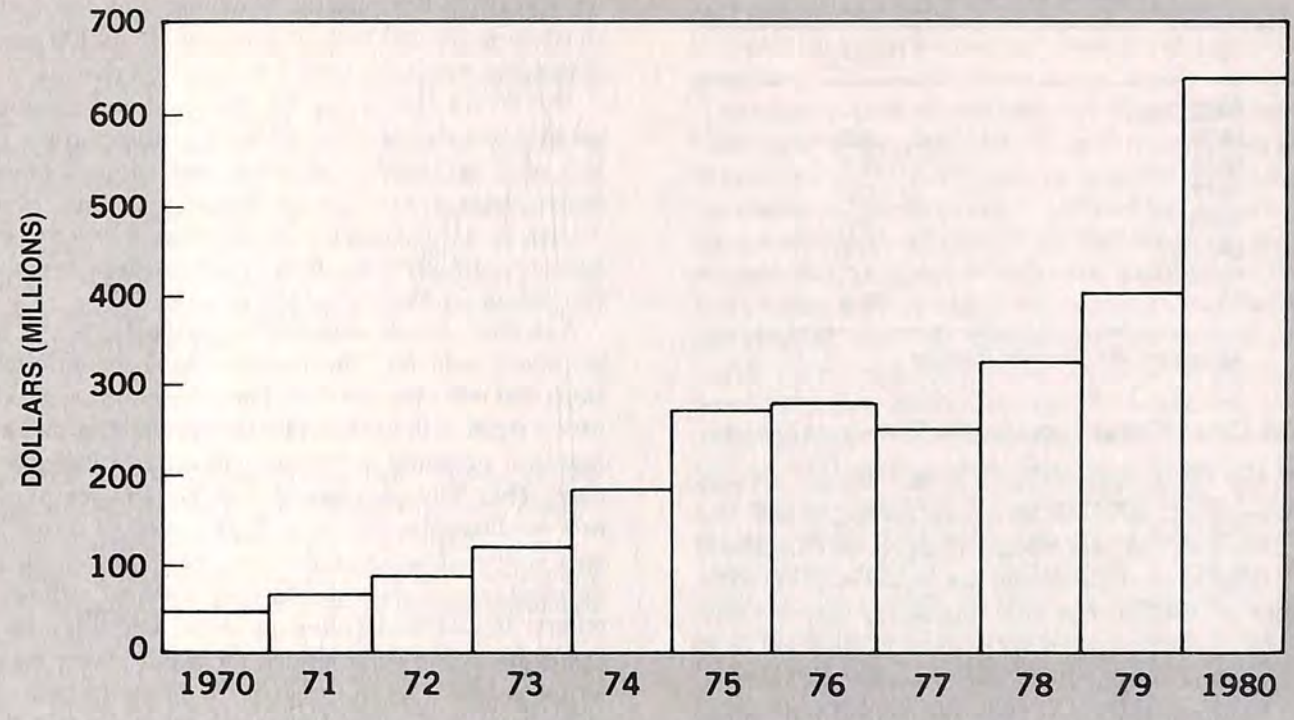
U.S. GENERAL AVIATION AIRCRAFT SHIPMENTS
1970–1980



SOURCE: AEROSPACE INDUSTRIES ASSOCIATION AND GENERAL AVIATION
MANUFACTURERS ASSOCIATION

FIGURE 30

U.S. CIVIL HELICOPTER SHIPMENTS
1970–1980



SOURCE: AEROSPACE INDUSTRIES ASSOCIATION

decline, and increased competition due to deregulation, the airlines are currently losing money, and new orders for commercial aircraft are falling off. In addition, the 1981 air traffic controllers strike stretched out existing orders, as the reduction in the number of aircraft departures lessened the airlines' need to add to their fleets. There has always been a close correlation between U.S. trunk airlines' net earnings and net orders for new aircraft. As earnings rise so do orders and, conversely, orders fall with earnings on the down-side of the cycle. Figure 14, shown earlier, presents this relationship through 1980. In 1980, airline earnings were negative, while orders remained relatively high, perhaps due to orders generated by noise regulation legislation. The 1981 air traffic controllers' strike, however, has caused a decline in traffic, with negative impact on orders for new aircraft. As Figure 14 and Table 15 indicate, U.S. wide-body aircraft manufacturers will probably suffer from overcapacity in 1982.

The aircraft industry tends to be cyclical and downturns are normally accepted as a way of life. Many of the problems the industry faces now, however, are not cyclical in nature and will continue to plague the industry. Fuel prices will continue to increase, as will route competition, but the major uncertainty in the future is foreign competition. Foreign aircraft producers present the normal threat of a rival in the competitive process, but there is also a tendency, whether by natural inclination or fiat, for potential foreign customers to buy from the home industry. Airbus, for example, has completed sales to almost every major airline in Europe: Air France, Alitalia, BCAL, Iberia, KLM, Lufthansa, SAS, Sabena and Swissair, among others. The importance of this foreign market can be seen in Table 16.

Though the extent and future threat of foreign competition are dealt with in greater detail elsewhere in this study, a brief overview is in order at this point.

TABLE 15

DELIVERY SCHEDULE OF EXISTING COMMERCIAL WIDE-BODY ORDERS
AS OF DECEMBER 31, 1980

Aircraft Type	1981	1982	1983	1984	Beyond 1984
L–1011	28	13	7	—	—
DC–10	19	6	—	—	—
B–747	51	18	6	1	—
B–757	—	—	29	26	57
B–767	—	28	74	55	9
A300	43	25	10	9	4
A310	—	—	24	26	24

TABLE 16

U.S. EXPORTS OF CIVIL AIRCRAFT, ENGINES AND PARTS 1970–1980 (Billions of Dollars)

Year	Exports
1960	1.1
1970	2.5
1976	5.7
1977	5.0
1978	6.0
1979	9.8
1980	13.2
1981[p]	13.8

SOURCE: Aerospace Industries Association

Airbus and Other Competitors in the Transport Market

In 1979, the European-produced Airbus was second only to the Boeing B-747/B-767 in bookings. Airbus, in fact, had as many orders as did McDonnell Douglas and Lockheed combined (Figure 31). One should not be led to believe that the number of 1979 Airbus sign-ups was a singular phenomenon for Airbus targeted 25 percent as its share of all wide-body orders during 1980, and achieved 32 percent. Moreover, as of September 30, 1981, the consortium held 43 percent of the world wide-body backlog.

The difficulty of coping with a competitor such as Airbus is that a U.S. contractor, having first fought head-to-head with another manufacturer, then finds it is fighting head-to-head with a consortium, strongly backed by the concerned governments. In discussing a Boeing lost sale in the Middle East, for example, *The Economist* stated that "Thanks to the direct intervention of President Valery Giscard d'Estaing (and, it is rumored, a nuclear power station contract) Kuwait Airways has ordered six A310 Airbuses."[2]

In addition to the European Airbus, the British provide some competition with a continuing low-key BAC-111 production (with licensing in Romania) plus the BAC-146, a short-range aircraft seating between 71 and 109 passengers, depending upon the model and seating density.

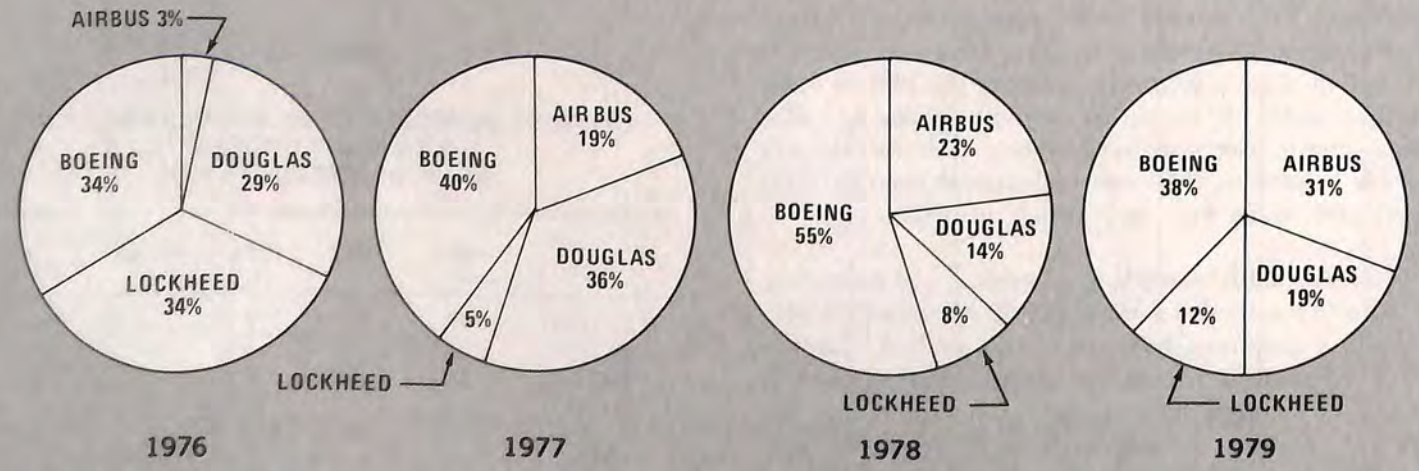
The Soviet Union has the technical and production capability to compete with Western manufacturers; however, lack of a worldwide marketing and support organization makes them a weak competitor at this time. Should the Soviets decide to remedy this situation in order to gain hard currency and prestige, they could perhaps become a real competitor by the end of the decade.

A distinct future competitive challenge is the Japanese aerospace industry. The Japanese have recently taken two steps that will enhance their know-how and capability. They have a significant portion of B-767 production and a team of Japanese stationed at Boeing will acquire valuable experience. They have also joined with Rolls Royce to develop a new medium-size 20,000 to 25,000 pounds thrust high-by-pass engine. Japan has also proposed collaboration on the development of an approximately 150-seat airliner, among others. Should the Japanese go ahead with this project, they would be laying groundwork for a full-blown commercial airline industry. As an article in *The Economist* stated: "Ever since Pearl Harbor the Japanese have shown that they have technical skills; today they can put together even the most advanced fighter as well as anybody else. When the Japanese decide to develop an industry as a national objective, others

[2] "Hard Times for America's Big Three," *The Economist*, August 30, 1980 p. 5 Survey section.

FIGURE 31

PERCENTAGE OF WIDE-BODY AIRCRAFT SIGNUPS OF MAJOR TRANSPORT MANUFACTURERS



SOURCE: AIRBUS REPORT

should watch out. Ask European steelmakers, West German camera manufacturers or Detroit's car giants."[3]

Foreign General Aviation and Helicopter Competition

Competition is growing in the general aviation and helicopter field. Aircraft are now available not only from Europe and the Soviet Union, but also from new sources such as Australia, Brazil, Canada, Israel, and Spain.

Imports of general aviation aircraft were $147 million in 1978, $260 million in 1979 and increased to $496 million in 1980. Helicopter imports were valued at $28 million in 1978 and $22 million in 1979 but rose to $54 million in 1980, a recession year. The overwhelming bulk of these aircraft, 85 percent, is imported from France with the remainder coming from Germany and Italy.

Sources and Levels of Government Support

The amount and depth of government support of civil aviation producers in the United States is greatly exaggerated. Several misconceptions must be clarified.

- The three airframe manufacturers have no government plant or equipment at their disposal for the production of civil aircraft.
- The fallout from military programs is now very minimal; in fact, there is a greater cross-over from civil to military technology.
- Much government R&D funding involves payback arrangements. The NASA composite materials program, for example, requires a royalty on each aircraft if the composite is utilized.

In regard to this last point, NASA Management Instruction 5109.3, "Recoupment Policy for the Use of NASA Technology," defines recoupment as ". . . a charge or fee (or royalty) imposed by NASA or by a contractor or subcontractor on the Government's behalf for the use of the technology or technological capability which was previously developed with NASA funding." An example of the application of the recoupment policy relates to the Pratt and Whitney JT8 refan engine being utilized on the McDonnell Douglas DC-9-80. The refan/acoustic work done under a NASA contract is being repaid to NASA through a fee paid on each engine delivered. Should Lockheed utilize active control technology for a small tail, recoupment would also take place.

