JObS
0 n the Wing

Trading Away the Future Of the U.S. Aerospace Industry

Randy Barber
&
Robert E. Scott

. Economic Policy Institute

1660 L Street, NW, Suite 1200, Washington, D.C. 20036
ISBN: O-944826-64-4

RANDY BARBER is director of the Center for Economic Organizing in Washington, D.C. He co-authored ***The North Will Rise Again: Pensions, Politics and Power in the 1980s,*** and produced a newsletter on this subject for the AFL-CIO for 10 years. He has written numerous articles for books, magazines, newspapers, and journals, including the chapter (with Teresa Ghilarducci) "Pension Funds, Capital Markets, and the Economic Future" in the EPI book ***Transforming the U.S. Financial System: Equity and Efficiency for the 21st Century.*** He has also provided advice to more than two dozen clients in the labor and public sectors on topics ranging from investment and benefit analysis (and "alternative" investment funds) to collective bargaining support, including strategic analysis of corporate finance and structure. He recently served as the principal advisor to International Association of Machinists' Vice President John Peterpaul during his tenure on the National Airline Commission.

ROBERT E. SCOTT is an assistant professor in the College of Business and Management of the University of Maryland at College Park, and an associate director of the college's Center for International Business Education and Research (CIBER). He received a Ph.D. in economics from the University of California in 1989. He recently published ***Short-Sighted Solutions: Trade and Energy Policies for the U.S. Auto Industry*** (New York: Garland Publishing, 1994) and a number of articles in scholarly journals and books on trade and industrial policies. His research has been published in ***Challenge, the Journal of Policy Analysis and Management,*** and ***the Stanford Law and Policy Review.*** He is also a principal author of a series of widely reported studies of the impacts of U.S.-Mexico trade under NAFTA.

Mr. Scott is also a research associate with EPI, where he has prepared studies of the effects of trade and protection on the U.S. textile, apparel, and steel industries.

ACKNOWLEDGMENTS

The preparation of this report required extensive support from several people, working under intense deadline pressures. Jessica Burton-Christian and Miranda Martin at EPI carefully word processed the text and tables, David Webster prepared the final graphs and figures, and Ruth Polk edited the text. Elizabeth Shannon of the Center for Economic Organizing provided excellent research assistance. We would also like to thank a number of experts who commented on earlier versions of 'this report, including Barry Bluestone, Pat Choate, William Grieder, Jeff Faux, Bill Frymoyer, Larry Mishel, David Napier, Richard Samuels, Barbara Shailor, Steve Sleigh, and Susan Tolchin. Of course, none of these individuals are responsible for any remaining errors, or for the analysis or policy recommendations contained in this report.

Library of Congress Catalog Card Number: 95-78624
ISBN: 0-944826-64-4

TABLE OF CONTENTS

EXECUTIVE SUMMARY

No industry in the United States better represents the successes and failures of American industrial policy over the last 50 years than aerospace. The winners in the aerospace industry-Boeing, General Electric, McDonnell Douglas, and Pratt & Whitney-have helped secure the peace and have created a global air transportation market. These and scores of other aerospace corporations grew through the combination of defense spending, an expanding commercial market, and a skilled workforce that produced airplanes better and quicker than anywhere else in the world. That era has come to an end with the cessation of the Cold War, economic recession, and the emergence of new global competitors in aerospace. This study examines the effects of these market changes on the industry and recommends a policy for assuring the continued future preeminence of the American aerospace industry.

The commercial success of Airbus, along wifh its explicit goal of job creation, presents a stark challenge to American policy makers.

Aerospace companies in the United States are at a critical juncture because of these new realities. How well they adapt-and how well US. policy adapts-will shape this industry well into the next century. Due to its critical nature in terms of national security and economic prosperity, the aerospace industry demands special attention from policy makers. In 1994, aerospace companies exported $3 1 billion in commercial products compared to total imports of roughly $13 billion. in commercial aerospace products—a trade balance unmatched by any industry sector. Despite this impressive performance, the import to export ratio is changing rapidly in commercial aerospace. The combined effects of reduced defense spending and the steepest recession in airline history over the last five years have resulted in the loss of nearly 500,000 American jobs in the aerospace industry, along with nearly 1 million other jobs dependent on this critical sector.

The European consortium—Airbus-presents a particularly aggressive and technologically sophisticated competitor to airframe manufacturers in the United States. The commercial success of Airbus, along with its explicit goal of job creation, presents a stark challenge to American policy makers eager to cut back government's role in assisting industry development at a time when further job loss in the United States is predicted.

