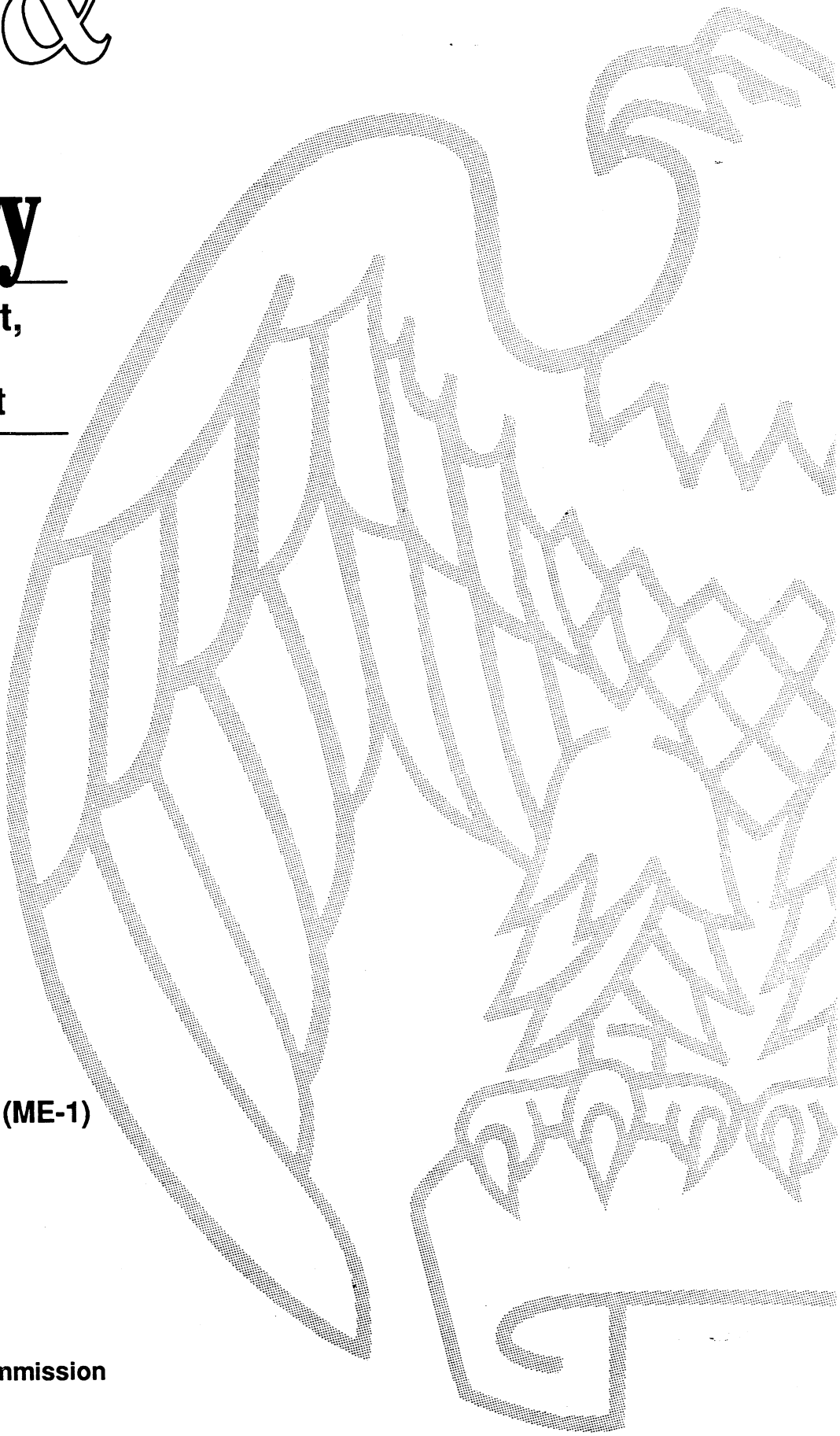
Industry & Trade Summary

Aircraft, Spacecraft, and Related Equipment



USITC Publication 2430 (ME-1)
November 1991

OFFICE OF INDUSTRIES
U.S. International Trade Commission
Washington, DC 20436

UNITED STATES INTERNATIONAL TRADE COMMISSION

COMMISSIONERS

Anne E. Brunsdale, Acting Chairman

Seeley G. Lodwick

David B. Rohr

Don E. Newquist

Office of Operations
Charles W. Ervin, Director

Office of Industries
Robert A. Rogowsky, Director

This report was prepared principally by

Peder A. Andersen

Transportation Branch
Machinery and Equipment Division

Address all communications to
Kenneth R. Mason, Secretary to the Commission
United States International Trade Commission
Washington, DC 20436

PREFACE

In 1991 the United States International Trade Commission initiated its current *Industry and Trade Summary* series of informational reports on the thousands of products imported into and exported from the United States. Each summary addresses a different commodity/industry area and contains information on product uses, U.S. and foreign producers, and customs treatment. Also included is an analysis of the basic factors affecting trends in consumption, production, and trade of the commodity, as well as those bearing on the competitiveness of U.S. industries in domestic and foreign markets.[1]

This report on aircraft, spacecraft, and related equipment, covers the period 1986 through 1990 and represents one of approximately 250-300 individual reports to be produced in this series during the first half of the 1990s. This is the first individual summary report published to date on the machinery and equipment sector.

[1] The information and analysis provided in this report are for the purpose of this report only. Nothing in this report should be construed to indicate how the Commission would find in an investigation conducted under statutory authority covering the same or similar subject matter.

CONTENTS

Figures

CONTENTS—*Continued*

Introduction

This report will discuss key aspects of the global aircraft, spacecraft, and related equipment industry during 1986-90. The aircraft industry includes airplanes, blimps, dirigibles, balloons, gliders, and kites. Spacecraft covered include remote sensing satellites and launch vehicles. Related equipment is a broad category of items that include parts of aircraft and spacecraft, parachutes and parts of parachutes, and ground flying trainers and parts thereof.

Aircraft are defined as machines or devices that, being supported by buoyancy or dynamic action, are capable of atmospheric flight. In general, aircraft have a propulsion system to impart forward motion and a means of directional control. The two main classifications of aircraft are heavier-than-air and lighter-than-air.

There are two theories that explain flight by heavier-than-air craft, all of which craft employ an airfoil. The first theory states that heavier-than-air craft are able to rise from the ground because of the airfoil's ability to give the surrounding air a downward momentum equal to the weight of the aircraft.[1] The second theory postulates that as the airfoil moves through the air, the air passing above the wing moves with a greater velocity than the air beneath the wing. The pressure beneath the wing is therefore greater than the pressure above the wing, causing the wing to rise. This pressure is called lift.[2]

Heavier-than-air aircraft include airplanes and helicopters (powered aircraft), kites (nonpowered aircraft), and gliders, which can be either powered or nonpowered. An airplane is designed to use the pressures created by its motion through the air to lift and transport loads. Airplanes consist mainly of a fuselage, wings, tail assembly, and one or more engines. The engine used to power an airplane may be a piston, turbojet, turbopropeller, or turbofan.[3] Airplanes are constructed primarily out of aluminum. For the fuselage, aluminum is cut into sheets, stretched and chemically milled, and riveted onto a rib. Ribs are connected by longerons to form frames. These frames are connected to form the diameter of the fuselage. For the wings of the airplane, aluminum is similarly treated, then riveted onto spars, which provide the shape of the wing necessary to produce the desired aeronautical reaction with the atmosphere. The wing is mated to the fuselage on larger aircraft at the wingbox, a fabrication which is designed to accept the loads transmitted by the wing while the aircraft is on the ground or in flight. Engines, avionics, and the electrical system are added to the airplane, as well as hydraulic systems should the aircraft be so configured. All systems are extensively tested prior to first flight.

Airplane manufacturers are increasingly using composite materials in place of aluminum, as composite structures have the advantage of a lower weight than aluminum. However, progress has been slow in introducing such materials, because of their high cost and difficult repair requirements.

There are two basic groupings of civil airplanes: general aviation and large transport. General aviation airplanes are defined as those having an empty weight of less than 33,000 pounds.[4] These airplanes include private-use leisure airplanes, business/executive airplanes, and commuter and cargo airplanes. Large transports are planes with an empty weight of 33,000 pounds or more.[5] These aircraft are used in airline operations and for cargo transportation. If designed for airline use, large transports are either wide-bodied (two aisles) or standard/narrow-bodied (single aisle).

A helicopter is a rotary-wing aircraft that depends principally upon lift generated by one or more power-driven rotors for its support and motion. These rotors operate on a substantially vertical axis. Civil helicopters are broadly classified into four main groups according to their gross weight. The light class covers aircraft up to 6,000 pounds gross weight; the intermediate class covers aircraft over 6,000 pounds and not exceeding 15,000 pounds; the medium class covers aircraft over 15,000 pounds and not exceeding 25,000 pounds; and the heavy class covers aircraft with a gross weight exceeding 25,000 pounds.[6] Civil helicopter models can operate in a hover to speeds of more than 170 knots and over distances of up to 620 nautical miles.

Military aircraft are designed or modified for specialized use by the armed forces. Basic types of military aircraft include bombers, fighters, transports, reconnaissance aircraft, helicopters, and various special-purpose aircraft, such as the tilt-rotor. Bombers are airplanes equipped to deliver conventional or nuclear weapons and to attack at night or through cloud cover. Fighters are highly maneuverable, fast airplanes designed to destroy opposing planes and to attack surface targets. These planes carry machine guns, cannons, rockets, missiles, and bombs, depending on the mission. Reconnaissance planes are used to observe visually or by radar and to photograph. These airplanes may be specially designed or may be modified

---

[1] Langewiesche, Wolfgang, *Stick and Rudder: An Explanation of the Art of Flying*, (New York: McGraw-Hill Book Co., 1944, 1972), p. 9.

[2] Macaulay, David, *The Way Things Work*, (Boston: Houghton Mifflin Co., 1988), p. 115. Bernoulli's Principle, *Private Pilot Manual*, (Jeppesen Sanderson, Inc.: Englewood, CO, 1984), p. 1-11.

[3] A piston engine derives its power from the action of pistons within cylinders. This engine can be either a two- or four-cycle design, air- or liquid-cooled. It moves an aircraft on the ground and in the air by means of a propeller. A turbojet engine utilizes a gas turbine to produce thrust which moves the aircraft. A turbopropeller engine is a turbojet engine with a gearbox and a propeller attached. This engine relies on the propeller for imparting motion to the aircraft. A turbofan engine consists of a turbojet with an enclosed fan attached to the front of the engine, which is larger in diameter than the engine itself.

[4] *Aerospace Facts and Figures 90-91*, (Washington, DC: Aerospace Industries Association of America, Inc. (AIA), 1990), p. 127.

[5] Ibid, p. 34.

[6] Discussion with member of National Research Council, Transportation Research Board, Civil Helicopter Subcommittee, Aug. 8, 1991.

from a basic bomber or fighter. Tilt-rotor aircraft are designed to offer the utility of helicopters with the speed of turboprop aircraft. Military helicopters are divided into the same four weight groupings as civil helicopters.

Gliders are light, predominantly engineless aircraft with extended wings designed for long periods of gliding after being launched from a towing vehicle. Fastened at the end of a long rope, a glider is usually launched by being towed into the air by an automobile or airplane, or by means of a high-speed winch. When the glider is towed to the desired altitude, it is released. A kite is an aircraft made up of one or more cloth surfaces stretched over a flexible framework, which, when propelled by a towing vehicle, will lift a passenger off the ground. Kites and gliders are used almost exclusively in recreational activities.

Lighter-than-air aircraft can rise and sustain their weight by virtue of a bag containing air or gas that weighs less than the displaced air.[7] The weight of such aircraft is sustained by buoyant forces. Balloons and airships are included in this category. Balloons are spherical, flexible, nonporous bags inflated with a gas that is lighter than air; this gas enables them to rise and travel through the atmosphere. Scientific instruments or a basket (car) to carry passengers is often attached to the gas bag. The majority of hot-air balloons are used in recreational activities. Balloons are also important in meteorological and military applications. An airship (or dirigible) is a type of balloon which is mechanically propelled and can be steered. An airship is composed primarily of a streamlined hull which contains one or more gas cells, fixed and moveable tail surfaces for directional control, a car or cabin for crew and passengers, and a propulsion system usually utilizing propellers.

Spacecraft are structures capable of leaving the Earth and its atmosphere to perform a specific mission in space. The launch vehicle is designed to put the spacecraft beyond Earth's atmosphere. Each type of spacecraft has its own mission criteria which determine its design. Specific missions include weather meteorological investigations, communications, lunar, planetary and deep-space probes, and orbiting laboratories; additionally, military applications such as surveillance, attack and defense, and exercising supply and logistic functions for orbiting vehicles are important. Spacecraft may be divided into two broad categories: manned and unmanned. Space vehicles and launch vehicles can be either manned or unmanned, while satellites and probes are normally unmanned.

Parachutes are umbrella- or wedged-shaped devices made from fabric designed to create a high coefficient of drag in order to retard the descent of a falling object or to reduce the speed of a vehicle. Parachutes are composed of one or more canopies, a harness, and lines between the canopy and harness. Canopies are primarily made from nylon, while either polyester or Kevlar may be used in the harness or in the lines.

Ground flying trainers consist primarily of flight simulators. These machines range from a reproduction of the panel of an aircraft to the complete cockpit of an aircraft. Complex simulators have the capability of motion on three axis, affording the students within the simulator realistic sensations in pitch, roll, and yaw, as well as visual and auditory cues.[8] The more complex simulators are primarily used to train pilots in the airlines, the military, or in executive flight departments.