Another source of government support which has also been vastly misconstrued is the government loan guarantee to Lockheed in 1971. The government did not lend money to Lockheed; it merely guaranteed the $400 million loan from the twenty-four banks involved. The risk to the government was minimal, as an article in *Fortune* pointed out: ". . . a risk Washington lawyers called 'de minimis'—in plain language non-existent. After all, the government held a first lien on Lockheed property valued far in excess of the guaranteed loans."[4] Far from being a free ride for Lockheed, the government realized a handsome return on its "no-risk guarantee"—a "$31 million profit through loan service fees."[5]

A major component of a foreign sale is the financing and the air transport industry has relied heavily on the U.S. Export-Import Bank. Unfortunately, Eximbank has been treated as a stepchild by the U.S. Congress, and its assistance to the industry has been falling short of that offered by other governments to their aircraft industries. A study by the Business International Corporation of export incentives said: "The U.S. Eximbank and the Foreign Credit Insurance Association (FCIA) have not kept pace with competing agencies in other countries. . . Many U.S. companies have found the stumbling blocks to be greater than the assistance offered."[6] A detailed look at export incentives available in other countries can be found in the chapter beginning on page 41.

[3] "The Aeroplane Makers," *The Economist*, August 30, 1980, p. 1 Survey section.

[4] "How Lockheed Got Back Its Wings," *Fortune*, October 1977, New York City.

[5] "With 7-Year Nosedive Behind It, Lockheed Sees Blue Skies Ahead," *Los Angeles Times*, September 1979.

[6] Business International Corporation, *International Export Incentives: Comparison and Analysis of Ten Key Countries* (New York, New York, 1979), pp. 251–252.

THE EUROPEAN AERONAUTICAL INDUSTRY

The Airline Industry

Generally speaking, the major European airlines are owned and controlled by their governments and are, in fact, an extension of these governments. The extent of government ownership in the case of each airline is shown in Table 17. This close relationship—partial to full ownership—between governments and their airlines assures the airlines of many benefits unavailable to U.S. airlines including direct subsidies, direct government loans, loan guarantees, special tax treatment, and government-sponsored travel promotions. Alitalia, British Airways, and Lufthansa, among others, have received direct subsidies from their governments; British Airways, Iberia, KLM, Lufthansa, and Sabena have been tendered government loans; and loan guarantees, an almost universal procedure in Europe, are available to airlines such as Alitalia, British Airways, Iberia, KLM, Lufthansa, and Sabena.

Even in countries with private airlines, the government-owned or controlled airlines are dominant. For example, Air France and Air Inter, both government-controlled companies, generate the bulk of French airline traffic. Recent data indicates that Air France and Air Inter, representing the public sector, account for about 75 percent of the French airline traffic while private airlines account for the remaining 25 percent. The European airlines controlled by their governments are under pressure to purchase locally-made aircraft. The B-767, which competes with the A300, has not been selected by any major European airline; only four of these aircraft, in fact, have been sold in Europe—two to Britannia and two to Braathens of Norway. On the other hand, almost all the major European airlines have selected the A300.

TABLE 17

GOVERNMENT OWNERSHIP OF EUROPEAN AIRLINES

Airline	Country	Percent Government-Owned
Aer Lingus	Ireland	100.0
Air Portugal	Portugal	100.0
British Airways	Great Britain	100.0
Olympic Airways	Greece	100.0
SAS	Scandinavia	100.0
Iberia	Spain	98.7
Air France	France	98.3
Austrian Airlines	Austria	98.1
Sabena	Belgium	90.0
Deutsche Lufthansa	West Germany	82.2
KLM	Netherlands	78.0
Alitalia	Italy	75.5
Finnair	Finland	75.0
Swiss Air	Switzerland	23.6

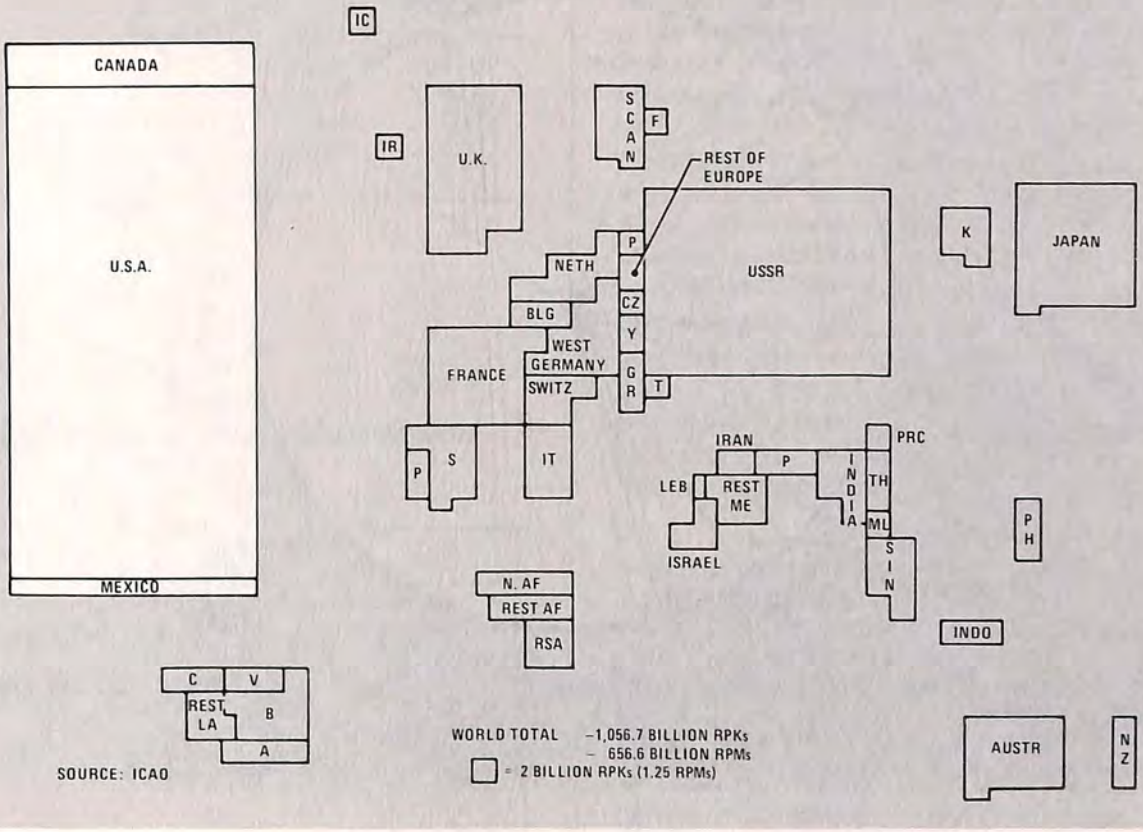
SOURCE: *Interavia*

Regional airline collaboration—A common practice among European flag carriers crossing national borders is to pool services and jointly establish schedules, equipment selection, and fares and rates. In some cases they will even pool and share revenues. An outstanding example of such collaboration is the Scandinavian consortium which formed SAS. Established shortly after World War II by the flag carriers of Denmark, Norway and Sweden, this organization collectively pooled the limited resources of these individual carriers to form a major international airline. The result is a major airline providing domestic service for member nations and carrying the flag on both scheduled and charter service around the world. Additional examples of collaboration are the ATLAS and KSSU groups. The ATLAS group consists of Alitalia, Lufthansa, Air France and Sabena, while the KSSU is composed of KLM, SAS, Swiss Air and UTA. ATLAS and KSSU were formed in the late sixties to combine the technical resources of their members in the areas of aircraft acquisition, aircraft modification, general maintenance and crew training.

Market Demand—Figure 32 has been developed in order to show the world market for scheduled airline traffic in terms of billions of revenue passenger miles served by the registered airlines of each country. If we combine all of the European segments, one can visually see that it is the second largest market in the world after the United States. Using 1979 International Civil Aviation Organization data, the world's scheduled airline traffic is broken out by nationality

FIGURE 32

WORLD SCHEDULED AIRLINE TRAFFIC
BY COUNTRY OF AIRLINE REGISTRATION
1979



of carrier in Figure 33. The segments representing the United Kingdom, France and the rest of Europe, when totaled, equal 18.3 percent, making that market again second in size to that of the United States.

The intra-European market had been growing at a rapid rate; from 1970 to 1979, it grew at an average annual rate of 12 percent. This market is projected to grow at almost double the U.S. domestic market (7.5 to 8 percent versus 4.5 to 5 percent) in the 1978–1985 period.

The Europe-Mideast market will be one of the fastest growing markets for the period 1978–1985, at 10.3 percent. Even the highly competitive North Atlantic market is forecast a 4.3 percent annual growth rate for the period 1978–1985, rising to 5.2 percent for 1985–1990. Therefore, market demand for the European carriers should be strong through this entire decade.

The Manufacturing Industry

The European aerospace industry is booming. Current estimated sales are running close to $22 billion dollars, not including such countries as Spain or Switzerland. As can be seen from Table 18, the marketing success of the Airbus program plus other continuing commercial and military programs has caused rapid increases in sales—24.3 percent in 1978 and 28.9 percent in 1979. Continued growth is expected in 1980.

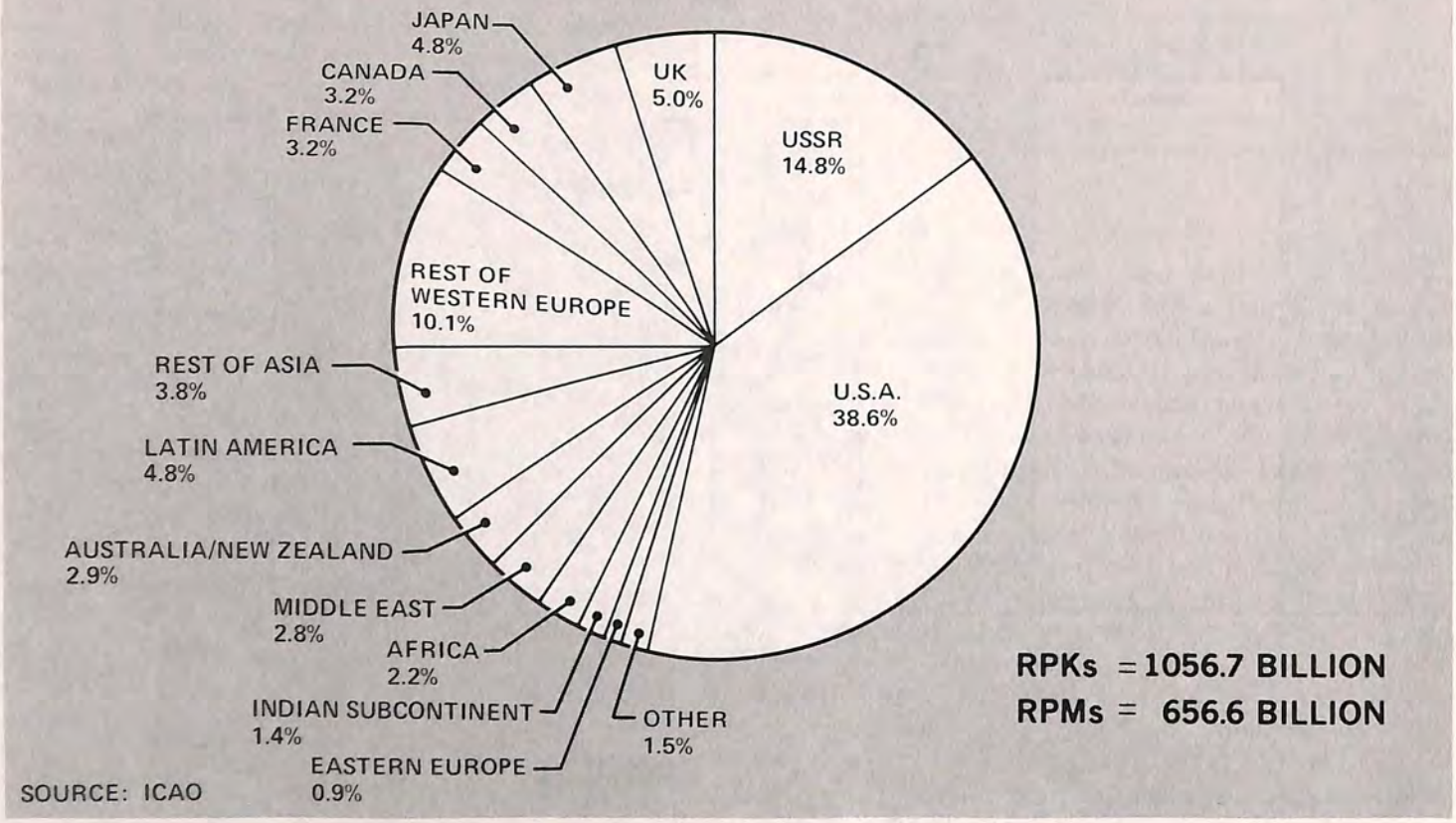
In line with the increased sales, employment in 1979 was up almost 4 percent over 1977 (Table 19). Total employment is about one half million people making aerospace a major industry. That the Europeans appreciate the value of this industry is clear: the government of Italy, for example, has declared the aircraft industry as valuable to the nation's industrial policy.