In addition to Airbus, developing competitors in Asia-particularly in Japan, China, and South Korea-are appearing on the horizon. For years, American companies have engaged in a practice known as offsets to gain access to Asian and other markets. Since many of the world's airlines were, and still are, state owned or subsidized, national governments had a power-

ful bargaining chip to use. In effect, these national airlines, working in concert with their governments, would only purchase airplanes if a certain amount of the work was performed in the home country. The cost of the plane was offset by the spinoff benefits of job creation. In recent years these offset arrangements have become a prerequisite to doing business, particularly in countries such as China that retain state control of the economy.

Offset arrangements have become a prerequisite to doing business, particularly in countries that retain state control of the economy.

In this report we summarize research which shows that U.S. manufacturers are forecast to lose $129 billion in sales to foreign producers between 1994 and 20 13. In addition, imported parts and aircraft could increase their share of domestic production by 9.5 percentage points in the same period. As a result of these increases in foreign competition and imports, we estimate that up to 250,000 jobs are at risk in aerospace and related industries in the year 2000, and up to 469,000 jobs could be eliminated in 2013 because of offset policies and increased foreign competition. Most of these positions are in manufacturing or closely related high-skill, high-wage service industries. Foreign competition in aerospace products, especially commercial aircraft and parts, could significantly impact the total level of high-skilled, high-wage manufacturing jobs in the U.S. in the next two decades.

In addition to offset arrangements, American aerospace companies are also faced with the need to raise billions of dollars in order to fund the development of the next generation of aircraft. The Boeing Company, for example, recently spent $6 billion developing the new 777 airplanes. Such a risk was too much to bear by Boeing alone.

As a result of antitrust restrictions and the reluctance of government to insure risk taking in commercial product development, a substantial portion of the development and production of the new 777 was undertaken by foreign partners, particularly the industrial giants of Japan. As a result, almost 30% of the value of the new Boeing 777 will come from outside of the United States. Not only has this cost jobs in the United States, but the technological transfer also will hasten the development of a new generation of commercial and military competitors. These developments, the trading of jobs for market access and risk sharing to foreign companies, shape the challenge for a 21st century aerospace policy in the United States. Can we, as a nation, afford to lose the high-skill, high-wage jobs that built the aerospace industry? Can we, as a nation, afford to lose the industrial base necessary to produce advanced aircraft so essential to national security? The answer, clearly, is no; we cannot afford to allow these developments to further erode our economic growth or national security.

An effective, national aerospace promotion policy must recognize the difficult position in which American companies are placed. Trading jobs for market access may in fact be the only way that American companies can sell their products in closed economies today. The newly formed World Trade Organization (WTO) recognizes that this practice amounts to an unfair trading relationship, but has done little to address the problem as it affects commercial aerospace. The General Agreement on Tariffs and Trade (GATT) and the WTO are designed to influence government policies and regulations that affect international trade. These institutions have little or no ability to regulate the behavior of *private* individuals or firms, or to compel governments to do so, even when those actions violate GATT principals and distort trade flows.

Up to 250,000 jobs are at risk in aerospace and related industries in the year 2000, and up to 469,000 jobs could be eliminated in 20 13.

Without strict rules and enforcement of universal fair trading practices, a unilateral American approach would disadvantage American companies. Like Ulysses, aerospace firms hear beautiful voices calling out "market access, market access." When one firm gives in, all must follow. If only they had a way to figuratively strap themselves to the mast, as Ulysses did, they could avoid falling for the siren's trap of market access in exchange for offsets. Strong mechanisms must be put into place that will keep all aerospace companies from pursuing short-term gains and market access at the expense of their own workers and the communities they live in, and national security.

The results of this study suggest that in order to preserve the aerospace industry's long-term viability, the United States must institute a coordinated aerospace policy. The following three points detail necessary attributes of a successful aerospace policy.