During 1986-90, the most significant changes in civil transport aircraft were in engine technology and computer-aided flight controls for large aircraft. The design of the airframe itself has not changed significantly during this period; however, the materials used to construct them have changed with the introduction of composites. McDonnell-Douglas has developed a helicopter that requires no tail rotor. By eliminating the tail rotor, the company has also eliminated a number of complex mechanical assemblies, which should increase the overall dispatch reliability of the helicopter and lessens the workload on the pilot. Small airplanes date their designs from decades ago. Some innovation in terms of advanced aerodynamics has been introduced; yet, by and large, no breakthrough design has been mass-produced. One notable exception is the all-composite Beech Starship, one of the first civilian aircraft made from these materials. Another innovative aircraft built during the period was the Bell-Boeing tilt-rotor. This aircraft is currently undergoing testing for the military, though civilian models may also be built.

Total U.S. shipments of the aircraft, spacecraft, and related equipment fluctuated yearly during the period, reaching $63 billion in 1990.[9] The airplane manufacturing industry accounts for the bulk of the sales in the aircraft manufacturing sector. In 1990, U.S. shipments of civil transport aircraft amounted to $22.2 billion, or 35 percent of total shipments of these goods. Imports of aircraft, spacecraft, and related equipment reached $6.4 billion in 1990, representing 10 percent of shipments and 16 percent of U.S. consumption. Parts for airplanes and helicopters represented the largest share of total U.S. imports of these products, amounting to $3 billion in 1990, or 47 percent of total U.S. imports.[10] Aircraft make up a significant share of U.S. exports of aerospace products which, in turn, comprise the leading category of total U.S. exports of all merchandise. Exports of aircraft, spacecraft, and related equipment during 1990 amounted to $29.4 billion, or 47 percent of total U.S. shipments.

[7] Davis, Frank, *Aeronautical Dictionary*, (Washington, DC: National Aeronautics and Space Administration, 1959), p. 107.

[8] Pitch is defined as the turning about a lateral axis so that the nose rises or falls in relation to the tail; roll is the motion of an aircraft around its longitudinal axis, which causes the wings to rise or fall; yaw is the motion around the vertical axis of an aircraft, causing the nose to turn left or right.

[9] Table 2, app. B.

[10] Ibid.

2

U.S. Industry Profile

Industry structure

Standard Industrial Classification (SIC) categories for aircraft manufacturing covered in this summary include the following numbers: SIC 3721, Aircraft; SIC 3462 (part), Iron and Steel Forgings (ferrous); and SIC 3463 (part), Nonferrous Forgings. SIC categories for spacecraft include SIC 3761 (part), Guided Missiles and Space Vehicles and SIC 3769 (part), Guided Missiles and Space Vehicle Parts and Auxiliary Equipment, Not Elsewhere Classified. Related equipment includes SIC 3728, Aircraft Parts and Auxiliary Equipment, Not Elsewhere Classified; SIC 2211 (part), Broadwoven Fabric Mills, Cotton; SIC 2273 (part), Carpet and Rugs; SIC 2531 (part), Public Building and Related Equipment; SIC 3429 (part), Hardware, Not Elsewhere Classified; SIC 3357 (part), Drawing and Insulating of Nonferrous Wire; SIC 3647 (part), Vehicular Lighting Equipment; and SIC 3769 (part), Guided Missiles and Space Vehicle Parts and Auxiliary Equipment, Not Elsewhere Classified. Parachutes are accounted for under SIC 2399 (part), Fabricated Textile Products, Not Elsewhere Classified; whereas ground flying trainers are incorporated in SIC 3699 (part), Electrical Machinery, Equipment, and Supplies, Not Elsewhere Classified.

Over 500 U.S. establishments produced a variety of aircraft, spacecraft, and related equipment during 1990. There are two to four manufacturers in each category of large transport, military, business jet, and other business, agricultural, and recreational aircraft. A large number of companies that supply kits to customers for assembly of recreational aircraft. Three major suppliers of rockets for launch services exist. The bulk of companies involved in the production of aircraft, spacecraft, and related equipment supply the major airframe manufacturers. U.S. production is generally concentrated in Washington, California, Kansas, Texas, and Connecticut. Employment in establishments producing these products was estimated to be 545,000 workers in 1990, compared with 524,000 workers in 1986, representing a 4 percent increase during the period. The ratio of production workers to all workers remained fairly constant at 53 percent during 1986-90.[11] According to USITC estimates, shipments per U.S. aerospace production worker remained relatively constant during 1986-88 at about $109,000, before declining to $91,000 in 1989, and increasing to $116,000 in 1990 (figure 1). The decline in output per production worker in 1989 was attributable to a labor strike at The Boeing Company during that year. Industry sources indicate that the majority of production workers employed in the aerospace industry are members of the International Union, United Automobile, Aerospace, and Agricultural Implement Workers of America, and the International Association of Machinists and Aerospace Workers. The average hourly wage earned by employees producing aircraft, spacecraft, and related equipment increased from $12.99 in 1986 to $14.54 in 1990.[12]

The level of skill required for production workers in the aerospace industry ranges from low or unskilled to highly skilled. Some of the tasks that were formerly performed by assembly workers fabricating wings and fuselages are now accomplished with the use of semiautomatic and robotic machines. Industry sources indicate that these robots are currently utilized primarily for riveting operations. The use of industrial robots in the aerospace industry is expected to expand into other areas as they become more sophisticated and the initial costs decline.

There are two U.S. manufacturers of large civil transport aircraft, the Boeing Company, located in Seattle, WA, and McDonnell-Douglas, headquartered in St. Louis, MO. Boeing produces multiengined jet aircraft that seat from 108 to over 500 passengers. Its primary competitors are McDonnell-Douglas and Airbus Industrie of France. Boeing also manufactures missiles, target drones, and helicopters for the military. In 1990, Boeing delivered 379 civil airplanes, had $27.6 billion in sales and other operating revenues, and recorded net earnings of $1.4 billion.[13]

McDonnell-Douglas is the leading defense contractor for the U.S. military. The company produces aircraft that seat from 109 to 323 passengers. It manufactures a variety of aircraft and missiles for both the U.S. and foreign markets. McDonnell-Douglas produces the Delta series of rockets, which has among the highest success rates in launches. In 1990, McDonnell-Douglas delivered 142 civil aircraft, had $16.2 billion in operating revenues, and recorded net earnings of $306 million.[14]

Commuter aircraft are produced by the Beech Aircraft Corporation of Wichita, KS, and the Fairchild Aircraft Corporation of San Antonio, TX. In 1990, these two manufacturers delivered a total of 66 commuter airplanes.[15] Primary competitors for these firms include EMBRAER of Brazil, British Aerospace of the United Kingdom, Dornier of Germany, and CASA of Spain.

Business jets are produced by the Beech Aircraft Corporation; Cessna Aircraft Company of Wichita, KN; Gulfstream Aerospace of Savannah, GA; and Learjet Corporation of Wichita, KN. These companies delivered a total of 168 airplanes in 1990.[16]

---

[11] *U.S. Industrial Outlook 1991—Aerospace*, U.S. Department of Commerce, January 1991, p. 22-4.

[12] "Average Hourly Earnings in the Aerospace Industry," AIA, Statistical Paper 91-38, Series 14-4, May 3, 1991.

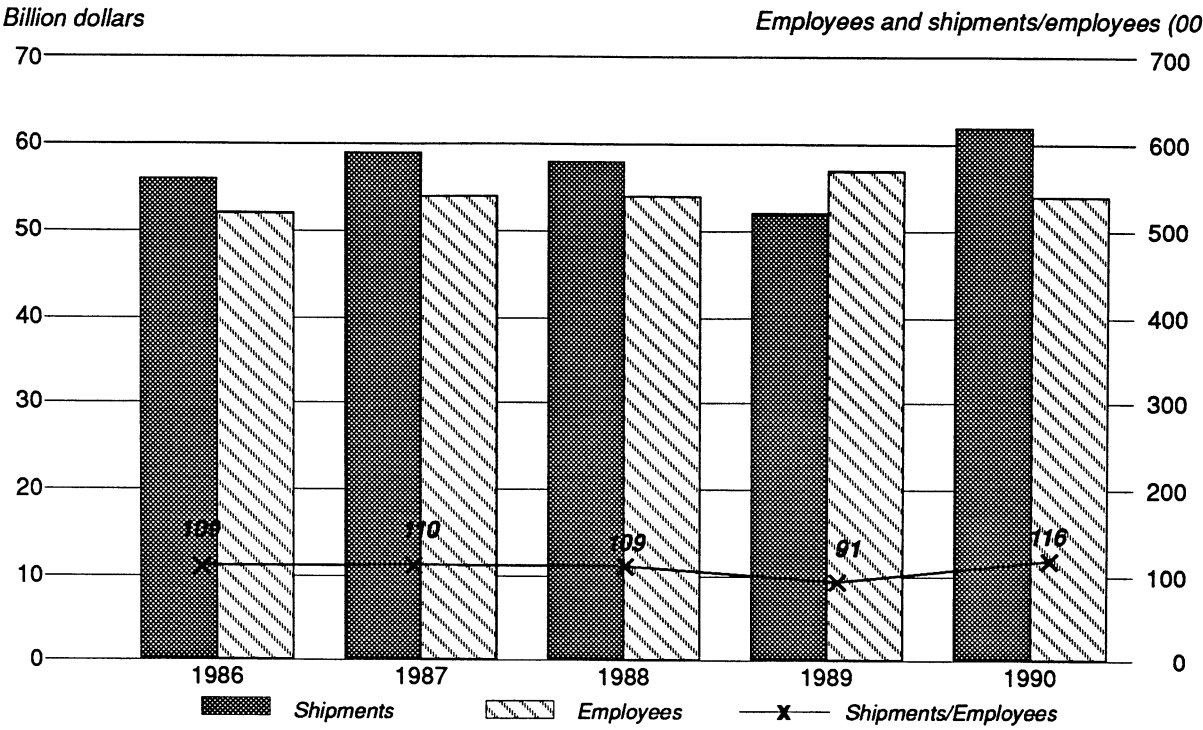
[13] "Orders, Shipments, and Backlog of U.S. Civil Jet Transport Aircraft," *4th Quarter 1990*, AIA, Statistics 91-14, Series 23-1, Follows 90-60/23-5, Feb. 27, 1991. *Boeing Annual Report 1990*, The Boeing Company, Seattle, WA, Feb. 25, 1991.

[14] Ibid. *McDonnell-Douglas 1990 Annual Report*, McDonnell-Douglas Company, St. Louis, MO, Feb. 22, 1991.

[15] General Aviation Manufacturers Association (GAMA), Washington, DC, press release, Jan. 17, 1991.

[16] Ibid.

Figure 1
Shipments, employees, and shipments per employee



Source: Aerospace Industries Association – AIA, USITC staff estimates, General Aviation Manufacturer's Association – GAMA.

International competitors of these U.S. business jet manufacturers are Dassault-Breuget of France; British Aerospace; Canadair Division of Bombardier, located in Canada; and Israel Aircraft Industries of Israel.

Turbopropeller aircraft used primarily for cargo or executive transport are produced by the Beech Aircraft Corporation; Cessna Aircraft Corporation; and Piper Aircraft Corporation of Vero Beach, FL. In 1990, these producers delivered a total of 213 airplanes.[17] Primary foreign competitors include British Aerospace, TBM International of France, and Rinaldo Piaggio of Italy.

The major producers of piston-engined aircraft, generally seating 1 to 6 passengers, are the Beech Aircraft Corporation; Maule Air Incorporated of Moultrie, GA; Mooney Aircraft Corporation of Kerrville, TX; and Piper Aircraft Corporation. These producers delivered 582 aircraft during 1990.[18] Numerous smaller companies also produced these aircraft, both assembled and in kit form, during 1986-90. Aerospatiale of France is the primary foreign competitor for these aircraft.

U.S aircraft manufacturers are not integrated with other U.S. or foreign suppliers. U.S. manufacturers have preferred the traditional relationship of employing outside firms in subcontractor positions. This type of business relationship may be changing, however, as new aircraft programs have been announced with foreign participation as risk-sharing partners. It is too soon to predict whether this type of relationship will flourish, as no foreign supplier has held more than a 21-percent share of a U.S. aircraft program on a risk-sharing basis.[19] Risk-sharing relationships reduce U.S. firms' financial risks and expenditures to develop programs; however, risk-sharing partnerships also diminish profits on successful products. U.S.-owned Boeing and McDonnell-Douglas, as well as Airbus of Toulouse, France, have cooperative ventures with other global aerospace companies to produce future airframe programs, such as the Boeing 777, the McDonnell-Douglas MD-12, and the Airbus A-330/340, respectively.

Previous endeavors by U.S. and foreign aircraft manufacturers have included Boeing's link with Japanese aerospace firms since the mid-1970s, in both the 757 and 767 programs. Boeing substantially expanded this relationship when, in March 1986, it announced that a Memorandum of Understanding had

[17] Ibid.
[18] Ibid.

[19] Japan will be responsible for approximately 21 percent of the Boeing 777 program announced in 1990.

4

been signed with Mitsubishi Heavy Industries, Kawasaki Heavy Industries, Fuji Heavy Industries, and the Japan Aircraft Development Company for the design, development, and production of a very high bypass-engined airplane. This airplane, to be known as the 7J7, was to be a 150-seat aircraft that would operate on up to 45 percent less fuel than did the then-available turbofan aircraft. This project did not go beyond design studies, as the price of jet fuel did not rise as fast as predicted, and the demand for air transportation services was such that operating older, less efficient aircraft was economically feasible. Boeing has assigned a token staff to continue with studies on this aircraft, while the Japanese continue to fund design studies as well. Currently, Japanese companies supply parts to both Boeing and McDonnell-Douglas.