The aerospace industry also provides Europe with a valuable source of trade dollars since a good deal of its product is exported (Table 20). The European aerospace industry is fairly well subsidized by local governments. In the section that follows, specific aircraft programs are cited and attempts made to indicate the degree and level of government participation. At this point, therefore, only a few general references will be made to government subsidization.

France—Government aid to the aeronautical industry exceeded $15 billion from 1970 to 1979 or an average of $1.67 billion per year. Funding for Airbus alone will total $1.21

FIGURE 33

DISTRIBUTION OF WORLD SCHEDULED AIRLINE TRAFFIC
BY NATIONALITY OF CARRIER
1979



SOURCE: ICAO

billion—almost a quarter billion dollars a year—over the next five years.

Germany—The West German Government will provide about $300 million annually through at least 1984 to support their industry's civil aviation projects.

Italy—A law was passed in 1978 to provide assistance for aerospace exports. Aeritalia is a nationalized company and military, government-funded business currently accounts for between 60 and 70 percent of total production. An example of the government's aid to Aeritalia in the commercial field is the approximately $225 million loan to help in the development of Aeritalia's portion of the B-767.

United Kingdom—The Conservative Government recently denationalized British Aerospace Ltd. but this company was heavily subsidized by previous governments on various commercial programs, particularly the Concorde. Further, the British government will have a share of between 48 and 50 percent of the new company and the firm's new relationship with the government will not endanger its participation in the Airbus program.[1] British Aerospace was expected to approach the government in 1981 for development loans to ensure its role in the A320 project.[2]

Netherlands—Fokker prides itself on being a free enterprise concern and yet the $40 million of F-28 development funds were half government funding and half government guaranteed loans.

[1] British Aerospace Offer for Sale of Ordinary Shares, published on behalf of the Secretary of State for Industry, United Kingdom, 1981.

[2] "Government Before Shareholders for BAE's Airbus 320 cash?" *Flight International* Vol. 120, July 4, 1981, p. 5.

TABLE 18

ESTIMATED EUROPEAN AEROSPACE SALES
1977–1979
(Billions of Dollars)

Country	1977	1978	1979
France	$ 5.5	$ 6.1	$ 9.4
United Kingdom	4.4	6.2	6.7
West Germany	2.6	2.7	3.5
Italy	.7	1.1	1.3
Netherlands	.3	.4	.5
Belgium	.1	.4	.4
Total	$13.6	$16.9	$21.8

TABLE 19

ESTIMATED EUROPEAN AEROSPACE EMPLOYMENT 1977–1979

Country	1977	1978	1979
France	106,000	103,425	106,300
United Kingdom	200,000	191,000	199,200
West Germany	52,400	55,000	62,000
Italy	34,500	36,000	38,500
Netherlands	7,300	7,425	7,935
Belgium	4,900	5,070	6,600
Total	405,100	397,920	420,535

TABLE 20

ESTIMATED EUROPEAN AEROSPACE EXPORTS 1978–1979 (Billions of Dollars)

Country	1978	1979
France	$4.2	$ 6.6
United Kingdom	2.6	2.8
West Germany	1.1	1.4
Italy	.4	.5
Netherlands	.2	.3
Total	$8.5	$11.6

In summary, with both sales and employment up, the European aerospace industry is booming. In effect, the individual governments of Europe are partners with the aerospace industry and underwite not only the total military portion but a great deal, if not most, of the commercial portion of production. The various governments also actively encourage exports and, in many cases, join in the selling of aerospace manufacturers.

European Programs: Two Decades of Aircraft Production

Table 21 shows the number of European commercial transports delivered over the past 20 years. It also illustrates the capabilities of the European airframe industry to build a wide range of types of aircraft from a shorthaul, forty-passenger aircraft such as the VFW-614 to a long-range supersonic transport like the Concorde. While most of the programs—the Mercure, Comet, VC-10, Concorde and VFW-614, for example—have been distinct failures, others have been reasonably successful from a marketing standpoint. Almost 300 Caravelles were delivered over a period of fifteen years (1959–1973). Over 200 BAC-111's have been delivered and, with license production to continue in Romania, deliveries are guaranteed well into the 1990s.

U.S. manufacturers, without their government's support, could not survive short production runs such as that of the Comet, VC-10, Trident, and Mercure. Convair, for example, went out of the commercial aircraft business when the 880/990 production stopped at 102 aircraft.

It is interesting to note that at no time during the twenty-year period from 1960 to 1979 were there less than two types of European jet aircraft ready for delivery and, at one point, there were seven active programs (Figure 34).

With only 16 aircraft built and 10 delivered, the Concorde program could be assumed a failure and, from a strictly financial standpoint, it was. From a technical standpoint, however, the Concorde must be considered a resounding success, and the psychological lift it has given to the European aerospace industry is difficult to measure. Europeans long inured to second place vis-a-vis their American counterparts could now stand with pride for being first with a supersonic transport. This pride has been further augmented by the marketing and technical successes of the Airbus program.

European Programs: Objectives and Funding Sources

Airbus—The Airbus program is without a doubt the most successful program ever attempted by the Europeans. As stated earlier, Airbus had greater wide-body aircraft sales in 1979 than both Douglas Aircraft and Lockheed Corporation combined. In units, in fact, Airbus had more wide-body sales than Boeing in 1979—132 aircraft vs. 130—capturing 40 percent of the market. In 1980, Airbus again outperformed Douglas and Lockheed and captured 32 percent of wide-body orders (Figure 35).

TABLE 21

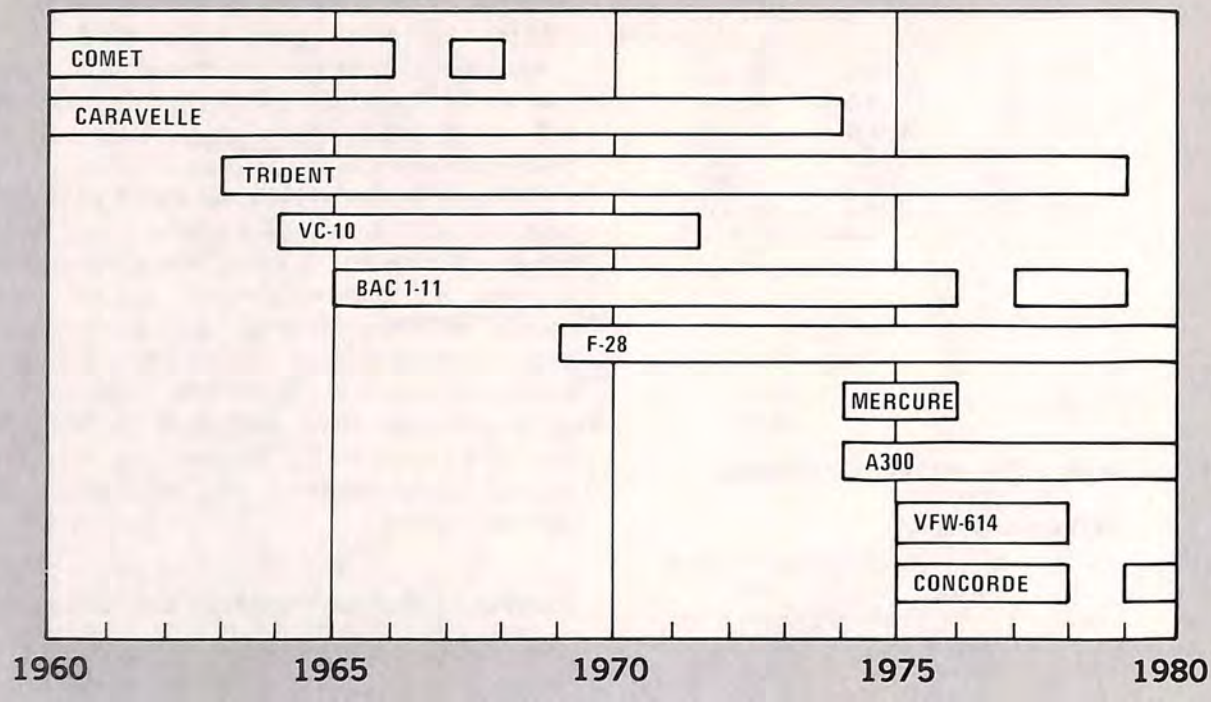
EUROPEAN JET AIRCRAFT DELIVERIES 1960–1979

Aircraft Type	Number
Comet	33
Caravelle	222
Trident	117
VC–10	54
BAC–111	224[a]
F–28	144[a]
Mercure	10
A300	81[a]
VFW–614	10
Concorde	10
Total	905

a Still in Production

FIGURE 34

EUROPEAN COMMERCIAL TRANSPORT DELIVERIES
1960–1980



The basic A300B2 is a twin-engine, short/medium range aircraft with about 245 seats. The A300B4 is similar to the B2 but with greater range. The A310 is a derivative of the A300B2/B4, with a 20-foot shorter fuselage and decreased seating capacity of about 210 passengers; it competes head-on with the Boeing B-767. Deliveries of the A310 will start in 1983. (See Figure 35.)

The A300 is built by a European consortium called Airbus Industrie composed of Aerospatiale of France, Deutsch Airbus (MBB and VFW-Fokker) of Germany, British Aerospace and CASA of Spain. Aerospatiale and Deutsch Airbus each have a 37.9 percent interest while British Aerospace has a 20 percent interest and CASA a 4.2 percent share. VFW and Fokker, who dissolved their partnership in 1980, are associate members of the A300 and A310 programs, while Belairbus of Belgium is an associate on the A310 program. With the exception of Fokker, all of the companies are fully or partially owned by either their federal governments and/or local state governments.

The production force for the A300/A310 is currently about 12,000 employees and, according to an Airbus official, should increase to a total of about 28,000–29,000 by 1985[3]

Both the German and French Governments have heavily funded the Airbus program. The Germans estimate they will have to invest well over 2.5 billion deutsche marks through 1985 on this program. The French have said their costs, ". . .since the beginning of the program, at the expense of the budget alone or of Aviation Civile (Civil Aviation) amount to a total of 2,574 million francs (1.03 billion U.S.)."[4] In addition, the French will provide another $1.21 billion of funding for the Airbus program through 1985.

The other major contributor to Airbus is Great Britain. In 1978 the British and the consortium reached an agreement whereby Great Britain would rejoin the program. After an initial fee of about $50 million, the British agreed to invest an additional $500 million through 1983.