1. **Creation of an aerospace executive and an interagency task force within the President's National Economic Council.** The aerospace executive would have the authority to coordinate the varied federal government programs that impact the aerospace industry, including the U.S. Trade Representative, the Department of Commerce, particularly the Export-Import Bank, and national security agencies including the National Aeronautics and Space Administration (NASA). The aerospace executive's work would be guided by an Aerospace Industry Advisory Board consisting of representatives from business, labor, and government agencies.
2. **Promotion of aerospace production and employment.** A broad review should take place immediately to eliminate all government policies that encourage the destruction of American aerospace jobs;

reaffirm through the budgetary process those programs that encourage the growth and stabilization of high-skill, high-wage American aerospace jobs, evaluate antitrust barriers to cooperation that allow U.S. companies to team with foreign companies but not with other American companies; and assess the possibilities for government to partner with American companies to insure against the risks inherent in the development of large-scale projects such as a new aircraft. Measures are also needed to promote the health of the domestic airline industry, in part to increase the demand for U.S. aerospace products, and also to ensure that critical aerospace engineering and maintenance skills are maintained.

The United States should negotiate a new aircraft trade agreement that prohibits firms from using the export of jobs and technologies as a marketing tool.

3. **Negotiate fair international trade agreements.** The U.S. Trade Representative's office, backed by all levels of government, must redouble its efforts to secure fair labor standards in the new WTO and to negotiate a new civil aircraft code in the WTO to forbid the practice of offsets. As a first step, the United States should open negotiations with the European Union designed to obtain a new bilateral civil aircraft trade agreement that prohibits Boeing, McDonnell Douglas, and Airbus Industrie from using the export of jobs and technologies as a marketing tool.

If acted on immediately, these three steps would greatly enhance the prospects for retaining and rebuilding a strong aerospace industry in the United States for the 21st century and the high-wage, high-skills jobs that go with it.

INTRODUCTION

> Heightened international competition [in the aircraft industry] will take place in an environment of unprecedented U.S. industry restructuring as a result of dramatic reductions in the defense budget. Therefore, U.S. industry will be severely challenged over the next decade just to hold its current position in global aircraft manufacturing. Achieving growth in global market share will be an even more difficult task. (National Research Council 1994, 75)
>
> ***-National Research Council***

The major North American aerospace companies have all been trading away American jobs and technology for market access.

> To meet the internal and external challenges confronting American [aerospace] producers during this decade, the United States will have to replace its outmoded and expensive military industrial policy with a civilian industrial policy. Rather than hope that foreign intervention in the industry will cease, the United States will have to respond with offsetting interventions at home. Rather than assume that dependence on foreign suppliers does not matter, it will have to recognize the dangers of excessive dependence on such suppliers for critical component technologies, such as advanced avionics. Rather than hope that the market will solve the problem of military conversion, it will have to fashion a domestic strategy to speed the process and reduce its costs. (Tyson 1992,211)
>
> ***-Laura D'Andrea Tyson***

In this era of corporate restructuring and consolidation, it should come as no surprise that our nation's premier capital goods manufacturing industry and leading exporter should itself be involved in a massive global restructuring of its entire production process. This restructuring has been masked, however, by the consecutive booms and busts in the commercial and military aerospace sectors since the late 1980s. When the industry was reaching record heights, the transfer of employment and technology to overseas producers was barely noticed. When both sectors simultaneously and precipitously declined, it was difficult to sort out the job losses due to canceled orders and defense budget cuts from those attributable to the globalization of the industry.

In fact, the major North American aerospace companies, Boeing, McDonnell Douglas, Pratt & Whitney, and General Electric, have all been trading away American jobs and technology for market access. US. aerospace com-

panies say they are deterrnined to maintain control over the design and final assembly, but they are "partnering" increasing amounts of this work as well.

A broad range of U.S. aerospace manufacturers have entered into joint ventures, coproduction deals, local content agreements, and offset arrangements. While this strategy may satisfy short-term-oriented shareholders (or at least keep the company's name on a product), it undermines the long-term interest of American workers, the communities they live in, and, quite possibly, the long-term viability of the companies by creating potential competitors across the entire array of technologies and capabilities required to launch an integrated aircraft manufacturing industry.

Commercial aerospace has become a key "target" industry for many advanced as well as industrializing nations.

Moreover, several countries around the world are clearly in the process of developing a full-service commercial aerospace industry, from China's assembling of entire Western-designed jetliners to the consolidation of the German aerospace industry under the umbrella of Daimler-Benz to Japan's systematic drive to become a premiere high-technology aerospace manufacturing power.'