In addition, McDonnell-Douglas began flying an ultra high bypass engined MD-80 on May 18, 1987, to test this engine technology on its current airframe. This program included Aeritalia from Italy, SAAB-Scania of Sweden, and the Shanghai Aviation Industrial Corporation of the People's Republic of China as risk-sharing partners. These tests led to the conclusion that such aircraft would have a 25 to 50 percent advantage in fuel-burn over similar aircraft on similar missions and would lower direct operation costs by up to 10 percent. McDonnell-Douglas planned on offering both a retrofit kit for its existing fleet of MD-80s, as well as a new, technologically advanced version of the aircraft, the MD-9XX. The cost benefits of this program failed to materialize as the price of oil and jet fuel, projected to climb, in fact remained low, averaging $14.09 a barrel and $0.54 a gallon, respectively, during 1986-1989; at present, the MD-9XX program is suspended.[20]

McDonnell-Douglas has also had a long relationship with Aeritalia, now part of Alenia,[21] which supplies airframe parts for both of its current production models, the MD-80 and MD-11. McDonnell-Douglas has coproduced the MD-80 series of aircraft with the Shanghai Aviation Industrial Corporation in China and allows the MD-80 to be built entirely by this Chinese company for the Chinese market.

The methods used to market aircraft and spacecraft differ according to product type and end use. Civil balloons, gliders, kites, and some small airplanes are typically sold through company-owned dealers or independent distributors. The manufacturer of these products typically advertises in listings included in trade journals listing the dealers' locations as sales outlets.

Large civil transport airplanes and helicopters are basically marketed in a similar manner throughout the world due to their uses as both passenger and cargo transports. There are two methods of marketing aircraft, one consumer-generated and the other manufacturer-generated. Airlines can approach aircraft manufacturers with a list of characteristics desired in a new aircraft. If enough interest is shown in the design specifications by other airlines, the manufacturer will consider initiating a new aircraft program. Most types of large civil transport aircraft begin this way; current models represent the evolution of the basic idea. However, as there were few original aircraft built during 1986-90, the bulk of airplane marketing in this segment was done by the aircraft manufacturer. Initially, attempts to generate interest in the product are made through articles and advertisements in trade publications, followed by a detailed sales campaign that includes soliciting new purchasers and attempting to sell aircraft to purchasers who have already expressed interest in the product. A salesman will visit prospective purchasers, stressing the quality of the aircraft and the reputation of the producing company. The salesman will often present a detailed route analysis, which illustrates the benefits of using the aircraft in the purchaser's normal operations. In most cases the sales process takes from 6 months to 2 years to complete. In recent years the sale of large commercial transports has include the acceptance of older, used aircraft from the buyer regardless of the original manufacturer.

Military aircraft, including airplanes, helicopters, balloons, gliders, and kites, are purchased by the individual branches of the U.S. and foreign armed forces. Each U.S. service branch or foreign government decides the type and number of aircraft needed within an allocated budget, using a series of studies done by individual offices in the U.S. Department of Defense or by individual country assessments. Once this determination is made, the branch or the foreign government solicits proposals from producers, choosing the one that will provide the best equipped aircraft at the lowest price. The proposed contract is usually for development of the aircraft (including research and development and building prototypes). If a foreign government requests to purchase U.S. military aircraft, the contract must be reviewed and approved by the U.S. Department of Defense. If the Department of Defense approves the contract, the contract proposals for both U.S. and foreign military aircraft purchases are then submitted to Congress for approval of the purchase. U.S. firms will keep in continual contact with the Department of Defense and try to interest the military in newly developed or existing products. Military aircraft are covered under the Buy American Act, which requires that at least 50 percent of the value of the aircraft be domestically produced. However, this requirement may be waived if the aircraft are to be purchased from North American Treaty Organization (NATO) countries.

U.S. producers of balloons, kites, and gliders generally base their price on the cost of production and a profit margin for both the manufacturer and the dealer. However, the pricing structure for civil airplanes and helicopters is quite different. Because the

[20] *Monthly Energy Review, April 1991*, U.S. Department of Energy, publication DOC/EIA-0035(19/04), p. 107.

[21] Alenia was formed in 1990 with the joining of Aeritalia and Selinia, both of Italy.

cost of the first several aircraft in a production series is higher than later ones because of production inefficiencies, the price is initially based on the estimated cost of producing a specific number of airplanes over an estimated number of future airplanes.[22] In addition, it is not uncommon for a manufacturer to offer financial incentives, such as reduced rates on training and parts and/or a lease-back of the aircraft for demonstration purposes for the launch customer or the first purchaser to sign a contract for firm orders of the airplane. To this base price, items such as spare parts, training, and follow up support are added for a final delivery price. The price for both military aircraft and military spacecraft is set forth in a contract, which specifies a certain dollar amount for a specific number of aircraft. This price also includes spare parts, training, and support.

The aircraft parts producers bid on specified contracts let out by the airframe manufacturers. Parts manufacturers who are awarded contracts may become the primary source of the item. The Federal Aviation Administration (FAA) certifies each part in an aircraft as being airworthy; therefore, airlines and airframe manufacturers use only parts that have been certified by the FAA. Due to the expense of certification, only a small number of manufacturers typically compete for specific contracts for specific parts.

According to the National Science Foundation, funding for research and development in the aerospace industry is substantially higher than the average for that in all manufacturing industries. In 1986, aerospace research and development expenditures totaled $21 billion; 71 percent of these funds, or $15 billion, were supplied by the U.S. Government and the remainder by the domestic industry. These expenditures rose to an estimated $26 billion in 1989. The percentage of U.S. Government and industry contributions remained approximately equal in 1986 and 1989 (figure 2 and 3).[23]

Examples of research and development projects undergoing development and currently in use are the increasing numbers and complexity of computers used to assist in the control of aircraft and spacecraft. "Fly-by-wire," or actuating a control surface by means of electronic messages sent to a computer, which then advises electric or hydraulic motors to respond, has been introduced into the civil aircraft fleet. Traditional electro-mechanical gauges are being supplanted by video representations of these gauges on a cathode ray tube. A study into the feasibility of both a next-generation supersonic transport airplane and a trans-atmospheric aircraft are being conducted globally. The NASA-Ames Research Facility in California is currently studying the environmental and atmospheric impact of such supersonic transports; its conclusions will strongly influence U.S. production of such aircraft.

A major factor adversely affecting the U.S. industry is product liability that limits U.S. production of general aviation aircraft, according to industry associations. Currently, there is no time limit to a U.S. or foreign company's liability when the company produces and sells aircraft that are subsequently registered in the United States; therefore, traditionally large U.S. producers of general aviation aircraft must continue to insure themselves for all aircraft produced by the company. This is a particular problem for producers of small single-engined general aviation aircraft, as product liability expenses often exceed the selling price of the aircraft itself.[24] U.S. manufacturers of general aviation aircraft face a greater number of product liability claims than do their foreign counterparts because most of the aircraft in the U.S. fleet are U.S.-made. This occurrence has reduced the production of these aircraft; deliveries of single piston-engined aircraft peaked at 14,398 units in 1978, but, in 1990, deliveries amounted to 608 units (figure 4). The average age of the U.S. general aviation fleet was 24 years in 1990; the average age of piston-engined aircraft, those which comprise most of the general aviation fleet and are used for recreation and pilot training, was 25.7 years.[25]

Consumer characteristics and factors affecting demand

The airlines of the world represent the largest market for civil transport and commuter airplanes. Large private corporations, air taxi services, commuter airlines, and individuals represent the market for business and executive turbopropeller and turbojet airplanes. Piston-engined airplanes are usually bought for pilot training, aerial application, aerial observation, and recreational purposes. The largest share by value of the domestic market for aircraft and spacecraft is made up of commercial users; the remainder consists of U.S. Government agencies and private individuals. However, general aviation aircraft, or those under 33,000 pounds and typically seating from 1 to 19 people, account for the bulk of active aircraft in the U.S. fleet.

U.S. demand for aircraft and spacecraft is cyclical, fluctuating with interest rates, the cost of fuel, U.S. Government procurement policies, passenger traffic, and route structure. The latter two were cited by the U.S. airlines as the primary factors influencing market demand for aircraft during 1986-90. As the hub-and-spoke system expanded during 1986-90 to meet the additional demand for air transportation

[22] Various USITC staff interviews with U.S. industry officials, 1988.

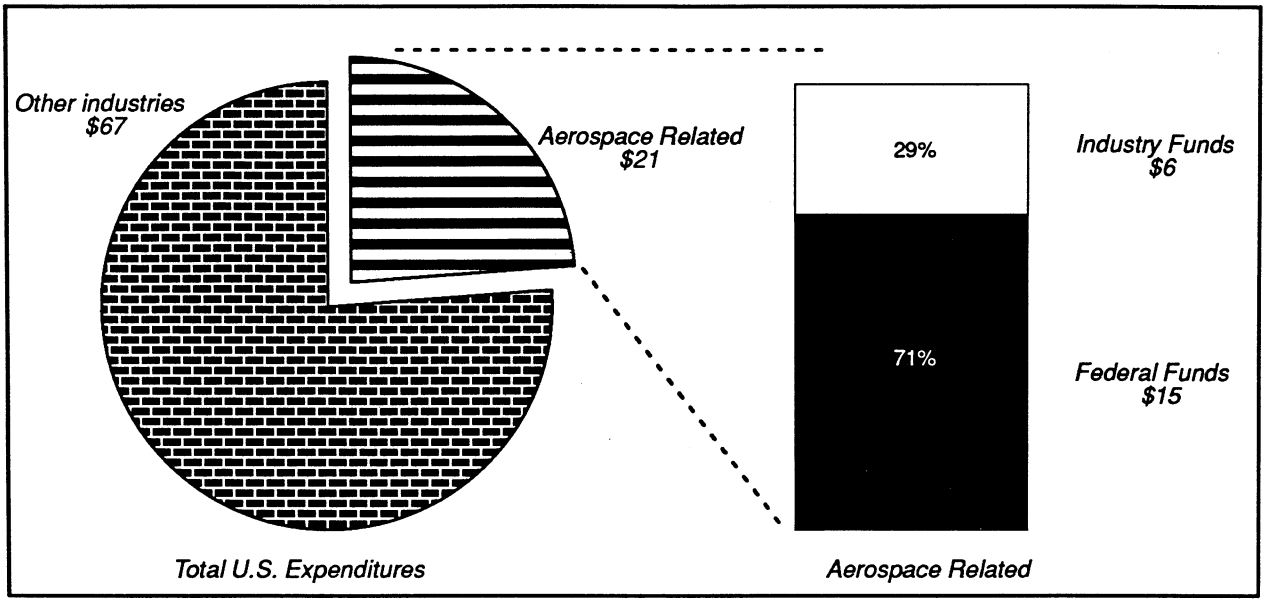
[23] USITC staff interviews with members of the National Science Foundation, May 17, 1991; *Aerospace Facts and Figures 90-91*, AIA, p. 104.

[24] "Product Liability Crisis Threatens U.S. General Aviation," General Aviation Manufacturers Association (GAMA), press release, Apr. 26, 1989.

[25] *General Aviation Statistical Handbook, 1990-1991 Edition*, GAMA, Washington, DC, p. 11; speech delivered by Mr. James Gormley, President, GAMA, Jan. 17, 1991.

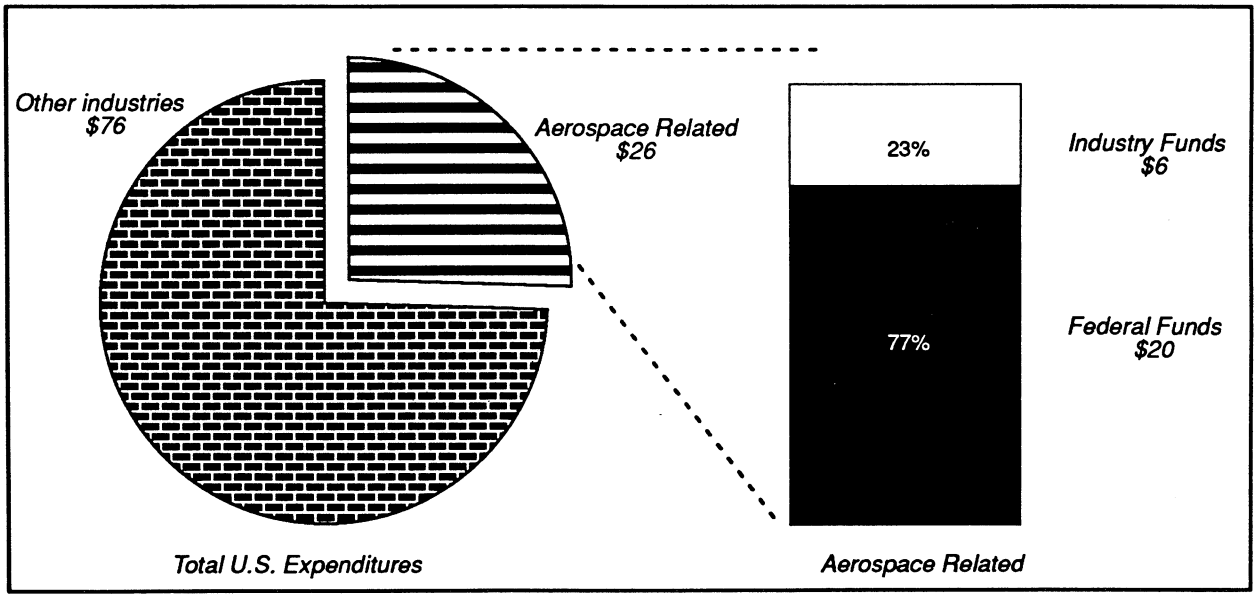
6

Figure 2
Research and development 1986: Total U.S. & Aerospace R&D expenditures in billions



Source: AIA, Nat'l Science Foundation.