As Francois Swarttouw, Chairman of Fokker, said in the July 1979 issue of *Interavia* magazine, "It's a delicate subject—Airbus. It's a successful aircraft, but it requires basic support from the German and French Governments. As you have written yourself, 10 million Deutsche marks per aircraft"

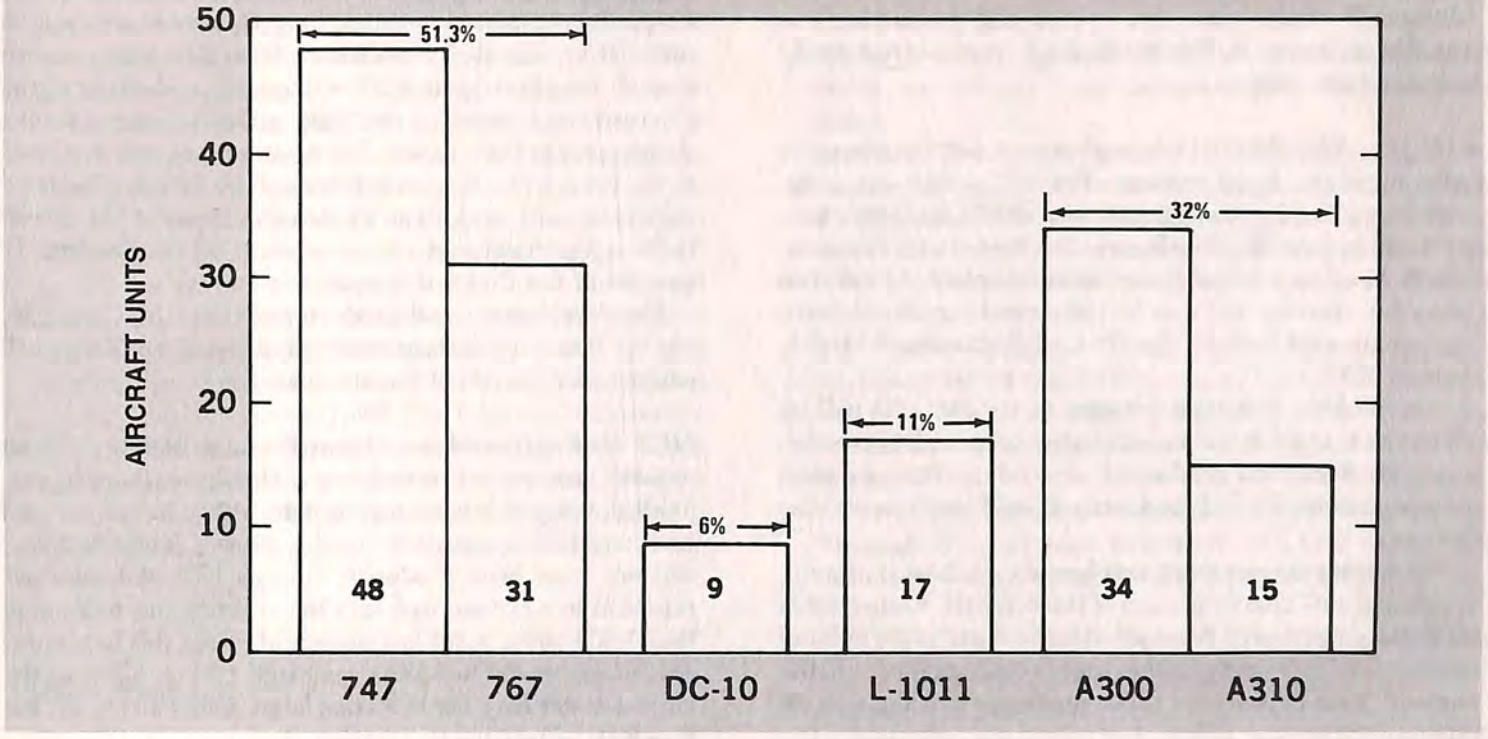
The backing of these governments gives Airbus Industrie tremendous leverage and this was most apparent in the sale to Eastern Air Lines in 1978. The terms and conditions offered Eastern were truly exceptional and would have been

[3] "Airbus Gears for Production Increase," *Aviation Week*, November 12, 1979, p. 56.

[4] "General Report presented in the name of the Commission of Finances, Budget, Control and National Economic Accounts on the Bill of Finances for the year 1980, adopted by the National Assembly," (translated from the French).

FIGURE 35

WIDE-BODY AIRCRAFT ORDERS
1980



impossible for any U.S. manufacturer to meet. Eastern was given four aircraft to operate on a nearly cost-free trial basis. When Eastern confirmed its order, the trial lease agreement was changed to a 14.5 year lease agreement. Airbus Industrie agreed to arrange for $250 million of 10-year export credit financing through a group of European banks at 8.25 percent interest. It provided approximately $96 million of manufacturers' subordinate financing and further agreed to underwrite the operating costs of a portion of the capacity of the aircraft for at least four years (Eastern said it needed only 170 seats while the purchased aircraft would have 244). Additional inducements were offered Eastern as well. Clearly, it would have been impossible for a private enterprise U.S. aerospace manufacturer to come close to meeting these terms.

The production schedule for the A300 and A310 models calls for 33 aircraft in 1980, 43 in 1981, 55 in 1982, 72 in 1983, and 89 in 1984. One Airbus official has said that total sales should run over 1200 units.[5] To keep production levels up the consortium is looking at various derivatives. One actively being considered is the A300B9, a stretched version capable of increasing the basic B4 capacity by 20 percent. Other stretch versions would increase capacity to 25 percent. Still another with deliveries slated for late 1983 is the A300-600 which involves a grafted tail on the B2/4 allowing it to carry 10 additional passengers. The SA 2 (single aisle aircraft) can seat 162 passengers and its range is over 1800 nautical miles, or the SA 1 can seat 132 passengers with a range of 2300 nautical miles.

Fokker F28/F29—The F-28, built by Fokker of The Netherlands, is a twin turbo-fan, short/medium range transport seating from 44 to 85 passengers in the stretched version. About 150 F-28s have been delivered through 1979. Production is expected to continue at a relatively low level well into the eighties and total production approaches 250 aircraft.

MDF-100—The MDF-100 is a 150-seat, short/medium range aircraft. Fokker has been actively seeking a partner to develop and produce the MDF-100 and early in 1981 signed a memorandum of understanding to explore an agreement with McDonnell Douglas. Fokker hopes to launch this program no later than 1982, with deliveries starting in 1986. It is difficult at this time to ascertain what the possible sales for this proposed program would be.

Fokker has prided itself that its only government assistance in launching the F-28 was an initial government order for twelve aircraft, plus subsidies and government loan guarantees of $40 million. The MDF-100 program will require the Dutch Government to fund from $250 million to possibly half the total of an estimated $800 million in development costs. The Dutch Government participation, in other words, could total $400 million.

[5] *Aviation Week*, March 3, 1980.

VFW-614—The VFW-614 was a short-range, commuter aircraft seating 40 to 44 passengers built by a consortium of German and Dutch firms with heavy government involvement. SABCA of Belgium and Short Brothers of the United Kingdom had minority interests in the project. Development of the VFW-614 was very slow causing costs to escalate. Additionally, there were few orders and production was curtailed at 10 aircraft. The involved governments reportedly lost over $125 million.

BAC-111—The BAC-111 is a short-range, twin-engine jetliner and the latest version—the -475 series—is configured for up to 80 passengers. A total of 227 BAC-111's have been sold to date. Under a license agreement with Romania, British Aerospace will deliver three complete aircraft (two passenger versions and one freighter) and transfer technology, which will lead to the first all-Romanian BAC-111, through 1985.

It is unlikely that new versions of the BAC-111 will be offered in view of other aircraft being proposed. Nevertheless, with Romanian production assured, additional orders must be anticipated and production should continue into the 1990s.

The British Government was heavily involved in the development and launching costs of the BAC-111. From 1960 to 1969, the government invested £18.75 (close to $50 million) on the BAC-111, and another nearly $25 million on the engines. Total payback on these programs was less than $9 million.[6]

Mercure—The Mercure was another multi-national project with the French in the lead with a 70 percent interest. Other members included Italy's Aeritalia and Spain's CASA with 10 percent each and SABCA of Belgium and F&W (Emmens) of Switzerland as minor partners. The Mercure is a 132/162 seat, twin-engine, short-haul transport. Only ten of the aircraft were delivered in 1974 and 1975 and the project was abandoned. The French pursued the idea of teaming with McDonnell Douglas on a joint venture to improve the Mercure and replace the DC-9, but this was abandoned after some preliminary work. The involved governments, primarily the French, invested and lost at least $150 million on this project.

Concorde—The Concorde is a technical accomplishment but a financial disaster. Not only was the production phase a tremendous burden on the British and French Governments but, in its current daily operational phase, the Concorde must continue to be subsidized.

The four-engine supersonic transport is capable of carrying 128 passengers approximately 3,000 miles, although with maximum fuel its range is somewhat greater. The program was doomed, however, by the cost of the project, the aircraft's high seat cost, restrictions prohibiting it from flying over land masses at supersonic speeds, and the ever increasing cost of fuel. A total of 12 Concordes were delivered, all to the state owned/controlled airlines of Britain (British Airways) and France (Air France). Four more Concordes remain undelivered.

The total cost of the Concorde to the British and French Governments is hard to determine. One trade publication said, "It is estimated that British Aerospace (government-owned) may lose up to $350 million on production of the Concorde not counting the $980 million invested in the development of the aircraft."[7] It must be assumed that costs to the French closely parallel those of the British. The same publication also said, "The French Government has agreed to bear the fixed cost of the aircraft, while covering 70 percent of the Concorde's operating losses".[8]

The development and production bill for the Concorde, and the losses, were staggering and the operating losses will continue for the life of the aircraft.

MBB Helicopter—Messerchmitt-Boelkow-Blohm is about one-half government-owned (city of Hamburg, Bavaria, etc). MBB developed a twin-engine light utility helicopter and has been highly successful in this project. Over 500 civil versions have been produced through 1979 and sales are expected to continue well into the eighties and total more than 1,000 units. MBB has successfully sold this helicopter around the world including mainland China. Sales to the United States have not been that large, under 100 in all, but they have penetrated that market. Sixty percent of the initial funding was in the form of a loan from the German Ministry of Economic Affairs, while additional funding was forthcoming from the German Ministry of Defense.

Aerospatiale Helicopters—Aerospatiale has been highly successful in the helicopter market. According to Rene Monory, French Economic Minister, "In the field of helicopters, SNIAS is in third place behind Bell and Sikorsky, and is exporting more than 60 percent of its production with a growing diversification into the private sector. Through its aerospace subsidiary, Helicopters Corporation in Dallas, it already has 25 percent of the American market for civil helicopters."[9] Government aid to the aeronautical industry exceeded $15 billion over the past nine years or an average $1.67 billion per year.[10]

Aerospatiale helicopters include:

- *Alouette*—A general purpose helicopter of which almost 300 copies of one version, the Lama, has sold in 24 countries and is now being produced in India under license. The SA316B has also been licensed to India, Romania, and

[6] Neil Carmichael, Joint Parliamentary Secretary, Minister of Technology, United Kingdom, quoted in *Flight International*, February 19, 1970.

[7] "Civil Aircraft," *DMS Market Intelligence Reports*, Greenwich, Conn., 1979.

[8] Ibid.

[9] "France 1980, Economic Expansion Japanese Style," *Business Week* (Special Section), 1980.

[10] Ibid.

Switzerland. Civil production of these models should continue to the mid-1980s, with annual production currently at 40 per year, and falling to 24 per year.

- *SA321 Super Frelon*—Sikorsky helped develop this version of which over 100 have been sold in eight countries.
- *SA330 Puma*—The Puma is a medium-size transport produced in a joint program with the United Kingdom. The basic Puma has sold almost 650 copies in 43 countries.
- *SA350 Ecureuil/Astar*—A six-seat, light, general purpose helicopter, with Astar and Twin Star versions aimed at the North American market. Well over 2,000 copies of these should sell by the mid-1980s.
- *SA360C Dauphin*-This light helicopter is aimed at the offshore oil, utility and executive transport market. Close to 100 are on order, including orders from the United States. The U.S. Coast Guard has selected the Dauphin to fulfill its Short Range Recovery Mission. Sales of this version should continue through the eighties and by that time should be well over 1,000. The French Government's participation in the helicopter industry has been a long and continuing one. The government/industry relationship has resulted in French aerospace exports soaring to $6.56 billion in 1979, up nearly 57 percent from the $4.18 billion of 1978.

Military Programs

Each of the European governments is deeply involved in military programs and while complete coverage of these programs would be out of place in this report, a brief overview would include the following.

- *Mirage*—This French fighter is one of the most successful military programs ever undertaken by the Europeans. Close to 2,000 have already been ordered by 27 different countries and production was licensed in Australia, Belgium and Switzerland. Overall production will continue into at least the mid-1980s and could run to over 2,500 aircraft. A follow-on program, the Mirage 2000/4000, is already under development with deliveries slated for 1982 and this should carry the program through the eighties.
- *Panavia Tornado*—Over 20 of this fighter/bomber produced by Italy, the United Kingdom and Germany have been delivered through 1979. Over 200 are to be delivered by the mid-1980s out of a total of approximately 800 currently on order.
- *Alpha Jet*—By early 1980, 100 of this French/German light attack aircraft had been delivered with almost 500 on order.
- *Harrier*—The British produce this V/STOL tactical aircraft and produced 123 for the British government through 1979. Another 180 were produced for the United States and 13 for Spain. Production will continue through at least 1982. McDonnell has received the license for production in the United States.

The smaller European nations such as Belgium and The Netherlands are all involved in many of these military programs as suppliers or minor participants. There are also other military programs in some of these countries. For example:

- *G222*—Italy builds this general purpose transport. Through 1979, 28 were delivered with total production anticipated at 500, carrying the program through the eighties.
- *C-212*—Production of this Spanish light STOL transport is currently about 60 per year and should continue at least through the mid-1980s.

The European aerospace industry as a whole has a solid business base subsidized by government defense departments. Military programs, such as those just mentioned, help pay overhead costs for all programs, reducing the cost of commercial aircraft programs and providing possible technical fall-out from military to commercial programs.