Commercial aerospace has become a key "target" industry for many advanced as well as industrializing nations. All-except the United States—have explicit industrial policies in place to advance their goals. Their government, companies, and workers share a common vision. Together they understand the aerospace industry has a broad range of "spillover" effects. The industrial infrastructure and skills inherent in the processes relating to aircraft electronics, advanced metal fabrication, composite materials, turbine engines, and other components of a jetliner can serve as a platform for many other industries (as well as an expanded or upgraded defense manufacturing sector). The organizational skills and discipline required to design, fabricate, assemble, market, and service commercial aircraft can be invaluable, especially to emerging industrial economies. Thus, as a result of these strategies to achieve increased market access, the United States could lose critical skills and technologies: what first begins as subcontracting, licensed production, and technology sharing could well result in the United States becoming dependant on other countries for basic aerospace-related processes and new technologies.

Our government is doing far too little to ensure that American aerospace workers and their companies will continue to occupy the preeminent position they have enjoyed over the past half century. While military research and development and subsequent procurement did much to catapult aerospace manufacturers into their world-leading positions, it will not be practi-

cal to rely on such assistance in the future.

Indeed, much of the future of aerospace lies in commercial aircraft and civil space applications. And, in these sectors, the U.S. policy has been and continues to be contradictory and often self-defeating. Our government has actively promoted the transfer of aerospace jobs and technologies under the rubric of national security, foreign policy, and international trade and cooperation. Even though substantial sums are expended by government agencies (particularly NASA) on basic technology development, the fruits of this research are broadly available, and some of the most important of these have had their first commercial applications on non-U.S. aircraft. Moreover, NASA has been explicitly prohibited from helping commercialize technologies, having been limited to more generic "technology enabling" research. As more than one researcher has observed, any benefits of government policy or action accruing to the U.S. commercial aerospace industry has been "incidental" and "unplanned" (Eberstadt 1991, 64, 68-69, 97).

U.S. policy has been and continues to be contradictory and often self-defeating.

We must recognize, however, that the aerospace industry is critical to our economic and *national* strength. The American people's security depends on the ability of our economy to sustain world-leading skills and technologies, and a vibrant aerospace industry represents one of the best ways to do so. Without it, we risk ceding the U.S. leadership role in this benchmark industry, as well as losing the ability to meet our national security requirements and the opportunity to maintain and expand high-skill, high-wage jobs.

In the past, the aerospace industry's strength has rested on a historic accident: the momentum of our undamaged post-World War II economy combined with huge defense and space-related expenditures in the midst of the Cold War. As a result, the United States developed a highly skilled aerospace workforce and companies that dominated the market globally.

In the late 1980s and early 1990s the industry was beset by challenges at home and abroad. At home, the domestic defense market was collapsing because of the end of the Cold War, dramatically reducing this most important source of demand for aerospace products. Abroad, a new foreign competitor, Europe's government-supported Airbus Industrie, was making dramatic inroads into the market of U.S. aircraft manufacturers.

These problems remain, despite the achievement of a new bilateral agreement between the United States and Europe on civil aircraft trade. However, the rapid growth of outsourcing in the 1990s by both U.S. producers and Airbus represents a new challenge to producers in both regions. Foreign governments, aided and supported by private and public air carriers based in

their home markets, are targeting aerospace production. They are using so-called offset policies to compel aerospace producers to locate production of both parts and various stages of aircraft design and assembly in those countries, in exchange for the rights to sell aircraft in those markets.

Workers in the United States would like to prevent Boeing and McDonnell Douglas from engaging in offset policies. Yet clearly Boeing, McDonnell Douglas, and Airbus Industrie are all caught in a classic prisoner's dilemma. If any one firm refuses to engage in offset policies, it will lose market share to the other two. However, if all three could agree to stop engaging in, the practice, the firms could enjoy a higher level of revenue. Aerospace output and employment would rise (or fall more slowly) in each market in the region. However, antitrust policies and purely competitive forces make it impossible for these firms to achieve the "first best" outcome (no offsets) on their own. For this reason, new policies are needed to allow and encourage these firms to resist pressures to engage in offset policies.

Boeing, McDonnell ***Douglas, and Airbus Industrie are all caught in a classic prisoner's dilemma.***

The lead time for creating a truly competitive aerospace industry is measured in decades. While for many reasons much of the rest of the world has been behind in aerospace technology and products, it is now catching up. This is occurring just at the time when our own industry is feeling the full impact of reduced defense procurement and pressures from investors to 'maximize current shareholder value." In addition, the industry is facing reduced research and development expenditures, a flagging economy, and rapidly increasing global competition.