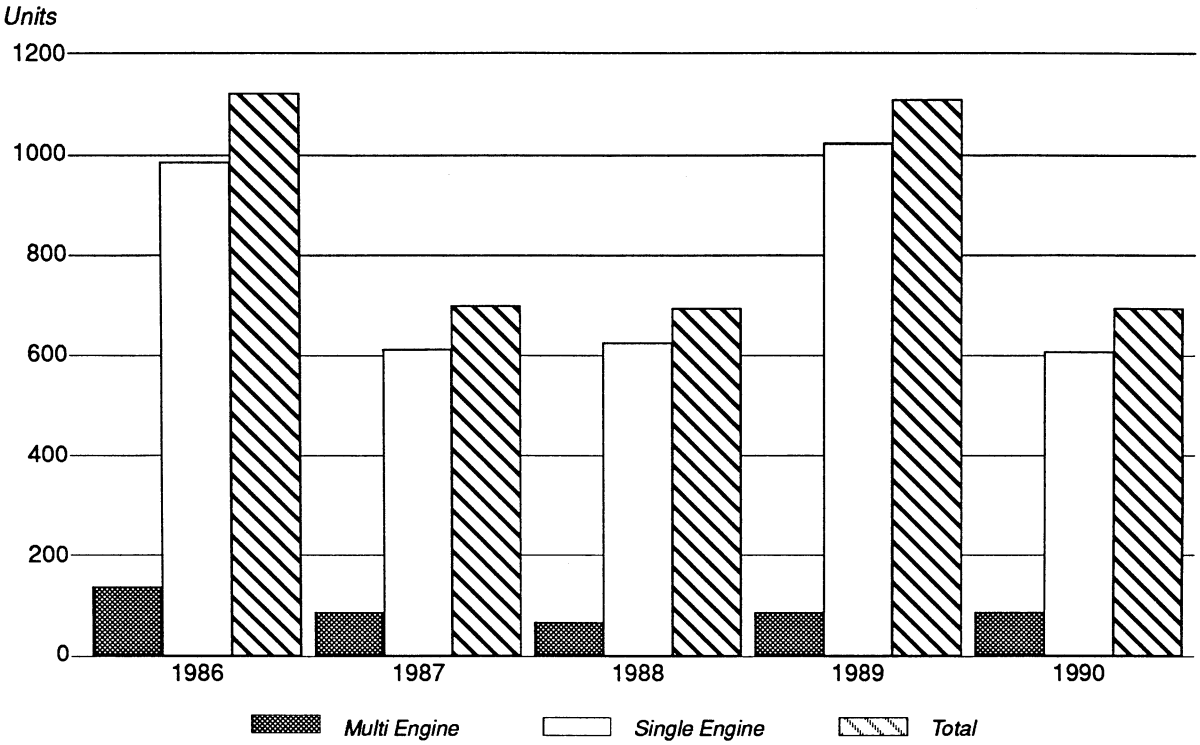
Figure 3
Research and development 1989: Total U.S. & Aerospace R&D expenditures in billions



Source: AIA, Nat'l Science Foundation.

7

Figure 4
U.S. production: U.S. piston-engine airplane production, 1986–90



Source: GAMA.

services, aircraft manufacturers increased their deliveries to record levels. Other factors noted were efficiency and passenger comfort.[26] Issues that have arisen in the late 1980s concerning large transport aircraft include the effects of aging on aircraft and the effects of noise produced by these aircraft.[27] Demand for both business and private-use aircraft is influenced by such factors as intended use, convenience of scheduled airlines, cost of fuel, cost of aircraft, and degree of expertise of the buyer. This market was depressed during 1986-88, because of corporate downsizing, but it experienced renewed interest in 1989-90. Industry sources indicate that these purchasers also tend to "trade up" aircraft as they gain more experience. The demand for military aircraft is based on complex political factors and budgetary limitations determined by the U.S. Government.

The demand for spacecraft depends on their use. The demand for military spacecraft, which include defense communication satellites, is determined by national defense concerns. Civil and commercial space development covers deep-space probes designed to discover more about solar systems, telecommunications satellites, weather and earth resources monitoring satellites, and the launch vehicles needed to place these satellites in space. The market for these products is influenced by the demand for this type of information and the availability of the product. To date, the largest demand for such vehicles has been from the military and communications sectors. Experiments in space manufacturing have not generated sufficient interest from the world's manufacturing industries to offset the cost of such endeavors.

Foreign Industry Profile

There are three major foreign manufacturers of large civil jet transport airplanes: Airbus Industrie, G.I.E.; British Aerospace, plc.; and the Fokker Aircraft Company of the Netherlands. Airbus Industrie, G.I.E., a consortium of European manufacturers, is the chief competitor of U.S.-manufactured large transport aircraft. France, the United Kingdom, Germany, and Spain have agreed to foster a relationship between each country's primary aerospace company (Aerospatiale, British Aerospace, Deutsche Aerospace, and

[26] U.S. International Trade Commission, *The Economic Impact of Foreign Export Credit Subsidies on Certain U.S. Industries*, USITC Publication 1340, January 1983.

[27] At the request of the FAA, a panel representing a broad range of aviation experts was convened to study each manufacturer's aircraft models currently in use in the global fleet. The panel's target was to identify sources of potential failure because of fatigue. Compliance with the findings was not legally-mandated, as the panel had no legal status.

Noise issues were addressed in the Airport Noise and Capacity Act of 1990, which was signed on Nov. 5, 1990. One of the provisions in this act calls for the mandated phasing-out of Stage II aircraft over a 10-year period.

8

Construcciones Aeronauticas S.A., respectively) to produce large transport aircraft over 150 seats in size. This coalition was formed in hopes of producing a commercially successful transport aircraft capable of competing with similar U.S.-manufactured aircraft, something that European firms had not been able to accomplish in the past. British Aerospace and Fokker produce jet transport aircraft in the 80 to 110 seat range, competing with U.S. manufacturers at the lower seat-range of the large transport market. In 1990, Airbus, British Aerospace, and Fokker delivered 151 airplanes, or 14 percent of total worldwide deliveries of large transport aircraft.[28] Airbus garnered more than a 31-percent share of new orders for large aircraft in 1990, a significant achievement given its relatively short 22-year history (figure 5).[29] Reasons for the popularity of Airbus products include competitive pricing, availability of delivery positions, and advanced technology.

U.S. manufacturers view Airbus and EMBRAER as their primary global competitors. Airbus benefits from loans from at least four European countries for the development and production of new aircraft. These funds are repayable to the European nations not according to a prescribed timetable, but as the company delivers an aircraft. Estimates of the total funds to date advanced to Airbus Industrie range up to $26 billion, including interest.[30] U.S. manufacturers do not have comparable access to similar types of government or commercial funding for civil aircraft; industry sources claim that this creates an unfair competitive environment. At present, the U.S. Government is requesting a GATT panel to comment on the appropriateness of Germany's subsidization of its foreign exchange rate to its Airbus member company, Deutsche Airbus, and the overall issue of alleged development and production subsidies.[31]

British Aerospace, Dornier of Germany, and EMBRAER of Brazil produce popular models of commuter aircraft that compete with similar sized U.S.-built aircraft in the 19-seat range. Canada, Brazil, the Netherlands, and Sweden, and a consortium formed by Aerospatiale and Alenia of Italy (ATR),[32] supply larger commuter aircraft to the U.S. market; however, these aircraft, typically having between 30 and 70 seats, compete with models from other European nations, not with any U.S. aircraft. France, the United Kingdom, Canada, and Israel produce and export business jets to the U.S. market. These models compete with U.S.-built business jets.

Major aircraft parts suppliers are found in most European nations, Japan, Korea, and Indonesia. Once the parts produced by these manufacturers are certified by the FAA, both U.S. manufacturers and foreign builders of aircraft source parts from these nations as necessary. Major manufacturers of flight simulators are located in the United States, Canada, the United Kingdom, France, and Spain. CAE Electronics of Canada and Rediffusion Simulation of the United Kingdom accounted for 85 percent of world commercial flight simulator sales in 1989, or a total of 56 units; Link-Miles and Simuflite of the United States together sold three simulators in 1989.[33] Spacecraft are currently produced in several European nations, Japan, China, and the Soviet Union.

The United States, China, the Soviet Union, and one European consortium currently provide launch services. Japan is currently developing a commercial space launch capability. The components and engines for Japan's H-2 rocket are undergoing testing, with the rocket being offered for commercial payloads in the mid-1990s.

Arianespace is the commercial provider and marketing arm of the European Space Agency, a consortium of eleven European aerospace companies, which, together, supply parts for the Ariane series of rockets. No European country has launched any military satellites, whereas the United States has launched many satellites with defense applications. At the same time, Arianespace has aggressively pursued commercial contracts; it currently holds over half of the global commercial launch business through 1995. In 1968, Arianespace began building launch facilities in Kourou, French Guiana, near the equator. Proximity to the equator, where the Earth's rotational momentum is greatest, grants a launch vehicle an additional lift and a potential cost advantage for geostationary orbit placements. A rocket launched from the Ariane base at Kourou provides 10 percent more lift than if it is launched from the U.S. Kennedy Space Center in Florida.[34]

The People's Republic of China and the Soviet Union both have launched commercial satellites for other nations. The U.S. Government reached an agreement with China in 1989 on launch prices and quantities. Following very low introductory prices for two launches, China agreed to offer market or "par" prices for its services, and to fly no more than nine payloads over six years. This agreement was formulated in response to U.S. and Arianespace concerns over below-market launch rates offered by China, which in two cases were one-third the current rate.

---

[28] *The European Aerospace Industry: Trading Position and Figures 1991*, Commission of the European Communities, Brussels, Mar. 1, 1991, p. 28. Jet aircraft deliveries included Airbus, 95; British Aerospace, 25; and Fokker, 31.

[29] Ibid., p. 25. Jet aircraft orders in 1990 were Airbus, 359; British Aerospace, 30; and Fokker, 37.

[30] *An Economic and Financial Review of Airbus Industrie*, Gellman Research Associates, (Jenkintown, PA), Sept. 4, 1990, p. ES-2.

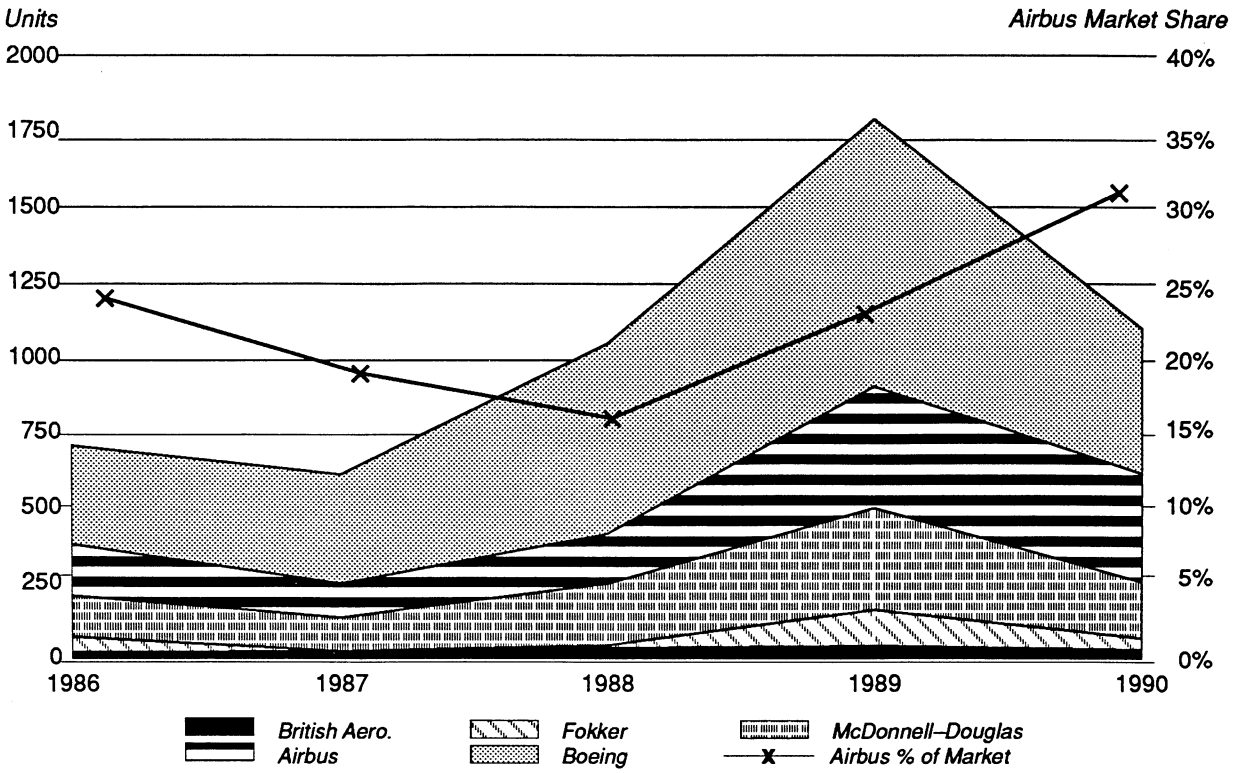
[31] "U.S. Takes Airbus Dispute To GATT for Consultations," *Aviation Week & Space Technology*, June 10, 1991, p. 18-19.