There is a significant difference between the European airlines and aeronautical industries and their American counterparts and that is government involvement and ownership versus free enterprise. The U.S. industries, while they do not desire greater government involvement, do feel that they are at a competitive disadvantage in their day to day activities.

JAPANESE AND BRAZILIAN AERONAUTICAL INDUSTRIES

Many countries of the free world, other than the United States and the nations of Europe, are rapidly developing capabilities in the production of both civil and military aircraft. Two of the most outstanding are Brazil, which has been particularly successful in production of general aviation aircraft, and Japan. Because of their outstanding technical and commercial successes in other areas, the Japanese are seen as formidable competitors as with government support, and planning, they move to develop their aeronautical industry.

JAPAN[1]

The Airline Industry

Japan's three major airlines are Japan Air Lines (JAL), All Nippon Airways (ANA) and Toa Domestic Airlines (TDA). JAL operates domestic trunk routes only while ANA flies both trunk and local routes. TDA operates primarily local routes, though it also serves two trunk routes. Regional scheduled services are offered by Japan Asia Airlines, Nihon Kinkyori Airways and Southwest Airlines. Of the three major airlines, JAL is the only one that is half government-owned and Japan Asia Airlines, the newest of the six carriers, is a wholly-owned subsidiary of JAL. The other airlines are privately-owned.

Japan's scheduled air services have experienced remarkable growth since commercial activities were resumed in 1951 following a post-World War II prohibition. The five domestic carriers handled 33 million passengers in 1979, up almost 16 percent from the previous year. On the average, growth for 1980 is forecast in the range of 10–15 percent. The long-term annual growth is expected to be about 7–10 percent.

All of the Japanese airlines have been particularly affected by the high and increasing cost of fuel in a nation dependent on imports for 99 percent of its oil, and the airlines are attempting to reduce fuel usage and to rationalize their operations. The airlines also face problems arising from the conflict of environmental concerns and safety considerations related to inadequate facilities (both have led to operational restrictions), and the important role of the industry in support of the national economy.

Higher fuel costs and airport usage taxes led to domestic fare hikes of 23.8 percent in March of 1980. The fare increases had a negative effect on the growth of passenger traffic, and on profits. Nonetheless, in general, the airlines are enjoying strong markets with reasonable growth as, increasingly, the Japanese are travelling—and travelling overseas. More than 4 million Japanese, it is estimated, travelled internationally in 1979.

JAL expects international passenger traffic to grow 7 percent annually in the first half of the eighties and international cargo traffic to increase 11 percent annually during the same period. In 1980, All Nippon Airways, Japan's largest domestic airline, planned for business to increase by 15 percent despite the negative impact of fare increases on demand.

As Japan's aeronautical industry has not had the development capability for supersonic transports or wide-body technology, the airlines have purchased larger transports from abroad. In the early sixties, the Japanese did develop a turboprop passenger transport, however—the YS-11. Although it is no longer produced, parts are available and the YS-11 turboprops are still operating around the world. Japan's own domestic airlines, however, have been actively seeking a replacement for the 64-seat aircraft, which does not satisfy their route demands. The airlines are particularly interested in an aircraft of 100 seats or more, as quiet as the YS-11, that can serve 1,200 meter runways. Since no suitable replacement has yet been found, an equipment and parts pool may provide a temporary answer for the airlines concerned.

The Manufacturing Industry

The Japanese aircraft manufacturing industry developed in the twenties when shipbuilding companies imported European aircraft for study and purchased technology from European companies. During the thirties, the aircraft industry received support from the Japanese Army and Navy and

[1] Source: *Japan Aviation Directory* (Tokyo: The Wing Aviation Press, Inc., June, 1980), Vol. 13.

expanded rapidly. During World War II, it produced more than 100,000 aircraft and employed, at the peak of production, more than one million people. At that time, Japanese technology was excellent and scientists and technicians were working on many highly sophisticated research and development projects. The end of the war, however, brought an end to industry activities. Only at the height of the Korean War in 1952 did the industry get underway again, doing repair work on U.S. military aircraft. Within two years, defense aviation activities were resumed and the local aircraft industry began doing repair work and then licensed production of jet aircraft and helicopters.

Eventually, the Japanese resumed developing their own aircraft, the first of which was the T-1 intermediate jet trainer in the late fifties. In the non-military field, they developed the MU-2 twin-engine turboprop business aircraft in the early sixties and the FA-200 single engine light aircraft in 1967. Because development of a commercial air transport was too large a project for any single company, the domestic industry jointly produced its first passenger transport, the YS-11 turboprop—also in the early sixties. The Nihon Aeroplane Manufacturing Company (NAMC) was set up by government and industry to coordinate YS-11 production and sales. Meanwhile, the Japanese industry continued licensed production of more advanced aircraft and helicopters as well and—through this combination of repair work, license production and its own domestic projects—began to catch up with Western technology. Original Japanese technology has included flying boats, the T-2 advanced trainer later modified into the F-1 support fighter, and the Kawasaki C-1, the first domestically developed jet transport.

The Japanese aircraft engine business began by doing overhaul and repair for U.S. forces. In the fifties, a program to develop its own jet engines was begun, however, and a new firm, Japan Jet Engine, Inc., was set up by a number of companies to begin work on an engine for the Japanese Defense Agency's new intermediate jet trainer. Basic development of the J3 was completed in 1959, but Japan Jet Engine was not set up for manufacturing. Instead, most of the J3 parts were made by Mitsubishi Heavy Industries and Kawasaki Heavy Industries. Not until the sixties did the local aeroengine industry move from overhaul to production work. In the sixties, various companies also began to license-produce engines for U.S. manufacturers such as General Electric, Allison and Lycoming. In the early seventies, Ishikawajima-Harima (IHI) began manufacturing the Rolls-Royce/Turbomeca Adour engine and Mitsubishi (MHI) undertook manufacture of the Pratt & Whitney JT8D-9. The Japanese also produced about 90 percent of the parts of both engines.

Today, IHI still produces GE and Rolls-Royce engines, MHI the Pratt & Whitney JT8D-9 and Allison T63, and Kawasaki the Lycoming T53. In 1978, IHI became prime contractor for the Pratt & Whitney F100 for the F-15 program and the Allison T56 for the P-3C. KHI and MHI each have about a 15 percent share of each program.

Major Japanese firms involved in aircraft and engine production include ANA Aircraft Maintenance Company, Fuji Heavy Industries, Ishikawajima-Harima Heavy Industries, Japan Aircraft Manufacturing Company, Kawasaki Heavy Industries, Mitsubishi Heavy Industries, New Japan Aircraft Maintenance company, Nihon Aeroplane Manufacturing Company, and Shin Meiwa Industry Company. Together, however, they comprise an aeronautical industry that is substantially smaller than that of the United States or of Europe. In 1978, it employed just 25,398 persons compared to 967,000 aerospace workers in the United States and 421,176 so employed in the European Economic Community.[2] And while Japan's Gross National Product is second largest in the free world, total aerospace sales in 1978 were only about $1.2 billion. One reason is that the industry is highly dependent on military orders which, in 1979, constituted 86 percent of its business. Nonetheless, the industry has the capability for almost any aerospace product other than supersonic or wide-body transport and Japanese planners have identified the industry's future growth prospects as lying with the commercial, not the military market. The industry's particular strength currently is in design, but production technology is developing as well and the Japanese have bid successfully on subcontracts for the B-747, L-1011, and DC-10.

Future Plans—In 1979, the Aircraft and Machinery Industry Council of Japan's Ministry of International Trade and Industry (MITI) presented recommendations concerning the growth of the aircraft industry in Japan. It encouraged:

- Active support of commercial aviation aircraft and engine development projects, while continuing support of the B-767 development work in which Japan is engaged.
- Development of new aircraft to meet social and economic demands for quieter, cleaner, more fuel-efficient aircraft with improved STOL capabilities.
- Growth and technological improvement of avionics, other aircraft equipment and materials.
- Government support of the development of new civil transports including examination of the possibilities of developing a 100 seat or larger civil aircraft to replace the YS-11 by the mid-1980s.
- Government consideration and support of new aircraft technologies in the areas of: improved STOL and VTOL techniques, flying boats, hybrid lighter-than-air craft, large helicopters, ultra-light planes, takeoff and landing systems, general aviation aircraft, hydrogen-powered aircraft and private-use LTA aircraft.

The MITI advisory body stressed that the Japanese government should bear the entire risk in development of new

[2] Commission of the European Communities, *The European Aerospace Industry, Trading Position and Figures* (Brussels, September 1980), p. 64.

civil aircraft technology although the ultimate business risk of the practical application of technology should be borne by industry. It also placed priority on participation in international joint development projects.

International Cooperation

A number of recent international agreements on aeronautical projects should move Japan's aircraft industry ahead rapidly. These include the joint development of the B-767 with Boeing and Aeritalia; the license production of the Lockheed P-3C and the McDonnell Douglas F-15; and development, with Rolls-Royce, of the RJ500 turbofan engine.

The Boeing 767 project, called the YX project in Japan, is being carried out by the Civil Transport Development Corporation (CTDC) set up in March 1973. CTDC's board of directors is composed of top representatives of the domestic airline and aerospace industries and the corporation is staffed by many who worked on the YS-11 program. Japan has about 15 percent of the work on the Boeing airplane and CTDC's work is the design and manufacture of the fuselage panels and wing ribs and fairings. Japanese firms have bid successfully for subcontracts for additional work. Prime subcontractors to CTDC are Mitsubishi Heavy Industries, Kawasaki Heavy Industries, and Fuji Heavy Industries.

The prime Japanese contractor for the McDonnell Douglas F-15—of which about 90 will be totally produced in Japan in this decade for the Japanese Self-Defense Force—is Mitsubishi Heavy Industries. MHI, manufacturer of the Japanese F-1, has also license-produced the F-86F, F-104J and F-4EJ. The major F-15 subcontractor, with almost 40 percent of contract value, is Kawasaki Heavy Industries.

Over a period of 11 years, Japan's Maritime Self-Defense Force will introduce 45 Lockheed P-3C patrol planes, most of which will be license-produced in Japan under another joint agreement. Local content will increase quickly from 30 percent to about 90 percent. Kawasaki Heavy Industries is prime contractor for the P-3C, the first of which will be delivered in 1982.

For other countries, advantages of a joint development program with Japan include government support and the market advantage that a product with Japanese production involvement will have. When MITI supports an aerospace project such as the Boeing 767 or RJ500 engine development, however, it limits support to the development stage, and considers the funding a loan rather than a subsidy. For the RJ500 development, MITI decided to support 75 percent of the initial launch stage, 66 percent of the cost of producing a flight-test engine and 50 percent of the remaining development expenses if the engine goes into production. This funding represents a loan which must be repaid with interest if and when the project is profitable. Basically, the financial arrangement is the same for the Japanese involvement in the B-767 project.

Although MITI considers the ultimate commercial risk to be that of business and does not provide funds for production or marketing, unlike some of the European countries, the advantages of Japanese joint venture participation have attracted other offers from abroad for project participation. The Dutch government, for example, has asked the Japanese to participate in the MDF-100 project being undertaken by Fokker and McDonnell Douglas.

A Japanese Civil Airliner Development Program

Even working together, the five Japanese aircraft manufacturers are not as large as their overseas competition, nor able to handle development of a civil airliner on their own. Transport projects have had to be handled by special consortiums such as the Nippon Aeroplane Manufacturing Company which built the YS-11, and the Civil Transport Development Corporation which is working with Boeing on the 767. The next major civil transport project, centering on their need for a YS-11 replacement, will undoubtedly involve a similar collective effort. The envisioned YX-X program, an approximately 150-seat jetliner, has attracted possible partners including Boeing, McDonnell Douglas and Fokker. It remains to be seen what types of international arrangements will produce an aircraft for this major new transport market, but one will very likely involve the Japanese.

The domestic aerospace industry's long-term planning committee—the Society of Japanese Aerospace Companies—has stressed the importance of building Japan's independent capability for new aerospace technology, including successful development and production of new aircraft, if industry technology is to be brought up to the level of Europe and the United States. It believes Japan must first develop the 150 passenger YX-X and then a revolutionary aircraft, perhaps a high-speed turboprop or a commercial flying boat. Preliminary to doing so, however, Japan must set up the large-scale research and test facilities to do basic and applications research that it now lacks.