In her path-breaking book published shortly before she was appointed chairman of the President's Council of Economic Advisors, Laura D'Andrea Tyson posed the challenge this way:

> The American [aerospace] industry in the early 1990s is once again at a critical juncture, confronting intensified competition abroad and cutbacks in military procurement and indirect subsidies at home. To address these challenges in ways that serve the national interest, the United States needs a civilian industrial policy. It can no longer afford the expensive, defense-oriented industrial policy of the past. Nor can it afford to cling to the soothing but irrelevant belief that market forces alone will determine industry outcomes in the future. (Tyson 1992,216)

As we approach the turn of the century, it is imperative that U.S. policy makers come to grips with the fact that one of the most important sectors in our economy is increasingly slipping away from us, and moving to countries that have the determination to nurture and grow this critical industry.

AN OVERVIEW OF THE AEROSPACE INDUSTRY

The aerospace industry is generally divided into five broad sectors: civil aircraft and engines, military aircraft and engines, missiles, space, and related products and services. These five sectors posted record combined sales in 1990 of $146.9 billion (in constant 1993 dollars); these declined to $124.2 billion in 1993 and are projected to decline to about $105 billion in 1995 **(see Table 1** and **Figure 1).**

The aerospace industry is our country's largest export industry. Aerospace sales reduced the U.S. merchandise trade deficit by more than $25 billion, or 20%, in 1994. This figure, however, is down from a $31.4 billion aerospace trade surplus in 1992 **(see Table** 2). Civil aerospace exports in 1994 totaled more than $3 1 billion (including complete aircraft and engines, parts and spares, and space-related products), down from $37 billion in 1992. Military aerospace exports in 1994 were about $7.5 billion, almost $5 billion of which were aircraft and engine parts and spares (reflecting in part the export of U.S.-designed products for final assembly abroad under various licensed and coproduction arrangements). Most of the roughly $13 billion in aerospace products the United States imported during 199'4 were civil, aircraft, engines, parts, accessories, and equipment (Aerospace Industries Association 1994a, Tables II, VII, and VIII).

Aerospace has been a major source of wages and employment for the national economy.

The relative importance of Department of Defense aerospace procurement (including missiles and defense space purchases) has declined significantly over the past decade: it represented 65% of purchases during most of the 1980s, but less than **48%** in 1994 **(see Figure 2).** Aerospace purchases by NASA and other U.S. government agencies accounted for about 8% of industry sales during the 1980s, but have risen recently to about 13%. Other aerospace industry customers (primarily airlines and other commercial customers) accounted for between 25% and 30% of industry sales during the 1980s, and have risen to more than 40% during the first part, of the 1990s (Aerospace Industries Association 1994a, Table II)."

Aerospace has been a major source of wages and employment for the national economy. According to a recently concluded study, the.U.S. aerospace industry accounted for about 2.4 million direct and indirect jobs in 1990, and provided over 2% of total wage and salary income in the U.S. economy. As a high-skill, high-wage industry, aerospace wages in 1993 were 45% higher than those in U.S. manufacturing as a whole (Steinbruner and Nation 1994, viii, 14). In 1990, the 1.3 million direct aerospace employees

TABLE 1
Aerospace Industry Revenues
(Billions of Constant 1993 Dollars)

	Total Aerospace	Total Aircraft	Civil Aircraft	Military Aircraft (a)	Missiles (a)	Space (a)	Related Products & Services
1979	$86.4	$50.2	$25.2	$25.0	$9.1	$12.5	$14.7
1987	132.9	71.5	18.7	52.8	12.3	26.9	22.1
1990	146.9	78.0	34.3	43.8	15.5	28.9	24.5
1993	124.2	66.5	33.8	32.8	8.1	29.0	20.7
1995e	105.0	54.4	24.8	29.7	6.3	26.7	17.5
Change in Constant Dollar Revenues							
1979-90	70%	55%	36%	75%	71%	132%	67%
1990-93	-15	-15	-2	-25	-48	0	-15
1993-95(e)	-15	-18	-27	-9	-22	-8	-15

Note: (a) includes funding for research, development, test, and evaluation.