[32] The initial ATR program, the ATR-42, was launched by Aerospatiale of France and Aeritalia of Italy on Nov. 4, 1981, by setting up a Groupement d'Interet Economique. The letters "ATR" correspond to the French and Italian words for regional transport aircraft. *Jane's All the World's Aircraft 1989-90*, London, 1989, p. 120.

[33] "Behind the Boom," *Flight International*, Apr. 4-10, 1990, p. 33.

[34] *Encouraging Private Investment in Space Activities*, Congressional Budget Office, February 1991, p. 17.

Figure 5
Transport aircraft: World jet transport airplane orders, 1986–90



Source: AIA, The European Commission.

The United States has traditionally been the leading market for aircraft in the world on account of its reliance on this mode of transportation. However, as other areas of the world experience further economic growth, the demand for aircraft in these regions will grow faster than the demand for aircraft in United States. In particular, the growth in demand for travel on airlines based in the Pacific Rim nations is projected to be twice that of the United States for the period 1990-2000.[35]

U.S. Trade Measures

Tariff measures

The provisions of the Harmonized Tariff Schedule of the United States applicable to aircraft and spacecraft and related equipment are shown in appendix B, table 1. The GATT Agreement in Trade in Civil Aircraft (ATCA), which became effective on January 1, 1980, provides for the elimination on a most-favored-nation (MFN) basis of all customs duties and similar charges of any kind levied on, or in connection with, the importation of civil aircraft.[36] Certain parts, components, or subassemblies of civil aircraft are also accorded duty-free treatment under the agreement if they are certified for use in civil aircraft. In addition, duties on foreign repair of civil aircraft were eliminated. The United States, the European Community, Canada, Japan, Austria, Norway, Romania, Sweden, and Switzerland are signatories.[37] As a result of this agreement, U.S. exports of civil aircraft to signatory countries enter that country duty free; however, GATT member countries which are nonsignatories, such as Brazil, may impose a duty on its imports, but export on a duty-free basis to signatory countries.

Nontariff measures

There are no known nontariff barriers to U.S. imports of aircraft and related equipment. For spacecraft, a nontariff barrier may be said to exist, as the two U.S. launch sites for space vehicles are only capable of launching U.S. rockets, due to the

[35] *Current Market Outlook: World Market Demand and Airplane Requirements*, (Seattle, Washington: The Boeing Commercial Airplane Group, February 1991), p. 39. The average annual growth 1990-2000 of airlines based in Japan, China, and other Asian nations along the Pacific Rim is projected to be 56 to 104 percent greater than that of the United States or Western Europe.

[36] See app. A, p. A-4.

[37] Duty reductions are not limited to the 18 signatories to the agreement, since, under the General Agreement on Tariffs and Trade (GATT), such reductions apply to all GATT member countries.

10

incompatibility of necessary launch systems. Typically any country that develops space launching ability also develops a unique launch facility for its vehicle. Currently, most launch vehicles compete with each other; therefore, launch facilities also compete with each other. None of the market-economy countries possessing space launch capabilities have ever indicated a desire to launch from the United States. However, a U.S. company did express interest in purchasing Soviet-made rockets for launch in Florida; this request was denied by the U.S. President.

U.S. Government Trade-Related Investigations

There have been no statutory investigations concerning aircraft by the U.S. International Trade Commission since 1982.[38] In 1986, the U.S. International Trade Commission conducted a self-initiated study, investigation No. 332-204, Competitive Assessment of the U.S. Commuter and Business Aircraft Industries. This study assessed the factors affecting the international competitive position of U.S. producers in domestic and foreign markets, compared the structural characteristics of the U.S. industry and foreign industries, and examined the extent of government involvement in the world market.[39]

Foreign Trade Measures

Tariff Measures

The primary foreign markets for U.S.-produced aircraft, spacecraft, and related equipment are Japan, the United Kingdom, and Germany. All of these nations base their tariff classifications under *Harmonized System Nomenclature* headings 88.02-88.05. The European Community and Japan are among the signatories of the Agreement on Trade in Civil Aircraft, which provides for the duty-free trade in civil aircraft among its signatories. Therefore, there are no tariffs on imports of U.S.-made civil aircraft, spacecraft, and related equipment into these countries. However, in some export markets that are not members of the GATT, trade is hindered by cumbersome certification procedures and difficulties in obtaining import licenses.

Brazil, which is not a signatory of the Agreement in Trade in Civil Aircraft, has reduced its import tariffs on aircraft from an average of 50 percent to 5 percent, effective January 1, 1991. Mexico imposes tariffs on imported aircraft and related equipment, including parachutes and flight simulators, ranging from 10 to 20 percent.

Nontariff Measures

All civil aircraft must be certified by an appropriate civil governmental authority, which grants airworthiness certificates to each type of aircraft. The United States and Europe demand that any aircraft flown in their skies meet stringent standards established for airworthiness. These standards are promulgated and administered by the Federal Aviation Administration in the United States; similarly, each European country currently has comparable civil authorities. As most transport aircraft are produced either in the United States or Europe, most aircraft in the world's fleets have been certified by one or both of these agencies. Therefore, standards do not inhibit the trade of civil aircraft, as all must conform to similar international standards.

Industry sources indicate that Brazil maintains a "hidden" duty; that is, various state governments in Brazil levy up to a 17 percent surcharge on the importation of aircraft. Brazilian authorities claim that this levy is a domestic tax and not an import duty.

U.S. Market

Consumption

According to industry sources, the United States is one of the world's largest markets for aircraft. In 1989, the United States had an estimated 225,179 active civil aircraft in its fleet, of which less than 3 percent were owned by airlines.[40] The estimated composition of the U.S. fleet is shown in the following tabulation:[41]

Aircraft Type	*Airline*	*General Aviation*	*Total*
Piston	353	193,479	193,832
Turboprop	1,476	6,433	7,909
Turbojet	3,942	4,446	8,388
Rotorcraft	7	7,475	7,482
Other	0	7,568	7,568
Total	5,778	219,401	225,179

U.S. consumption of aircraft, spacecraft, and related equipment rose from $46.3 to $47.3 billion during 1986-87, and fluctuated downward from $43.9 billion to $39.9 billion during 1988-90 (figure 6).[42] U.S. consumption during 1988-90 was influenced by the general decline in domestic civil and military deliveries.[43] U.S. exports nearly doubled during the period, rising from $15 billion to $29 billion; this

[38] USITC investigations Nos. 701-TA-174 and 701-TA-175, Certain Commuter Airplanes from France and Italy; USITC investigation No. 701-TA-188, Certain Commuter Aircraft from Brazil. On July 7, 1982, the Commission determined that the domestic industry had not been materially injured, or threatened with material injury or that establishment of an industry was materially retarded by imports of certain commuter aircraft from France or Italy. On September 21, 1982, the Commission again determined that the domestic industry had not been materially injured by imports of these products from Brazil.

[39] This study reported that U.S. producers were losing global market share to foreign competition because of size, price, and quality issues. Product liability costs were also responsible for some losses in U.S. sales.

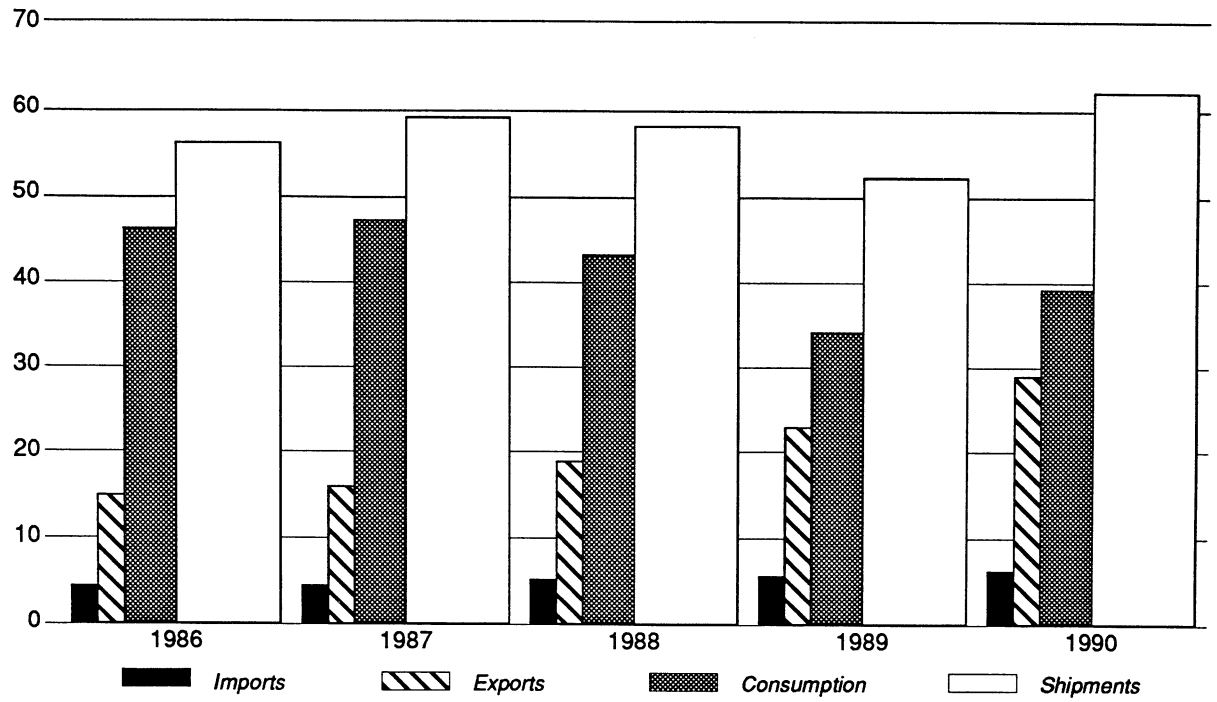
[40] *AOPA 1991 Aviation Fact Card*, Aircraft Owners and Pilots Association, Frederick, MD.

[41] Ibid.

[42] Table 2, app. B.

[43] Table 2, app. B. *Aerospace Facts and Figues 90-91*, AIA, p. 30-31.

Figure 6
U.S. industry statistics: Imports, exports, producer's shipments, and apparent consumption, 1986–90



Apparent Consumption–Producer's Shipments+Imports–Exports
Source: USITC, AIA.

increase was spurred by foreign demand to satisfy projected capacity needs primarily of airlines in the EC and the Pacific Rim nations.[44] The number of U.S.-manufactured large civil aircraft exported during the period increased by 89 percent, whereas domestic deliveries increased by 29 percent.[45] U.S. imports grew by approximately 50 percent during the period, from $4.4 to $6.4 billion, principally representing the growth of U.S. commuter airlines and their need for aircraft and related equipment.[46] The import share of the U.S. market increased from 10 percent in 1986 to 17 percent in 1989, before declining to 16 percent in 1990.[47] Nineteen-ninety marked the first year of significant deliveries of foreign transport class aircraft to the United States, a trend that may continue for the next few years as orders for those aircraft are filled. However, the United States is likely to retain its lead in total deliveries of aircraft, spacecraft, and related equipment for the foreseeable future, as no country in the world currently has a comparable aerospace manufacturing and support infrastructure as that found in the United States.

Production

During 1986-90, U.S. shipments of aircraft, spacecraft, and related equipment rose from $57.0 billion to $63.0 billion, or by 11 percent (figure 7). The largest portion of U.S. shipments of civil aircraft and spacecraft was made up of civil transports, which more than doubled from $10.3 billion to $22.2 billion during the period.[48] This rise was attributable to increased demand by world airlines and aircraft leasing companies, the primary customers for these products. Overall, U.S. unit shipments of airplanes rose modestly, while the type of airplane delivered shifted toward large civil transports to meet global capacity shortfalls and replacement of aging aircraft. The number of transports shipped has increased whereas the number of general aviation aircraft shipped has declined (figure 8). The increase in helicopter unit shipments is attributable to military orders, as the civil market remains depressed. The composition of the

[44] Table 4, app. B. Delivery dates for large civil transport aircraft typically must be secured at least 2-5 years in advance. Production capacity for large civil transports is limited and difficult to increase over the short-term; therefore, airlines are rarely able to purchase an aircraft from the manufacturer for immediate delivery.

[45] *Aerospace Facts & Figures, 90-91*, AIA, p. 30. "Orders, Shipments, and Backlog of U.S. Civil Jet Transport Aircraft," AIA.