Aircraft Research and Development

In Japan, the Agency of Industrial Science and Technology (AIST), a division of MITI, is responsible for coordinating and upgrading the nation's industrial technology level, for promoting research and development by the private sector and government, and for planning and implementation of a comprehensive R&D policy. It promotes a National Research and Development Program, known as the "large-scale national project" system, under which government funds are directed to developing technology which would be impossible without joint effort. As of 1980, the FJR710 fanjet engine—development of which gave Japan the technology for participation in the RJ500 program—was the only national aerospace project.

The Japanese do not have a focal point for aerospace research activities, such as the National Aeronautics and Space Administration in the United States, which helps plan and coordinate R&D activities between government, industry

and the universities, and which contracts for R&D programs. Instead, research is conducted through the National Aerospace Laboratory, the Research Coordination Bureau, and the National Research Institute for Metals, under the auspices of the National Science and Technology Agency (STA). Related research groups—the National Space Development Agency and Remote Sensing Technology Center—operate, indirectly, under STA auspices.

The National Aerospace Laboratory conducts a high level of research activity which focuses primarily on V/STOL technology; jet transport technology; aircraft safety, noise and pollution research; jet engine technology; and launch vehicle and satellite technology. The National Research Institute for Metals is concerned with upgrading currently used metals and developing new processing techniques.

While the FJR fanjet program has given the aircraft industry R&D facilities it did not previously have, the Japanese consider that they lack important aeronautical R&D facilities including—for engine development, for example—an altitude test chamber, a large capacity facility for testing the aerodynamic qualities of engine elements, and parts endurance and hardness test facilities. These and other essential facilities will have to be introduced carefully over the long-term, the Japanese feel, before their aeronautical technology will equal that of other nations.

General Aviation

In the general aviation field, Mitsubishi's MU-2 turboprop series has been Japan's bestselling plane; 600 had been sold as of September 1979. The same company's new MU-300 Diamond business jet began production in 1980 and early heavy sales allowed Mitsubishi to quickly sign up the first two year's worth of production, or 60 aircraft. Another entrant in the general aviation market is Fuji Heavy Industries, producer of the FA-200, of which it has sold over 300.

Helicopters

Japan has done least well in the development of helicopters. While between 900 and 1,000 have been domestically manufactured, nearly all were under license agreements with American firms or were remodeled versions of American helicopters. Japan, by itself, has not developed a helicopter except for the BK-117 utility craft currently underway. A Kawasaki helicopter project, similar to one under development by Messerschmitt-Boelkow-Blohm, has resulted in a joint development agreement between the two firms. First delivery of the BK-117 is scheduled for 1981. It is hoped that the BK-117 will capture at least 20 percent of the market based on estimates that 5,000 medium size helicopters will be sold over the next 10 years.

Exports

To date, Japan's exports have centered around the sales of their general aviation MU-2, as well as sub-contract work from other countries. Still, in 1978, exports were only 0.4 percent of total aerospace output. In the United States, on the other hand, exports were 26 percent of total sales in the same year and have increased to 30 percent of sales in 1980. Even at the peak of YS-11 transport sales, Japan's aerospace exports were only 19 percent of production.

Currently, Japan is not a threat in the world marketplace where aeronautical products are concerned. Still, it is preparing for a stronger position and its developing capabilities, and clear intent to move into the commercial market, indicate it could carve out an excellent position for itself in the future. The successful example of the Japanese in numerous other areas of technology, where they have moved ahead rapidly once a commitment has been made, adds good reason to believe Japan will become a strong participant in the community of nations with aeronautical capabilities.

BRAZIL

During the late sixties and early seventies the so-called "Brazilian Miracle" was characterized by high growth rates and accomplished by high, though manageable, inflation rates. This period of high growth was the outcome of an economic development strategy centering on export-led manufacturing growth and heavy reliance on foreign capital inflows. The Brazilian government chose the commercial aviation manufacturing sector as a field for expansion not only because of the potential for exports, but in order to reduce the larger number of aviation imports necessary in order to implement economic growth plans in a nation with such a large and underdeveloped land mass.

The worldwide oil crises of 1973 and 1979 have had a major impact on Brazil, which imported more than 85 percent of its petroleum. More recently, the Iran-Iraq war has forced Brazil to seek new sources to replace the 20 percent of Brazilian oil imports interrupted by the conflict. Brazil has been in its most critical socio-economic period in the last decade with the rate of inflation rising to a 16-year high of over 100 percent. The current account for 1980 was expected to reach $12.5 billion, up $2 billion from 1979 and Brazil's foreign debt, largest among developing countries, was to exceed $55 billion for 1980. These economic difficulties coincide with a political liberalization process now under way and with a revival of labor unionism that has produced wage settlements equal to or greater than the rate of inflation.

The momentum of the Brazilian economy at this time is such that the tough measures being taken to curb aggregate demand and thus maintain foreign borrowing at sustainable levels are likely to continue and to result in lower levels of aviation imports.

Aviation Sector

Brazil has made a greater effort than most other Latin American countries to foster the nation's own manufacturing capabilities through its procurement program. Currently the sixth largest aircraft producing nation in the world, Brazil is positioning itself for emergence as a significant economic, military and manufacturing power in the eighties. Using sophisticated European technology as its base, for example, Brazil's armament industry is not only aiming at self-sufficiency but also at a large exportable surplus. Brazil's potential has attracted arms producers from France, Belgium, West Germany, and Italy—all willing to collaborate in coproduction. This effort at self-sufficiency, and a current bias among some Brazilian procurement officials away from U.S. weapon systems, was largely the result of U.S. refusal to sell advanced weapon systems to Brazil in the mid- and late sixties. The United States suggested that Brazil instead spend its money on more immediate social and economic needs. Relations further deteriorated in the late seventies following U.S. criticism of Brazil with respect to human rights.

Over the last five years, U.S. civil aviation exports to Brazil have averaged $175 million per year with significant growth occurring in all components during 1980.[1] In the large transport sector, Brazil is no longer exclusively supplied by U.S. manufacturers—not since the introduction of the Airbus A300 at Cruzeiro in 1980. In the general aviation sector, U.S. exports to Brazil have averaged more than $16 million per year with significant growth occurring in 1979 and 1980.[2] U.S. civil aviation imports from Brazil, consisting primarily of general aviation equipment, have grown dramatically over the last five years reaching almost $25 million in 1980 and exceeding U.S. general aviation exports to Brazil for the first time.[3]

While Brazilian aviation exports to the United States and other countries have been growing, Brazil has restricted general aviation imports through high duties, taxes, import deposit schemes and import licensing red tape. Some importers can apply for and do receive exemptions from these duties and deposits. Brazil has a "Law of Similars" which applies to those imports for which locally produced goods can be substituted; the imports, as a result, are not eligible for duty reduction or exemption, foreign financing or other government incentives. "Similar" imports are not prohibited outright, however.

In the early seventies, Brazil conducted a worldwide competition to determine which general aviation manufacturer would be selected for a joint program with Brazilian industry to assemble piston engine aircraft kits in Brazil. In 1974, a comprehensive, cooperative agreement was signed with Piper Aircraft Corporation involving assembly and eventual manufacture in Brazil of several twin and single-engine aircraft. Consequently, most general aviation products are covered under the Law of Similars and are difficult to import into Brazil.

Although Brazil is not a signatory to the GATT Agreement on Trade in Civil Aircraft, the U.S. Government has held several bilateral discussions with Brazil to eliminate these trade-distorting practices. In particular, an attempt was made to gain access to the Brazilian market for assembled aircraft which were substantially different from those of Brazilian manufacture. To date, this approach has been unsuccessful. The Brazilian Government did agree to streamline its import licensing procedures; it is, however, too early to detect any improvement.

The aviation industry in Brazil is controlled by the Federal Government. Airline routes, services, and fare increases are regulated by the Air Ministry through the Department of Civil Aeronautics (DAC) in much the same way as they have been regulated in the United States by the Civil Aeronautics Board. In addition, the Air Ministry is involved in equipment selection for the airlines. The Centro Tecnico Aerospecial (CTA) organization within the Air Ministry is responsible for technical matters including training, research and development, certification, and the development of the aviation industry.

The Airline Industry

The airline industry in Brazil consists of two basic groups: the national/international carriers—Varig, Cruzeiro, VASP, and Transbrazil; and the more recently established regional carriers—TAM, Rio-Sul, Nordeste, TABA and Votec.

The performance of Brazilian airlines, as shown in Table 22, significantly improved from 1975 through 1978 and compared favorably with their performance in the early seventies. Though the growth of revenue passengers per kilometer reached 25 percent in the early seventies—more than double the expansion of the gross national product of that period—the petroleum crises of 1973 and 1975 initially resulted in fares which were higher than those of other countries with similar route structures, and in financial difficulties for the Brazilian airlines. The majority of the shares in Cruzeiro, however, were acquired by a major shareholder in Varig, one of the largest private airlines outside of the United States. While retaining separate identities and legal status, Cruzeiro and Varig have combined schedules to avoid duplication. That consolidation and the rise in productivity of

[1] U.S. Department of Commerce

[2] Ibid.

[3] Ibid.

TABLE 22

BRAZILIAN AIRLINE TRAFFIC
1976–1980
(Millions of Revenue Passenger Kilometers)

Airline	1976	1977	1978	1979	1980
Varig	6,116	6,277	6,904	8,217	8,735
Cruzeiro	1,730	1,867	2,101	2,249	2,431
Vasp	2,040	2,215	2,674	3,108	3,217
Transbrasil	875	957	1,194	1,528	1,930

SOURCE: *Interavia* data, 1976–79
1979–80 Air Transport World, May 1981

Varig, Cruzeiro, VASP and Transbrazil contributed to the industry's recuperation. Another program which contributed to the recovery was the policy instituted by DAC to diminish fuel usage by coordinating the optimal use of equipment, and reducing flight frequency. To compensate for the loss of air service in many smaller communities the government gave subsidies for the operation of regional airlines, serviced mostly by general aviation aircraft manufactured in Brazil. TAM, Rio-Sul, Nordeste and TABA were created with stockholder participation of the four large airlines and already serve over 130 cities.

The Manufacturing Industry

Embraer (Empresa Brasileira de Aeronautica S.A.) evolved from the former Departmento de Aeronaves of the Brazilian Government in 1969 and is today the nucleus of the Brazilian aircraft industry. The company employs over 5,000 workers turning out an average—over the last several years—of 40 aircraft a month in modern facilities at Sao Jose dos Campos.[4] Embraer's sales and orders for aircraft, technical assistance and spare parts first exceeded $100 million in 1976. Reduced Brazilian economic growth due to the world energy crisis held sales in 1977 and 1978 at about the same level but by 1980, they had reached $171.3 million. Export sales which were at $38 million in 1978 had more than doubled, reaching $84.1 million, in 1980. At the end of 1980, Embraer's paid-up capital was CR 2,678.1 million ($42 million.) The Brazilian Government owns 54.5 percent of the voting shares, with 89.2 percent of subscribed capital being held by private shareholders.

Embraer produces 11 different types of aircraft in 50 separate models. These include: the EMB-110 Bandeirante; the EMB-111 maritime reconnaissance version of the Bandeirante; the pressurized EMB-121 Xingu twin-turboprop transport aircraft; the EMB-326GB Xavante license-built version of the Italian Aermacchi M.B. 326GC jet trainer and ground attack aircraft; the EMB-210A Ipanema agricultural aircraft; and various Embraer-built versions of the Piper Cherokee Pathfinder, Arrow II, Cherokee SIX, Lance, Seneca II and Navajo Chieftain, built under license. The Bandeirante is the most sophisticated Brazilian undertaking and has gained worldwide sales. It is a twin-engine turboprop with a Pratt & Whitney PT6 engine. Its great advantage is its ability to take off from a 200-yard runway. Embraer is now producing an average of four Bandeirantes per month, but this production rate could double over the next five years as a result of U.S. certification for commuter operations.

Several new programs are underway or being considered by Embraer, including: development of the EMB-120, a twin turboprop 29-passenger commuter aircraft, as a follow-on to the EMB-121 Xingu—production not expected until 1982; development of a tandem-seat, single-engine, turboprop-powered primary flight trainer; joint development, along with Aeronautica Macchi of Italy, of a new single-seat, light attack aircraft to meet the requirements of both the Italian and Brazilian Air Forces.

Other general aviation manufacturers in Brazil include Neiva and Aerotec which build military trainers and subcontract to Embraer.