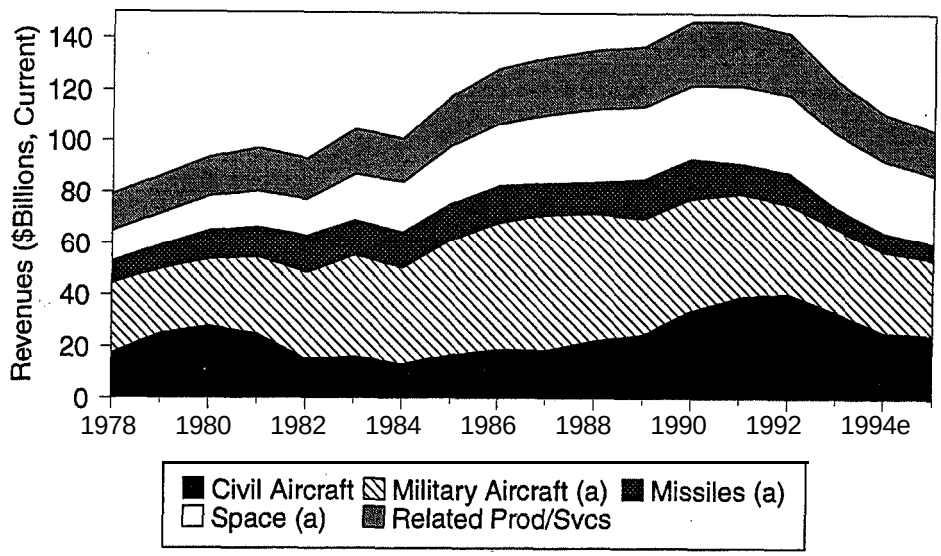
Source: Aerospace Industries Association, Year-End Review and Forecast (1994a, Table I).

TABLE 2
Total U.S. Aerospace Revenues to Aerospace Exports, Imports, and Balance of Trade
(Billions of Current Dollars)

Year	Total Aerospace Revenues	Total Aerospace Export Revenues	Exports as % of Total Aerospace	Total Aerospace Import Revenues	Imports as % of Total Aerospace	Aerospace Balance of Trade	Aerospace Exports as % of All US. Exports
1979	$45.4	$11.7	25.9%	$1.6	3.6%	$10.1	6.3%
1990	134.4	39.1	29.1	11.8	8.8	27.3	9.9
1991	139.2	43.8	31.4	13.0	9.3	30.8	10.4
1992	138.6	45.0	32.5	13.7	9.9	31.4	10.0
1993	124.2	39.4	31.7	12.2	9.8	27.2	8.5
1994e	112.8	38.5	34.1	12.8	11.4	25.6	7.6

Sources: Aerospace Industries Association, Facts & Figures (1993b, 1994c); Year-End Review and Forecast (1994a).

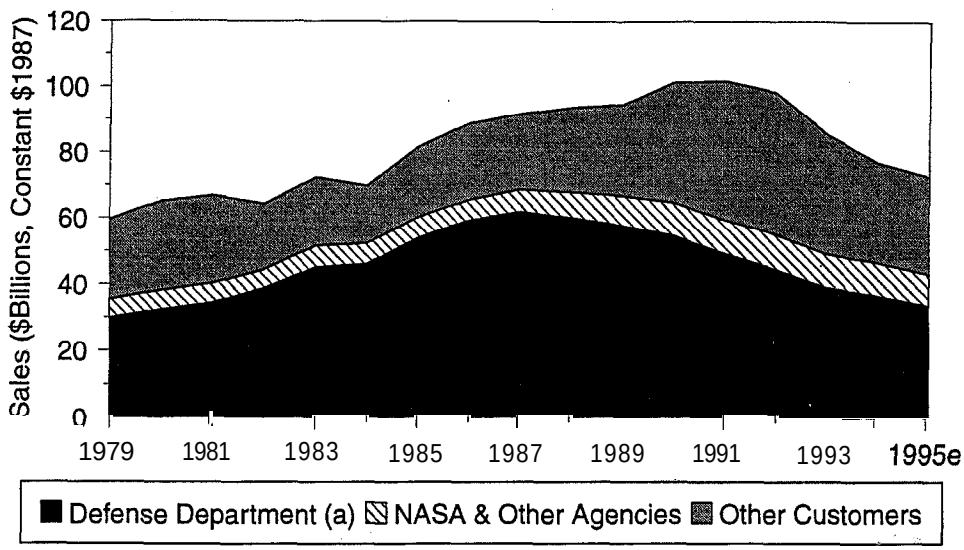
FIGURE 1
Aerospace Industry Revenues by Product, 1978-95



(a) includes funding for research, development, test, and evaluation.