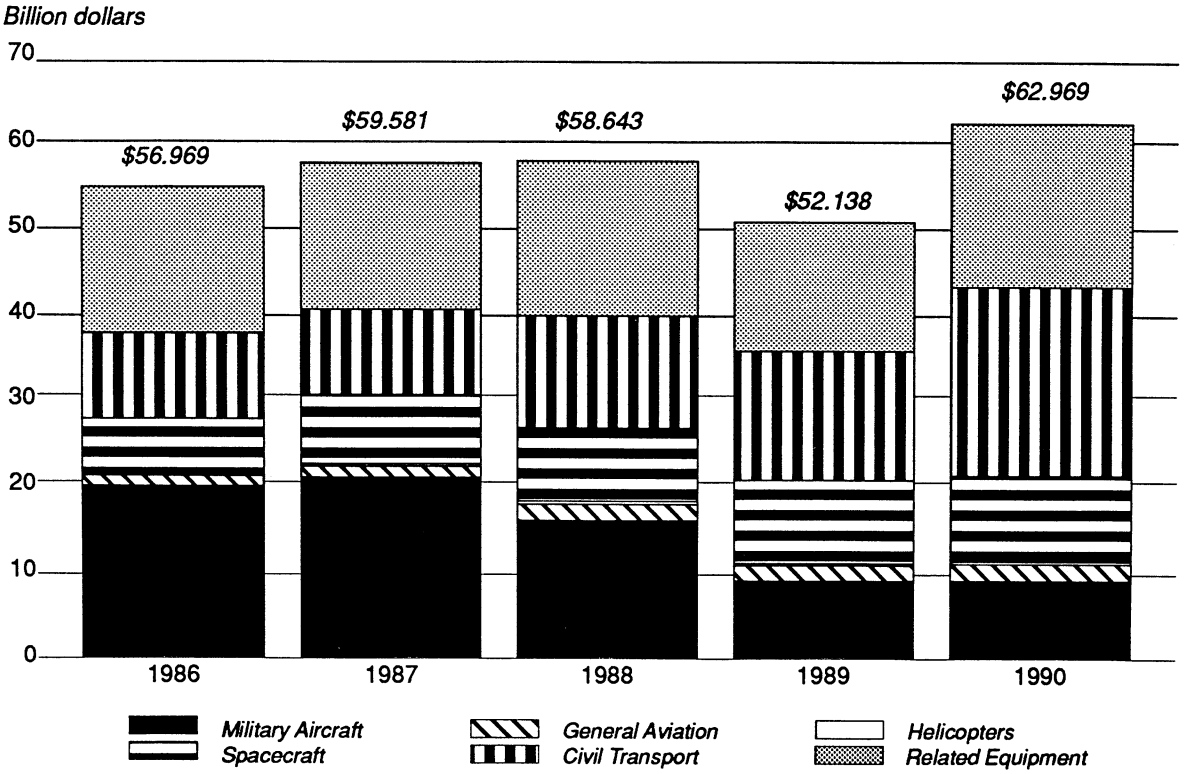
[46] Table 3, app. B.

[47] Table 2, app. B.

[48] *Aerospace Facts and Figures 1990-91*, AIA, p. 34; "Orders, Shipments, & Backlog of U.S. Civil Jet Transport Aircraft," AIA.

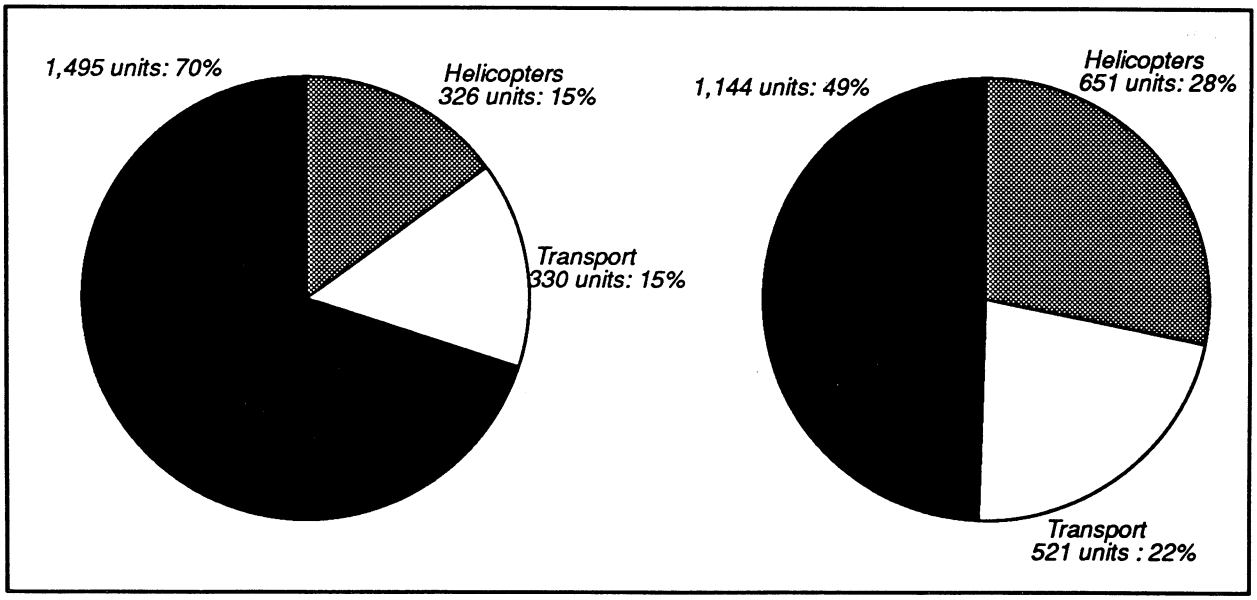
12

Figure 7
U.S. shipments, 1986–90: Aircraft, spacecraft, and related equipment



Source: AIA, USITC.

Figure 8
U.S. shipments, 1986 and 1990: Civil shipments by airplane type



Source: *GAMA, AIA, USITC.*

13

value of U.S. shipments by type of aircraft/spacecraft indicates a significant drop in military aircraft shipments overall, a significant rise in civil transport airplanes, and a steady rise in shipments of U.S. spacecraft (figure 9). Both helicopter and general aviation shipments remain stable, with general aviation showing a modest rise in the value of its shipments.

The United States does not produce as many civil flight simulators as other countries; however, as more of the airplanes that have been ordered are delivered, U.S. production of simulators may rise.

U.S. production of large civil transports may decline as current contract orders are filled. The number of new orders rose from $17.7 billion during the first half of 1990 to $27.8 billion during the second half of 1990. However, orders are not expected to increase again at the record-setting 1986-90 pace (see figure 5) since interim capacity needs appear to be met. Sales of military aircraft slowed steadily during the period, reflecting the overall reduction of world tensions and a reluctance on the part of world governments to allocate funds for armaments.

Imports

Products Imported

U.S. imports consisted primarily of nonmilitary aircraft between 2,000 and 15,000 kg, which are for the most part commuter and business/executive aircraft, and other parts. Only two U.S. manufacturers compete with the several European companies in the commuter market niche; further, these U.S. firms only compete at the lower end of the market, producing small commuter airplanes. At present, the market for commuter airplanes is moving toward larger airplanes. Four large U.S. companies produce business and executive jets, while a Canadian, an Israeli, and two European manufacturers also produce these jets. In addition, U.S. imports of complete large civil transport airplanes from France, headquarters for the European Airbus consortium, will continue to increase, as more U.S. operators begin taking delivery of airplanes they have ordered.

Import Levels and Trends

Imports of aircraft, spacecraft, and related equipment rose from 8 percent to 11 percent of shipments during 1986-89, declining to 10 percent in 1990 (appendix B, table 2). Parts for aircraft, large commuter aircraft which the United States does not produce, and large transport airplanes from Airbus Industrie accounted for and will continue to comprise the bulk of future imports. Spacecraft, in the form of satellites, may be imported; however, foreign launch vehicles will not be imported because they are incompatible with U.S. launch facilities and because the U.S. Government, which is the primary source of U.S. launch business, requires its payloads to be launched by U.S.-built systems. There are no foreign-made rockets currently produced that could utilize U.S. launch facilities, because of the custom-nature of each installation.

Principal Import Suppliers

The top five suppliers of U.S. imports during 1986-90 were Canada, the United Kingdom, France, the Netherlands, and Brazil, supplying between 74 and 76 percent of total imports of these items (figure 10). Imports from Canada grew from $1.2 billion to $1.8 billion, or by 45 percent during the period, whereas imports from the United Kingdom rose by 9 percent, from $1.1 to $1.2 billion. Imports from Japan more than doubled, to $436 million; Japan will likely become a leading source of U.S. imports, because of its aforementioned association with Boeing.

U.S. Importers

The principal importers of foreign-made aircraft are the commuter airlines; flight simulators are imported by major airlines, whereas major U.S. airframe manufacturers import parts for their aircraft.

Foreign Markets

Foreign market profile

Historically, Europe has been the leading U.S. export market for aircraft, spacecraft, and related equipment. While European firms possessed the capability of manufacturing these items, until the mid-1980s, European companies lacked sufficient capacity and product line to meet domestic demand. As Airbus Industrie expands its capabilities, European countries will become more able to meet their needs from European sources.

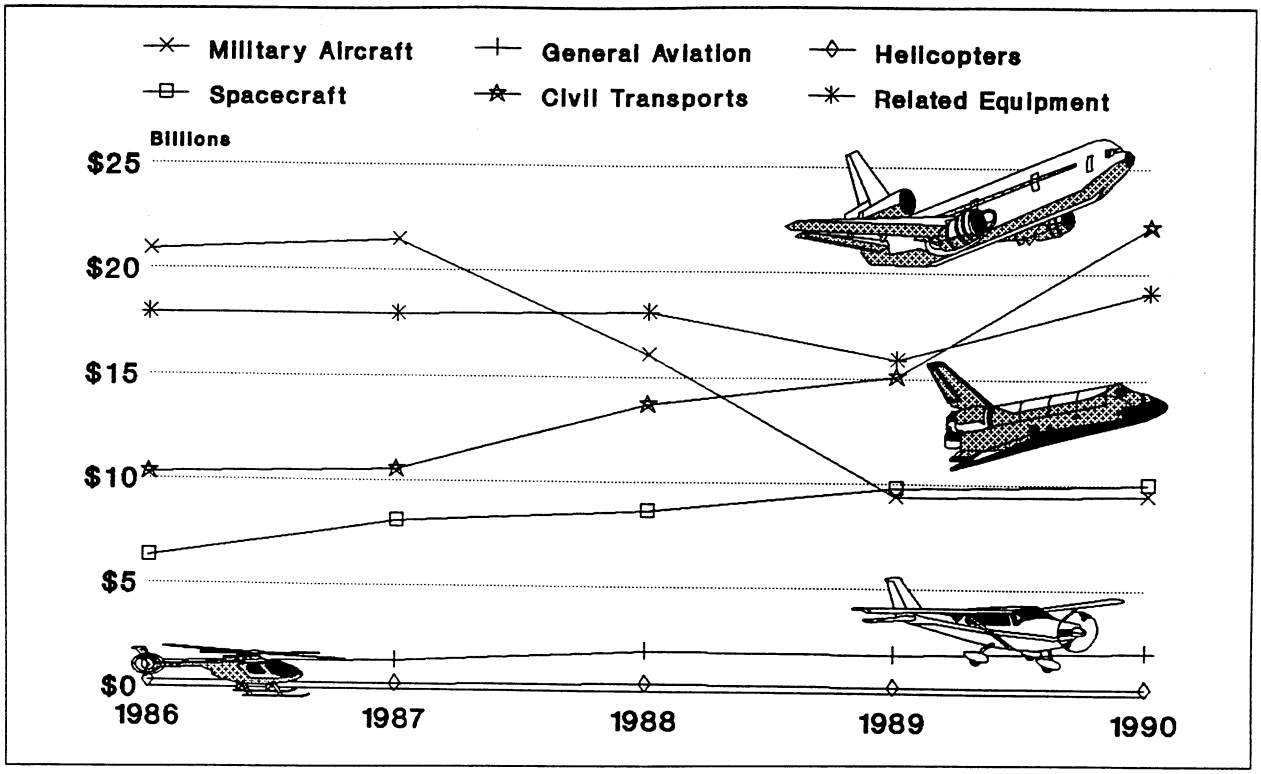
The Pacific Rim nations are currently the fastest growing market for air travel.[49] These countries, notably Australia, Japan, Singapore, Korea, and Taiwan, have experienced a sharp growth in demand for aircraft capacity, necessitating an expansion of their transportation infrastructure and capabilities. U.S. aircraft manufacturers have met these countries' demand for air transportation with U.S.-built airplanes, training, and parts for airplanes. Currently, U.S. firms hold a dominant sales position in the Pacific Rim; however, this is being aggressively contested by Airbus Industrie, which has recently sold airplanes to airlines in Japan and Thailand.

Central and South America hold limited prospects for U.S. manufacturers, due to the fiscal difficulties present in the countries of this region. U.S. industry sources are not optimistic about short-term prospects in Eastern Europe, largely because of the uncertain economic conditions and the need to pay for goods in a convertible currency.

[49] *FAA Aviation Forecasts, Fiscal Years 1991-2002*, Federal Aviation Administration, FAA-APO91-1, February 1991, p. 40.