Helibras (Helicopteros do Brasil, S.A.) was formed in late 1977. It is jointly owned by Aerospatiale of France and the State of Minas Gerais (45 percent) and Aerofoto, a Brazilian firm (10 percent). It has embarked on a program that will involve assembly, and in time the local manufacture, of Aerospatiale helicopters. Assembly of the Aerospatiale Lama began in 1979 and, according to Helibras' reports of recent sales in Bolivia and Chile, the 1981 production run of 18 units has already been sold. Production will be increased to 24 aircraft in 1982; thereafter, predictions are optimistic that Helibras will repeat Embraer's success in meeting domestic needs and expanding into foreign markets. U.S. and European helicopter manufacturers can expect increasing competition from Helibras—initially in the Latin American market and, eventually, elsewhere.

[4] Embraer, *General Information, Brazilian Aeronautical Industry 1980.*

While the aeronautical establishment in Brazil is currently experiencing some difficulties, primarily due to the nation's economic problems, it is expected to grow at above-average world rates over the longer term. Airline activity at both the trunk and regional level will expand vigorously as Brazil industrializes. The aviation manufacturing sector is also expected to experience rapid growth both from meeting the country's general aviation air transport needs, and from continued diversification into new product areas such as military trainers and helicopters. The cloud on an otherwise bright future is Brazil's dependency on imported petroleum. Further shocks to the world's petroleum supply sources and distribution system could have a pronounced effect on Brazilian development and on its aviation industry.

THE SOVIET AERONAUTICAL INDUSTRY

The Airline Industry—Aeroflot

In 1973, an Aeroflot official visiting the United States described his organization as being, "in American terms, a combination of the Civil Aeronautics Board, The Federal Aviation Authority, several major airlines and general aviation operators."[1] Aeroflot is, in other words, the operator, regulator, overseer and standard setter for an industry that, domestically, includes only one airline—Aeroflot. In addition, it is the only airline in the world that warrants its own aerospace industry to support it. Figure 36 shows the relationship between Aeroflot and the Soviet aircraft design bureaus.

In addition to being the world's largest airline, Aeroflot also includes: an agricultural division; a helicopter (forest, fire) patrol; and survey, ice and fish reconnaissance, and aeromedical services. Aeroflot is also involved in hotel operations, catering, logistics, air traffic control development, as well as preparation of specifications for both aircraft and ground equipment. A few statistics in regard to these ancillary activities will indicate their vast scope.

"The agricultural aviation fleet performs some 80 percent of all spring fertilizer distribution and 40 percent of all plant protection work. The annual defoliation of the cotton crop before harvesting employs some 1,300 An-2 and a few helicopters. . . The aero-medical service made some 70,000 emergency flights in 1979, serving some 118 medical institutions in the USSR."[2]

In order to maintain these many services, Aeroflot employs about 500,000 people.

Although Aeroflot serves 90 countries in Europe, Africa, Asia and the Americas, it is predominantly a domestic airline. It serves over 3,500 points within the Soviet Union, which includes 8,650,000 square miles—an area greater than the United States, Canada and Mexico combined. The breakdown of Aeroflot passengers, domestic versus international, is shown in Figure 37a and 37b.

Being a monopoly provides Aeroflot with distinct advantages, but also with minor disadvantages. Because it is a monopoly and is as large as it is, Aeroflot has its own aerospace industry to supply its needs. The aircraft provided are very rugged, heavy, and reliable and fit in well with the terrain and climatic conditions of the Soviet Union. However, because it is not ruled by cost or the competition of other airlines, Aeroflot has tended to offer aircraft that, for the most part, are short on comfort and not very fuel efficient. With the ever-increasing cost of fuel and the demand for greater passenger appeal, these aircraft pose little threat to the aerospace industries of the non-Soviet bloc.

As a monopoly, Aeroflot has the advantage of a captive audience (or captive customers) but, again, due to lack of competition, these customers receive service within the Soviet Union that tends to be capricious, sporadic, perfunctory and, generally, a non-satisfying experience.

The Manufacturing Industry

The aerospace manufacturing industry of the Soviet Union is second to none in the world, its capabilities covering the entire spectrum of aerospace activities: space, missiles, satellites, and military and commercial aircraft.

Space Activities—Soviet exploits in space are well known, starting with Sputnik in 1957 to the recent record-breaking endurance feat of maintaining cosmonauts in space for 175 days.

Military Aircraft—In the military aviation field, Soviet achievements are no less spectacular. Their interceptor aircraft may well be the finest in the world, while their fighters and bombers rank with the best. In addition, they have the capability to produce military aircraft in large quantities. The International Institute for Strategic Studies, for example, has compiled statistics showing the strength of NATO tactical air forces versus those of the Warsaw Pact nations.[3] Even when 100 American dual-based fighters and 400 French fighters are added to the NATO forces, the communist block still holds a numercial advantage with 5,795 to 3,800 aircraft. While the NATO aircraft were built by the

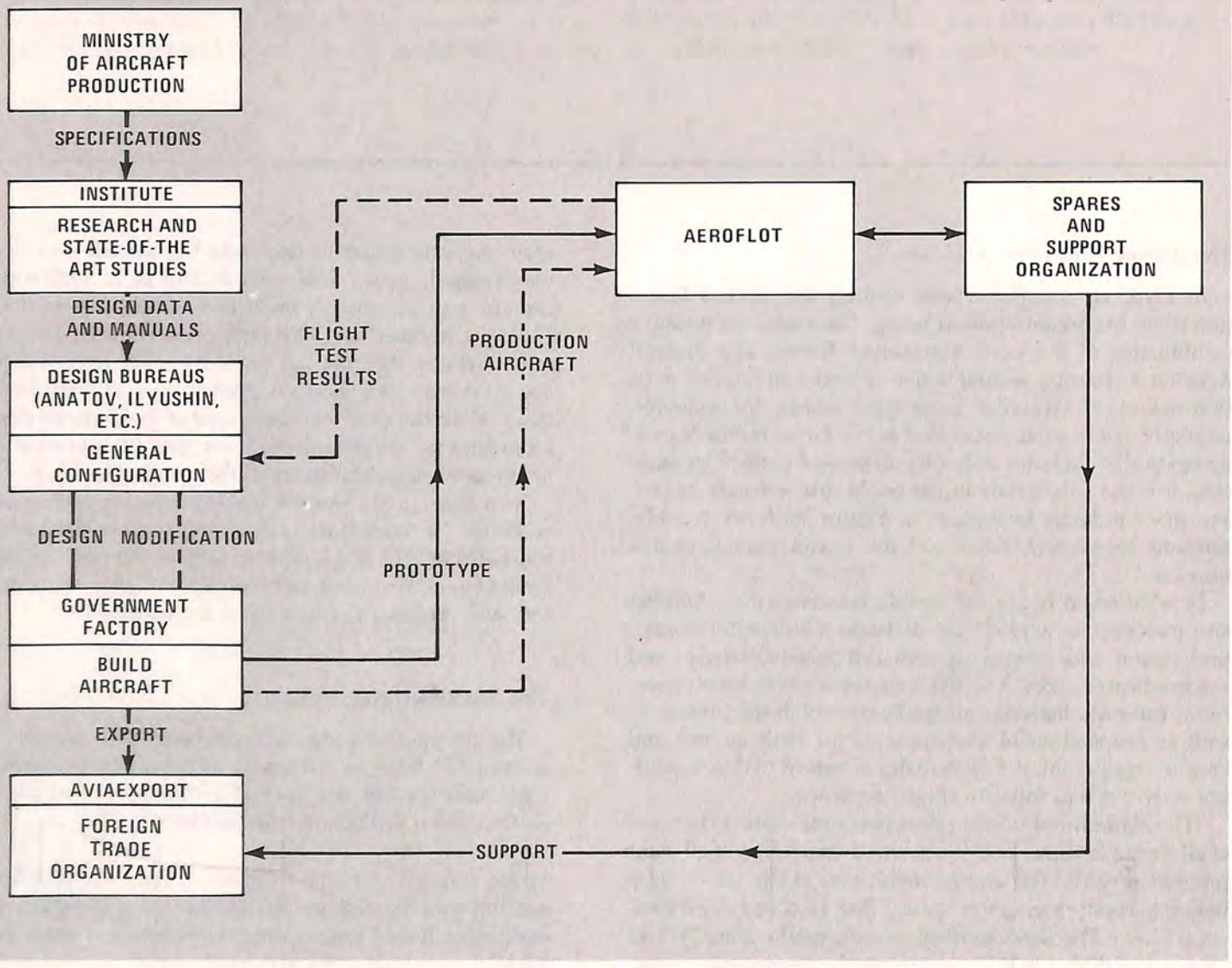
[1] "Soviet Civil Aviation Training Programs," *Interavia*, Volume 34, September 1979, p. 829.

[2] "World Airline Directory," *Flight International*, July 26, 1980, p. 260.

[3] "The Military Balance," *Aerospace International*, The International Institute For Strategic Studies, December 1979/January 1980, Vol. 15, No. 6, p. 134.

FIGURE 36

SOVIET AEROSPACE INDUSTRY ORGANIZATION



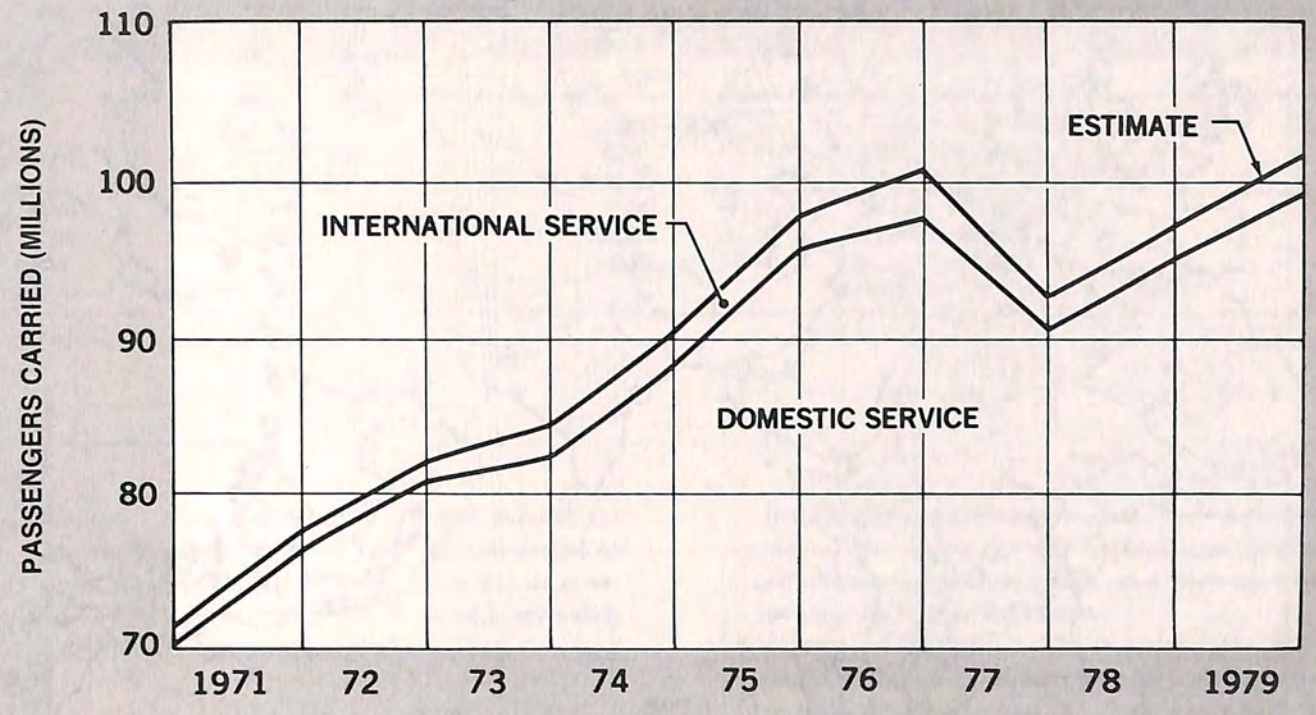
United States, France, the United Kingdom, and other European nations, the nearly 6,000 Warsaw Pact aircraft were built by the Soviet aerospace industry. Figure 38 indicates those nations that fly Soviet military aircraft excluding the Americas and, in particular, Cuba. In one sense, the map overstates the Soviet position in that China and Egypt are no longer part of the Russian sphere of influence. One must also keep in mind that many of the Soviet designed aircraft in the Indian inventory are built in India. Nevertheless, the depth of penetration of Soviet military aircraft into Africa, the Middle East, and Far East not to mention Eastern Europe and Finland (which is not shown on the map) is clear.

Mention of their space and military aircraft program is made to show not only the technical achievements of the Soviets but also their productive capability. In a totalitarian state such as the Soviet Union, an official edict can change the product mix of an industry at any given moment. If the Soviets should decide to expend greater effort in the commercial field, they would have the required manpower, plant, equipment and technological know-how to become a full-fledged competitor of the United States.