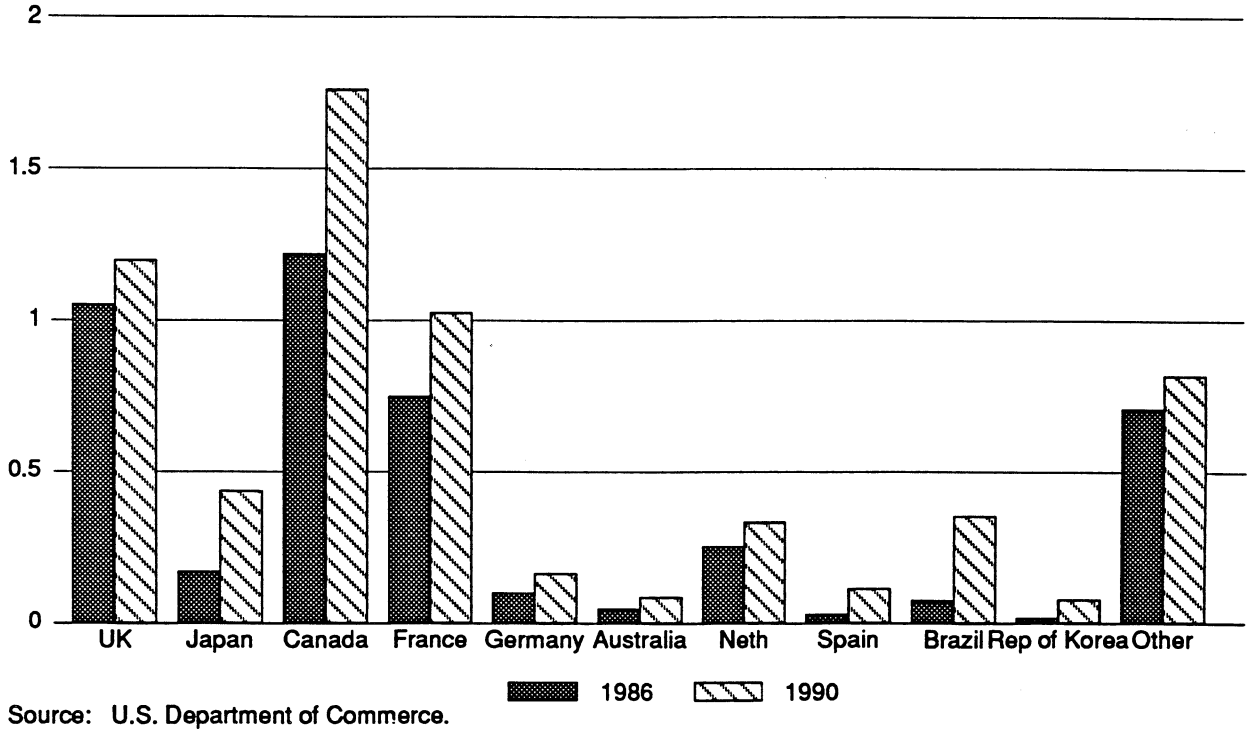
14

Figure 9
Trends in U.S. shipments



Source: AIA, USITC.

Figure 10
U.S. imports, 1986 & 1990: Aircraft, spacecraft, and related equipment
Billion dollars



Source: U.S. Department of Commerce.

The largest potential market for U.S. airplanes is the Soviet Union. Aeroflot, the national airline of the Soviet Union, has the largest civil fleet of airplanes in the world. The large transport aircraft in its fleet, all Soviet-designed and built, are not comparable to Western airplanes in terms of quality, economy, and comfort. In 1990, Aeroflot estimated it had turned away over 20 million potential passengers because of a lack of capacity.[50] Western airplanes could immediately fill a sizeable portion of this capacity shortfall. However, even if the technology transfer issues are resolved, the Soviet airline will still face the difficulty of paying for the airplanes in hard currency. Aeroflot has acquired 5 Airbus aircraft and has conducted talks with former Eastern Airlines officials in hopes of buying up to 13 used Lockheed L-1011 aircraft.[51] If the Soviet economy improves, Aeroflot will likely seek more Western airplanes for its fleet.

Two U.S. manufacturers have concluded contracts with the Soviet Union for production of U.S.-designed airplanes. Gulfstream Aerospace Corporation, builder of the Gulfstream G-IV business and executive jet, has teamed with P.O. Sukhoi Design Bureau of the Soviet Union to produce the world's first supersonic business jet.[52] American General Aviation Corporation, builder of a series of general aviation aircraft formerly manufactured by Gulfstream and Grumman, is seeking a partnership with the Tbilisi Aircraft Manufacturing Association of Soviet Georgia to produce a light twin-engined general aviation aircraft. This aircraft, called the Cougar, was last produced in the late 1970s by Grumman American Aviation in the U.S. State of Georgia.[53]

Neither Boeing nor McDonnell-Douglas have announced joint-ventures with Soviet manufacturers for sourcing components or cooperation in the production of aircraft. At present, both firms have U.S. military production contracts; this may preclude such a linkup.

Factors that foreign and domestic airlines consider in placing an order for a particular type airplane with a supplier include: the level of commonality with their current fleet, which will determine the level of training necessary to fly and maintain the new aircraft; the supplier's ability to provide timely product support throughout the world; reputation for quality; and price, which may include training, parts, and factory support for a specified period of time. U.S. airplane manufacturers have enjoyed a strong reputation for quality and service throughout the world. However, due to the expense of developing new programs, U.S. and foreign manufacturers generally did not offer competing products over a wide range of airplanes during 1986-90. The most competitive sector of the airplane manufacturing business during the period was in the narrow-bodied aircraft with approximately 150 seats. This niche has three competitors vying for sales; this is an atypical situation. In 1989, 845 of these aircraft were ordered from all manufacturers; U.S. firms accounted for 87 percent of these orders, or 735 units. Of the 437 such aircraft ordered during 1990, U.S. manufacturers' market share declined to 68 percent, or 299 orders. This decline was attributable to the popularity of the Airbus A-320, which captured 32 percent of this market.[54]

Factors affecting the purchase decision of spacecraft launch services can be influenced by the manufacturer of the satellite. Satellites purchased by the U.S. Government can be launched only on U.S. rockets by U.S. companies, for national security reasons. However, commercial purchasers are free to choose among U.S. or European competitors, whereas use of a launch service in a Communist country raises issues concerning the transfer of technology.

U.S. exports

Products Exported

Airplanes and other aircraft, of an unladen weight exceeding 15,000 kg, accounted for the largest share of exports during 1986-90. This commodity grouping, primarily composed of large civil and military airplanes, accounted for 44 to 60 percent of total exports of aircraft, spacecraft, and related equipment during 1986-90. In 1990, exports of these aircraft amounted to nearly $18 billion. The United States supplied over 79 percent of all global transport aircraft during 1986-90.[55] Other parts of airplanes or helicopters accounted for the second largest share, representing 28 percent of total exports in 1990, or $8.4 billion.[56]

Export Levels and Trends

U.S. exports of aircraft, spacecraft, and related equipment rose during 1986-90, primarily because of the increased demand for large civil airplanes. In contrast, exports of military airplanes declined during this period. While it is significant that the historical export markets of the United Kingdom, Japan, Germany, and Australia continue to increase their demand for U.S. aircraft, more significant is the 57 percent increase in demand from nontraditional markets, such as the Pacific Rim countries (figure 11). Industry sources indicate that demand from these countries will fuel the future of the U.S. aircraft industry. However, these markets are also being targeted by European competitors.

[50] "A Take-off into New Territory," *Financial Times*, London, Aug. 30, 1990.
[51] "Soviets Look to West for New Technical, Commercial Alliances," *Aviation Week & Space Technologies*, Nov. 26, 1990, p. 76; "Aeroflot Discusses Buying Used Jets from Eastern Air," *Journal of Commerce*, Oct. 23, 1990.
[52] Gulfstream Aerospace Corporation, press release, October 1989.
[53] "America's Cougar will Roar in Russia," *Aviation International News*, Mar. 1, 1991, p. 60.
[54] *The European Aerospace Industry*, p. 25.
[55] *The European Aerospace Industry*, p. 28.
[56] Compiled from official statistics of the U.S. Department of Commerce for the Harmonized Tariff Schedule number 8803.30 for the years 1986-90.

16

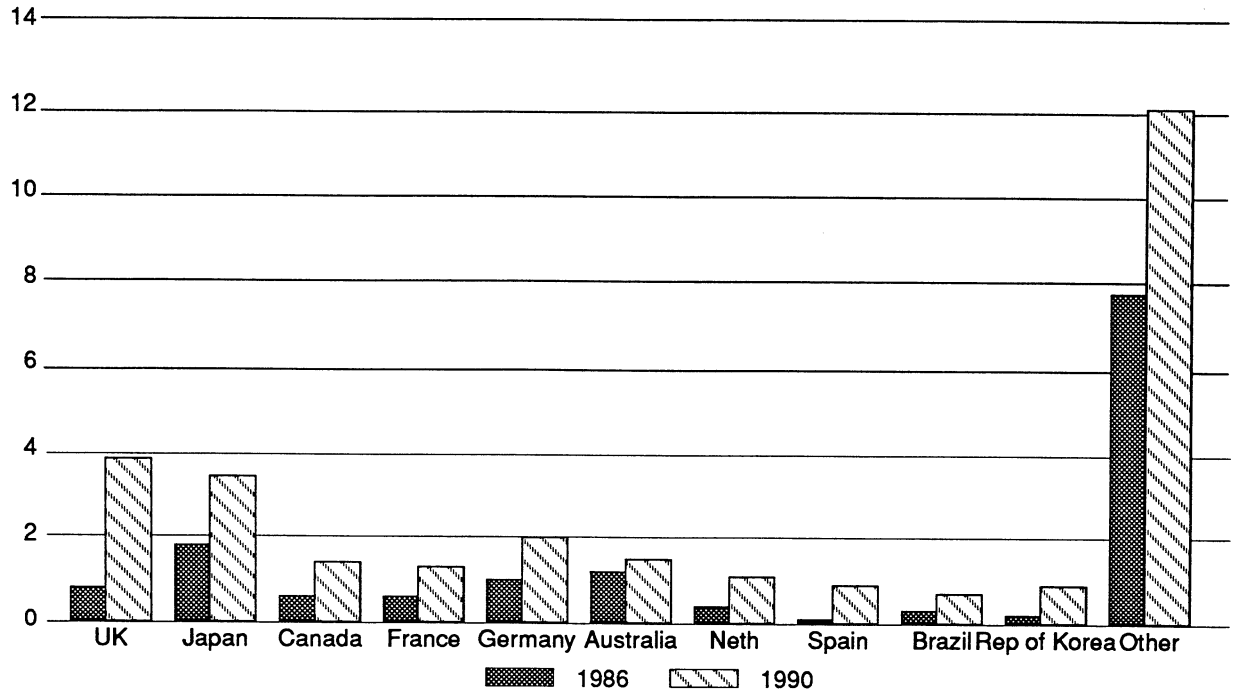
U.S. trade balance

The United States maintained a trade surplus in aircraft, spacecraft, and related equipment during 1986-90 (figure 12). The largest increase in the surplus was recorded during 1988-90, from $15 billion to $23 billion.[57] Worldwide demand for air transportation services led airlines to place record orders for aircraft and parts during this period. The United States has been the primary beneficiary of this demand, as it is the world's top producer of these products.

[57] Table 5, app. B.

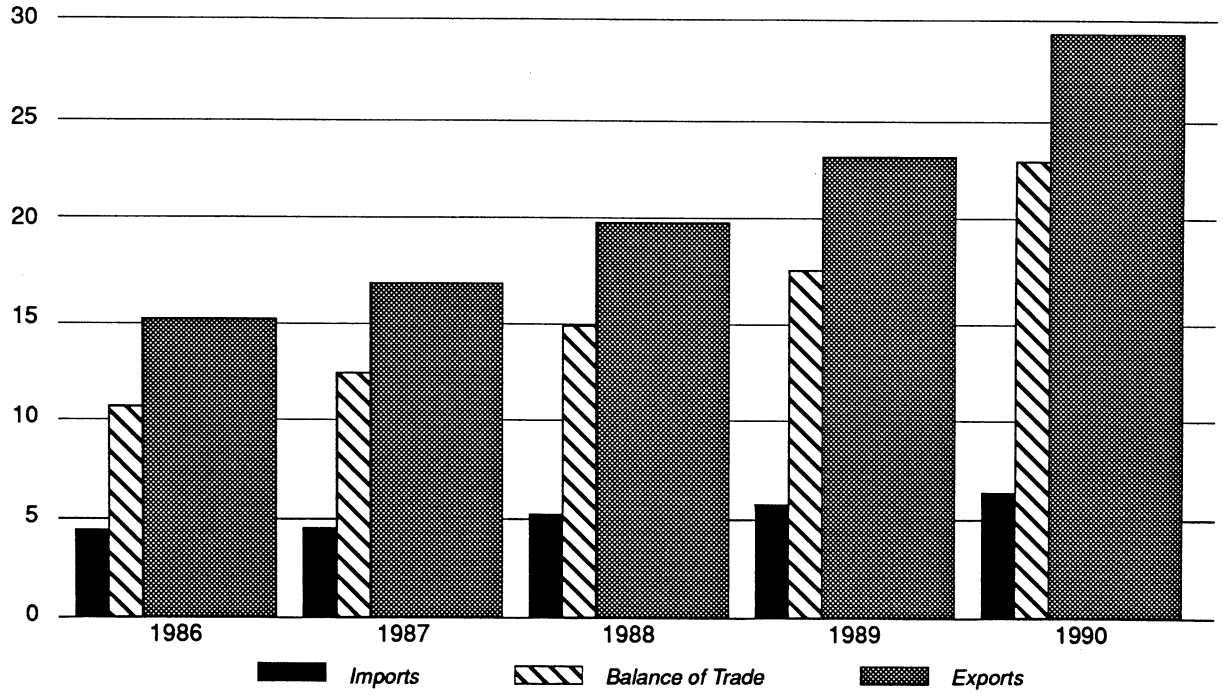
17

Figure 11
U.S. exports, 1986 & 1990: Aircraft, spacecraft, and related equipment
Billion dollars



Source: U.S. Department of Commerce.

Figure 12
U.S. balance of trade: Aerospace shipments, exports, imports, and balance of trade, 1986-90
Billion dollars



Source: U.S. Department of Commerce, USITC.

18

APPENDIX A
EXPLANATION OF TARIFF AND TRADE AGREEMENT TERMS

TARIFF AND TRADE AGREEMENT TERMS

The ***Harmonized Tariff Schedule of the United States*** (HTS) replaced the *Tariff Schedules of the United States* (TSUS) effective January 1, 1989. Chapters 1 through 97 are based on the internationally adopted Harmonized Commodity Description and Coding System through the 6-digit level of product description, with additional U.S. product subdivisions at the 8-digit level. Chapters 98 and 99 contain special U.S. classification provisions and temporary rate provisions, respectively.

Rates of duty in the ***general*** subcolumn of HTS column 1 are most-favored-nation (MFN) rates; for the most part, they represent the final concession rate from the Tokyo Round of Multilateral Trade Negotiations. Column 1-general duty rates are applicable to imported goods from all countries except to those enumerated in general note 3(b) to the HTS, whose products are dutied at the rates set forth in ***column 2***. Goods from the People's Republic of China, Czechoslovakia, Hungary, Poland, and Yugoslavia are among those eligible for MFN treatment. Among articles dutiable at column 1-general rates, particular products of enumerated countries may be eligible for reduced rates of duty or for duty-free entry under one or more preferential tariff programs. Such tariff treatment is set forth in the ***special*** subcolumn of HTS column 1.

The **Generalized System of Preferences** (GSP) affords nonreciprocal tariff preferences to developing countries to aid their economic development and to diversify and expand their production and exports. The U.S. GSP, enacted in title V of the Trade Act of 1974 and renewed in the Trade and Tariff Act of 1984, applies to merchandise imported on or after January 1, 1976, and before July 4, 1993. Indicated by the symbol "A" or "A*" in the special subcolumn of column 1, the GSP provides duty-free entry to eligible articles that are the product of, and are imported directly from, designated beneficiary developing countries, as set forth in general note 3(c)(ii) to the HTS.

The ***Caribbean Basin Economic Recovery Act*** (CBERA) affords nonreciprocal tariff preferences to developing countries in the Caribbean Basin area to aid their economic development and to diversify and expand their production and exports. The CBERA, enacted in title II of Public Law 98-67, implemented by Presidential Proclamation 5133 of November 30, 1983, and amended by the Customs and Trade Act of 1990, applies to merchandise entered, or withdrawn from warehouse for consumption, on or after January 1, 1984; this tariff preference program has no expiration date. Indicated by the symbol "E" or "E*" in the special subcolumn of column 1, the CBERA provides duty-free entry to eligible articles that are the product of, and are imported directly from, designated countries, as set forth in general note 3(c)(v) to the HTS.

Preferential rates of duty in the special subcolumn of column 1 followed by the symbol "IL" are applicable to products of Israel under the ***United States-Israel Free-Trade Area Implementation Act*** of 1985, as provided in general note 3(c)(vi) of the HTS. When no rate of duty is provided for products of Israel in the special subcolumn for a particular provision, the rate of duty in the general subcolumn of column 1 applies.

Preferential rates of duty in the special duty rates subcolumn of column 1 followed by the symbol "CA" are applicable to eligible goods originating in the territory of Canada under the ***United States-Canada Free-Trade Agreement***, as provided in general note 3(c)(vii) to the HTS.

Other special tariff treatment applies to particular ***products of insular possessions*** (general note 3(a)(iv)), goods covered by the ***Automotive Products Trade Act*** (general note 3(c)(iii)) and the ***Agreement on Trade in Civil Aircraft*** (general note 3(c)(iv)), and ***articles imported from freely associated states*** (general note 3(c)(viii)).

The ***General Agreement on Tariffs and Trade*** (GATT) (61 Stat. (pt. 5) A58; 8 UST (pt. 2) 1786) is the multilateral agreement setting forth basic principles governing international trade among its more than 90 signatories. The GATT's main obligations relate to most-favored-nation treatment, the maintenance of scheduled concession rates of duty, and national (nondiscriminatory) treatment for imported products. The GATT also provides the legal framework for customs valuation stan-

A-2

dards, "escape clause" (emergency) actions, antidumping and countervailing duties, and other measures. Results of GATT-sponsored multilateral tariff negotiations are set forth by way of separate schedules of concessions for each participating contracting party, with the U.S. schedule designated as schedule XX.

Officially known as "The Arrangement Regarding International Trade in Textiles," the ***Multifiber Arrangement*** (MFA) provides a framework for the negotiation of bilateral agreements between importing and producing countries, or for unilateral action by importing countries in the absence of an agreement. These bilateral agreements establish quantitative limits on imports of textiles and apparel, of cotton, wool, silk blends, and other vegetable and manmade fibers in order to prevent market disruption in the importing countries—restrictions that would otherwise be a departure from GATT provisions. The United States has bilateral agreements with more than 30 supplying countries, including the four largest suppliers: China, Hong Kong, the Republic of Korea, and Taiwan.

APPENDIX B
STATISTICAL TABLES

Table 1
Aircraft, spacecraft, and related equipment: Harmonized Tariff Schedule subheading; description; U.S. col. 1 rate of duty as of Jan. 1, 1991; final MTN concession rate of duty; U.S. exports, 1990; and U.S. imports, 1990

HTS subheading	Description	Col. 1 rate of duty As of Jan. 1, 1991 General	Special[1]	U.S. exports 1990	U.S. imports 1990
				Million dollars	
8801.10.00	Gliders and hang-gliders	4.5%	Free (A,C,CA,E,IL)	3	1
8801.90.00	Balloons, dirigibles, and non-powered aircraft, other than gliders hang gliders	5.0%	Free (A,C,CA,E,IL)	13	2
8802.11.00	Helicopters, of an unladen weight not exceeding 2,000 kg	5.0%	Free (A,C,CA,E,IL)	147	133
8802.12.00	Helicopters, of an unladen weight exceeding 2,000 kg	5.0%	Free (A,C,CA,E,IL)	584	54
8802.20.00	Airplanes and other aircraft, of an unladen weight not exceeding 2,000 kg	5.0%	Free (A,C,CA,E,IL)	154	36
8802.30.00	Airplanes and other aircraft, of an unladen weight exceeding 2,000 kg but not exceeding 15,000 kg	5.0%	Free (A,C,CA,E,IL)	1,246	1,798
8802.40.00	Airplanes and other aircraft, of an unladen weight exceeding 15,000 kg	5.0%	Free (A,C,CA,E,IL)	17,540	815
8802.50.90	Spacecraft (including satellites) and spacecraft launch vehicles, other than communication satellites	3.7%	Free (A,C,CA,E,IL)	8	0
8803.10.00	Parts of goods of heading 8801 or 8802: Propellers and rotors and parts thereof	Free	Free (A,C,CA,E,IL)	343	26
8803.20.00	Parts of goods of heading 8801 or 8802: Undercarriages and parts thereof	Free	Free	276	47
8803.30.00	Other parts of airplanes or helicopters	Free	Free	8,371	3,006
8803.90.90	Other parts of aircraft or spacecraft	Free	Free	503	242
8804.00.00	Parachutes (including dirigible parachutes) and rotochutes; parts thereof and accessories thereto	6.0%	Free (A,E,IL) 4.2% (CA)	18	8
8805.10.00	Aircraft launching gear and parts thereof; deck-arrestor or similar gear and parts thereof	3.7%	Free (A,CA,E,IL)	25	2
8805.20.00	Ground flying trainers and parts thereof	Free	Free	255	200

[1] Programs under which special tariff treatment may be provided, and the corresponding symbols for such programs as they are indicated in the "Special" subcolumn, are as follows: Generalized System of Preferences (A); Automotive Products Trade Act (B); Agreement on Trade in Civil Aircraft (C); United States-Canada Free-Trade Agreement (CA); Caribbean Basin Economic Recovery Act (E); and United States-Israel Free Trade Area (IL).

Source: U.S. exports and imports compiled from data of the U.S. Department of Commerce.

Table 2
Aircraft, spacecraft, and related equipment: U.S. shipments, exports of domestic merchandise, imports for consumption, and apparent U.S. consumption, 1986-90

Year	U.S. shipments[1]	U.S. exports	U.S. imports	Apparent U.S. consumption	Ratio of imports to consumption
	Million dollars				Percent
1986	56,969	15,097	4,420	46,292	10
1987	59,581	16,871	4,570	47,280	10
1988	58,643	19,941	5,230	43,932	12
1989	52,138	23,278	5,728	34,588	17
1990	62,969	29,430	6,369	39,908	16

[1] Estimated by the staff of the U.S. International Trade Commission.

Source: Compiled from official statistics of the U.S. Department of Commerce, except as noted.

B-3

Table 3
Aircraft, spacecraft, and related equipment: U.S. imports for consumption, by principal source 1986-90

Source	*1986*	*1987*	*1988*	*1989*	*1990*
			Value (1,000 dollars)		
United Kingdom	1,053,952	1,097,097	1,070,735	910,695	1,200,791
Japan	169,852	235,965	325,280	383,228	436,291
Canada	1,221,198	1,205,996	1,290,988	1,238,885	1,765,102
France	749,321	949,269	1,394,311	1,712,017	1,026,706
Germany	99,946	132,914	152,803	151,049	163,009
Australia	45,709	52,023	57,533	73,494	84,304
Netherlands	253,451	104,661	115,762	221,083	331,607
Spain	28,434	34,901	57,799	82,918	111,539
Brazil	72,854	108,555	167,631	181,779	352,987
Korea, Republic of	15,077	15,994	20,828	46,016	75,926
All other	710,218	632,397	576,366	727,137	821,093
Total	4,420,012	4,569,772	5,230,036	5,728,301	6,369,355

Source: Compiled from official statistics of the U.S. Department of Commerce.

B-4

Table 4
Aircraft, spacecraft, and related equipment: U.S. exports of domestic merchandise, by principal market, 1986-90

Market	*1986*	*1987*	*1988*	*1989*	*1990*
			Value (1,000 dollars)		
United Kingdom	845,800	1,674,839	2,049,173	2,498,005	3,867,419
Japan	1,825,670	1,892,366	2,144,587	1,893,381	3,447,269
Canada	629,253	663,471	1,294,122	1,338,948	1,445,214
France	610,012	360,055	743,899	851,926	1,316,140
Germany	1,015,251	958,204	1,063,429	2,242,604	2,059,139
Australia	1,209,169	862,369	1,017,445	1,075,118	1,576,893
Netherlands	490,540	445,978	524,545	1,020,787	1,101,572
Spain	164,317	375,826	621,985	714,579	904,242
Brazil	328,634	760,426	791,176	643,015	714,911
Korea, Republic of	267,093	300,585	763,600	1,155,343	918,214
All other	7,711,528	8,577,380	8,927,286	9,844,417	12,079,109
Total	15,097,267	16,871,499	19,941,247	23,278,123	29,430,122

Source: Compiled from official statistics of the U.S. Department of Commerce.

B-5

Table 5
Aircraft, spacecraft, and related equipment: U.S. exports of domestic merchandise, imports for consumption, and merchandise trade balance, by selected country and country group, 1986-90[1]

(Million dollars)

Item	1986	1987	1988	1989	1990
U.S. exports of domestic merchandise:					
United Kingdom	846	1,675	2,049	2,498	3,867
Japan	1,826	1,892	2,145	1,893	3,447
Canada	629	663	1,294	1,339	1,445
France	610	360	744	852	1,316
Germany	1,015	958	1,063	2,243	2,059
Australia	1,209	862	1,017	1,075	1,577
Netherlands	491	446	525	1,021	1,102
Spain	164	376	622	715	904
Brazil	329	760	791	643	715
Korea, Republic of	267	301	764	1,155	918
All other	7,712	8,577	8,927	9,844	12,079
Total	15,097	16,871	19,941	23,278	29,430
EC–12	4,067	4,873	6,062	9,158	11,310
OPEC	1,100	466	491	854	851
ASEAN	881	854	606	1,552	2,162
CBERA	149	57	61	198	175
Eastern Europe	121	64	90	176	153
U.S. imports for consumption:					
United Kingdom	1,054	1,097	1,071	911	1,201
Japan	170	236	325	383	436
Canada	1,221	1,206	1,291	1,239	1,765
France	749	949	1,394	1,712	1,027
Germany	100	133	153	151	163
Australia	46	52	58	73	84
Netherlands	253	105	116	221	332
Spain	28	35	58	83	112
Brazil	73	109	168	182	353
Korea, Republic of	15	16	21	46	76
All other	710	632	576	727	821
Total	4,420	4,570	5,230	5,728	6,369
EC–12	2,420	2,578	3,093	3,370	3,218
OPEC	2	1	1	1	1
ASEAN	76	40	20	100	33
CBERA	1	[2]	[2]	4	1
Eastern Europe	4	3	3	4	5
U.S. merchandise trade balance:					
United Kingdom	–208	578	978	1,587	2,666
Japan	1,656	1,656	1,820	1,510	3,011
Canada	–592	–543	3	95	–320
France	–139	–589	–650	–860	289
Germany	915	825	910	2,091	1,896
Australia	1,163	810	959	1,002	1,493
Netherlands	238	341	409	800	770
Spain	136	341	564	632	792
Brazil..	256	651	623	461	362
Korea, Republic of	252	285	743	1,109	842
All other	7,002	7,944	8,351	9,117	11,258
Total	10,677	12,301	14,711	17,550	23,061
EC–12	1,647	2,295	2,969	5,788	8,092
OPEC	1,098	465	490	853	850
ASEAN	805	814	586	1,452	2,129
CBERA	148	57	61	198	175
Eastern Europe	117	61	87	172	148

[1] Import values are based on customs value; export values are based on f.a.s. value, U.S. port of export. U.S. trade with East Germany is included in "Germany" but not "Eastern Europe."

[2] Less than $500,000.

Source: Compiled from official statistics of the U.S. Department of Commerce.

B-6