Commercial Aircraft—The Soviet aerospace industry supplies aircraft to the world's largest airline, Aeroflot, in addition to the airlines of its satellites—East Germany, Czechoslovakia, Hungary, Romania, Bulgaria, Yugoslavia, and Cuba. Other countries using Soviet commercial aircraft are Vietnam, Laos, North Korea, Afghanistan, and the Peoples Republic of China (prior to the Chinese/Russian split). YAK-40s (a Soviet short-haul transport) are also included in the inventory of West German, Italian, and French operators.

FIGURE 37a

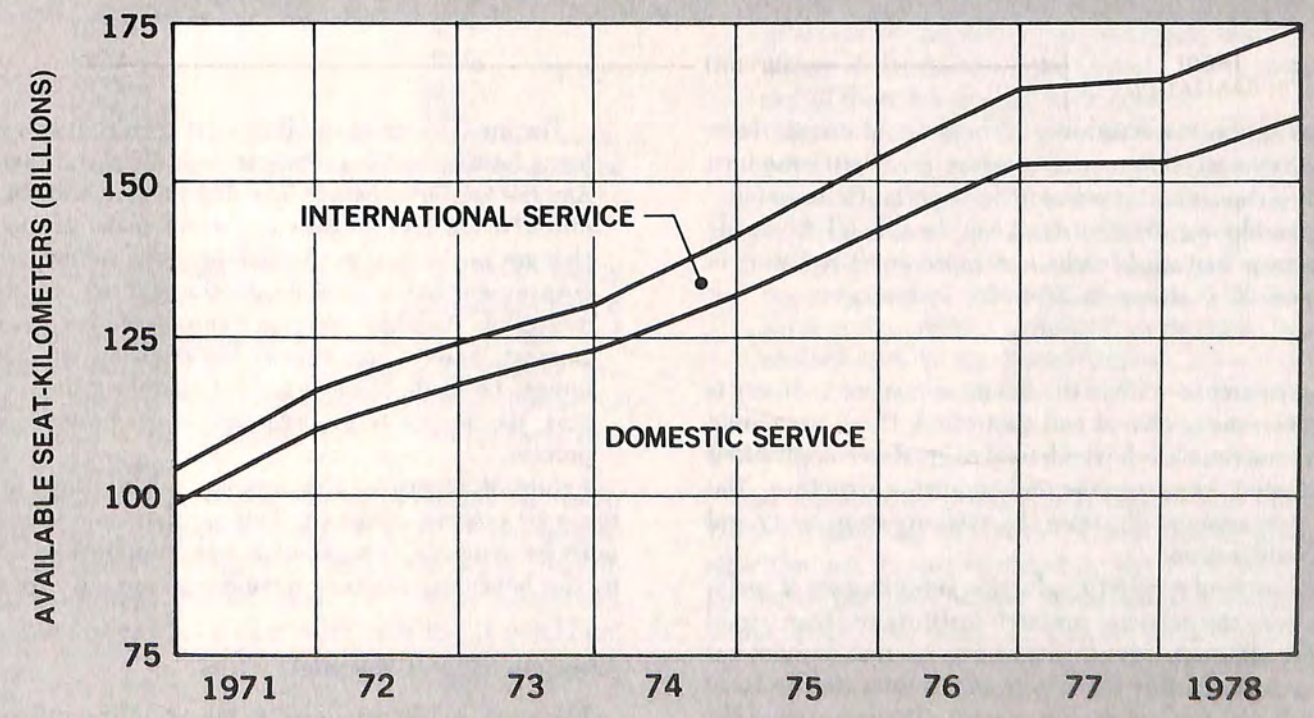
AEROFLOT AIRLINE TRAFFIC
1970–1979



SOURCE: INTERAVIA DATA

FIGURE 37b

AEROFLOT AIRLINE TRAFFIC
1970–1978



SOURCE: INTERAVIA DATA

FIGURE 38

COUNTRIES OF AFRICA, EUROPE, MIDEAST AND ASIA
THAT FLY SOVIET-DESIGNED MILITARY AIRCRAFT

The Soviets build a wide array of commercial aircraft, from small taxitype aircraft to the most sophisticated modern widebody airbuses and supersonic transports. From a range/capacity standpoint, these aircraft could easily fill the needs of the average free world airline. A representative listing of current aircraft is shown in Table 23.

Industry Structure—Since the Soviet aerospace industry is totally government-owned and controlled, there are a great many bureaucratic levels which tend to create a complicated, uncoordinated, cumbersome and confusing structure. The following paragraphs illustrate the system's complexity and lack of coordination:

The Ministry of Aircraft Production submits a set of specifications to the relevant research institutions. One would assume, although it is not necessarily so, that Aeroflot has been a party to this act. These institutions do the basic research and state-of-the-art studies. They, in turn, submit design data and manuals to the Design Bureaus.

The final design of the Bureau is then sent to a government factory and a prototype is built and delivered to Aeroflot for flight testing. The flight test results are resubmitted to the Design Bureaus, which make the necessary changes in the design. A final design is submitted to the government factory and production aircraft are built and delivered. Another distinct group provides spares and support. Should the aircraft be exported or should attempts be made to export it yet another group—Aviaexport, the foreign trade organization—is brought into the process.

Figure 36 illustrates the complex relationships between these various organizations. This cumbersome structure, it must be assumed, is one restraining influence on attempts by the Soviets to increase commercial aircraft exports.

Aerospace Export Potential

The Soviet aerospace industry has a built-in active market with its East European satellites and, previously, with the

TABLE 23

SOVIET COMMERCIAL TRANSPORTS CURRENTLY IN OPERATION
(Over 85 passengers only)

Aircraft	Number of Passengers	Range (Maximum Payload) (miles)	Comments
Il–18V	84–110	1990–2300	Over 700 built (100 exported)
YAK–42	100–120	620	First flight March 1975
Il–62	122–186	4160	In service September 1967
TU–144[a]	140	4030	Supersonic Transport
TU–154	152	2050	In service 1974
Il–62M	186	4160	In service 1974
Il–86	350	—	Wide-body in service in 1981

a Currently not in regular service

mainland Chinese. Data indicate that aircraft exports increased quite rapidly from 1960 to 1965 and continued to increase significantly through mid-1970 (Table 24). It is assumed that the more recent figures include military sales; they are nevertheless, quite instructive.

TABLE 24

SOVIET AIRCRAFT EXPORTS[a]

Year	Rubles (In Millions)
1960	3.8
1965	94.1
1970	153.0
1975	303.0
1976	363.0

a Member States of the Council for Mutual Assistance, *Statistical Yearbook*

Despite these impressive export figures, the Soviet Union has not made any serious inroads in the non-Soviet-satellite world. Only the 25-30 passenger YAK-40 has been sold outside this sphere and its sales have been quite limited. The reasons for this are many and varied and it is difficult to pinpoint which is the most important. Several of these reasons are listed below.

- *Design Emphasis*—The Soviet emphasis has been based upon operating in rugged weather and remote areas. Genrikh Novozhilov, Chief Designer of Ilyushin Design Bureau, has said that, "One of the stipulations for the design (IL-86 wide-body) was that it should not involve any reconstruction of existing airports and runways."[5] Even in an age of rising fuel costs the Soviets still emphasize ruggedness and, as a consequence, pay a penalty in higher fuel costs.
- *Spares and Support*—To remain competitive, free world airlines must adhere to existing schedules, which in turn are based upon the ready availability of spares and support services. The bureaucratic organization of the Soviet aerospace industry makes its after-sales service highly questionable.
- *Maintenance and Service*—In the free world, the airlines maintain their own aircraft and aircraft are designed with this in mind. The Soviets, on the other hand, due to a shortage of trained mechanics, return products to the factory for overhaul. This places the airline at the mercy of the system, taking maintenance out of their hands and their control.
- *Other*—Since the Soviets have one major customer, Aeroflot, the product is designed for that airline. Since Aeroflot is a monopoly in Eastern Europe and Russia, its demands are for a safe reliable aircraft, not necessarily one with great customer appeal. The close working relationship that exists between a U.S. manufacturer and an airline is difficult to duplicate in a closed society such as the Soviet Union.

Detente

The cooperative World War II relationship between the United States and the Soviet Union quickly disappeared after the war. It was replaced by the Cold War and symbolized by the Iron Curtain. There have been highs and lows in the intervening years but, despite some very serious and

[4] Member States of the Council for Mutual Assistance, *Statistical Yearbook*.

[5] Quoted in "Soviet Exports," *Interavia*, Vol. 35, May 1980, p. 426.

potentially dangerous situations such as the U-2 flights/Gary Powers incident and the Cuban Missile Crisis, the trend has been toward accommodation or *detente*. Currently, the Soviet invasion of Afghanistan and subsequent U.S. reaction have once again strained East-West relationships. It is conceivable, however, that this situation will be resolved and that the process of detente will be resumed.

It is interesting to note the reluctance of many of the United States' allies to punish the Soviets for Afghanistan. Our allies have many lucrative business arrangements with the East and do not want to jeopardize them; West Germany, as an example, is negotiating a $9 to $13 billion gas pipeline project.[6] Western Europe is heavily enmeshed economically with Eastern Europe and Russia and a complete break is almost inconceivable. Visits by the heads of state of France and Germany to Moscow indicate the depth of this relationship. While Chancellor Helmut Schmidt of West Germany, in his visit, was firm in his stand on Afghanistan, his overall stance was conciliatory.

The reluctance of many free world countries to boycott the Olympics as a symbolic condemnation of the Soviets for their actions in Afghanistan is also noteworthy. It seems to indicate that large segements of the free world, or at least those nations not aligned with the Soviets, will act independently of the United States in their relations with the Soviet Union.

The climate for a future, intensified Soviet commercial aircraft sales campaign must therefore be considered positive. Increased East-West trade and greater economic interdependence is the current trend and will continue and probably intensify. Third World countries, many of which have purchased Soviet military aircraft, will undoubtedly feel no compunction about buying Soviet commercial aircraft. *Not* buying U.S. aircraft may, in fact, be a way for a nation to flaunt its independence of the United States. The purchase of a Soviet airliner could become a badge of honor, instead of a stigma, in a political context.

Future Soviet Plans

The Soviet Union is a controlled, closed society not given to revealing its specific long-range plans—except for its politically-oriented and often unattained Five-Year Plans. Any attempt, then, to predict Soviet intentions in any area must necessarily be based upon the existing situation, changing factors that impinge upon the situation, and judgments as to whether these factors may result in a new plan, and what it will be. One indication of their interests may lie in the recent announcement of a new support and maintenance system to provide better service for foreign purchasers of their aircraft.[7] In any event, it is clear the Soviets do have the capability to design and build commercial aircraft that can compete with those of the United States and Europe. The inhibiting influences—poor fuel economy, lack of passenger appeal, lack of spares and support services—would have to be considered in an assessment of whether or not the Soviets may, or can, become a worldwide competitor.

A declining rate of petroleum production through the eighties could have a profound influence upon Russian design criteria. Previously, aircraft design decisions have been influenced by ruggedness and safety, not economy. As quoted earlier, the chief designer for Ilyushin stated that the major stipulation for the IL-86 was not fuel economy but rather existing airports and runways. However, the Deputy Minister of Civil Aviation, Yuri G. Mamsurov, writing in the Soviet air transport newspaper has said that the fuel conservation plan outlined by the Central Committee of the Communist Party and the Council of Ministers requires, "a creative search of all possibilities for economizing on fuel resources."[8]*

The Soviets have then, the ability and capability to design and produce sophisticated, safe, modern transports in large quantities, but for various reasons, including lack of fuel efficiency, customer appeal and support services, have not been successful in selling their aircraft except in their satellite countries or to allies. The obstacles in the way of Soviet sales to the free world are not, however, insurmountable and there is a strong possibility that the Soviets must be reckoned with as competitors, perhaps as soon as the end of this decade.

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[6] "West Germans Planning Soviet Pipeline Jobs," *New York Times*, July 5, 1980.

[7] Soviets Stress Product Support," *Aviation Week and Space Technology*, June 22, 1981.

[8] "Soviets Facing Aircraft Fuel Shortage," *Aviation Week*, September 3, 1979.

* In 1981, the CIA revised earlier estimates and indicated that the Soviet oil reserves are more extensive than originally projected. While the production rate will decline gradually throughout the 1980s, the Soviet Union has the potential to increase production in the 1990s.

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