Source: Aerospace Industries Association, Year-End Review and Forecast (1994), Table 1.

FIGURE 2
Aerospace Sales by Identified Customer, 1979-95



(a) includes funding for research, development, test, and evaluation.

Source: Aerospace Industries Association, Year-End Review and Forecast (1994a, Table II).

accounted for 6.8% of total manufacturingemployment in the United States and 11.7% of total durable goods manufacturing employment in the country (Aerospace Industries Association 1994c, 140).

As a result of the combined effects of the decline in military budgets, the global recession, and increased low-wage competition, aerospace employment has fallen dramatically, with major declines in every year since 1989 **(see Table** 3). At year-end 1994, industry employment stood at 836,000, down from 1,33 1,000 in 1989, a 37% decline in just five years. The Aerospace Industries Association projects that an additional 34,000 aerospace jobs will be lost during 1995, which will bring the industry's employment to its lowest level since 1955 (Fuqua 1994, l-2).

Aerospace employment has fallen dramatically every year since 1989.

Worse, some industry sources project U.S. aerospace employment could fall to 600,000-700,000,[3] a 55% decline since 1989. In California alone by 1996, aerospace employment is projected to decline to only one-third of its 1986 peak level of 383,000 (*Los Angeles Times,* September 13, 1994, 1A).

TABLE 3
Aerospace Industry Employment, 1982-95
(Thousands, Year-end, as Reported to Aerospace Industries Association)

	Total Aerospace	Total Aircraft	Civil Aircraft	Military Aircraft	Missiles & Space	Other Related
1982	1,027	516	231	285	243	268
1983	1,027	484	174	310	259	284
1984	1,097	517	Ia4	333	286	294
1985	1,206	588	210	378	294	324
1986	1,272	639	238	401	309	324
1987	1,300	653	257	396	316	331
1988	1,311	666	280,	386	313	332
1989	1,331	702	326	376	306	323
1990	1,270	687	341	346	281	302
1991	1,180	660	345	315	251	269
1992	1,040	597	322	275	217	226
1993	907	523	275	248	176	207
1994e	836	484	255	229	165	188
1995e	802	463	251	212	157	183

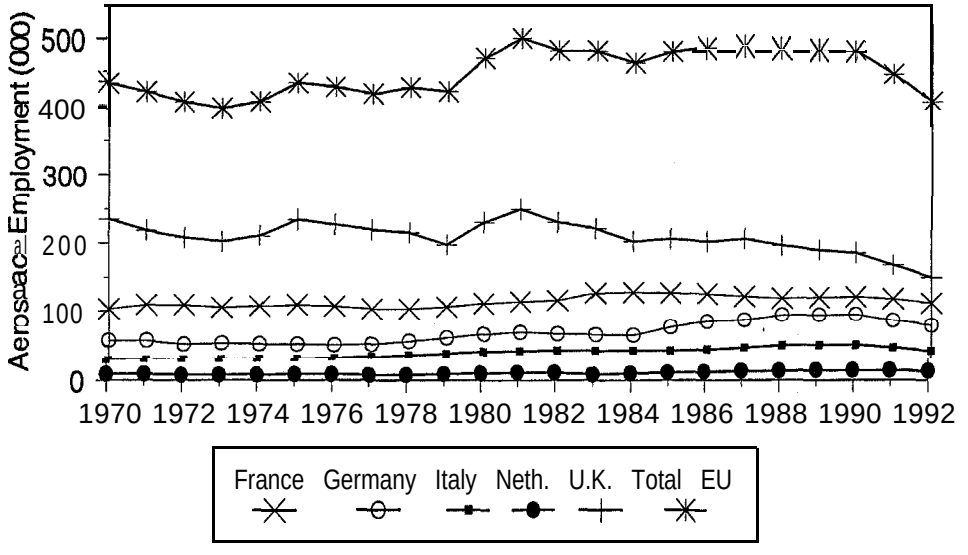
Source: Aerospace Industries Association, Year-End Review and Forecast (1994a), Table IX).

By contrast, overall European Union (EU) aerospace sales peaked in 1990 at about $68 billion, and had declined by 19.4% in real terms by 1993 (compared to a real decline of 18.8% for the United States during the same period). EU aerospace employment peaked in 1980 at about 500,000 and held relatively steady through 1990 **(see Figure 3).** By 1992, employment had dropped to about 409,000 (down 72,000 from 1990) and has since continued to decline. Interestingly (as shown in **Table 4**), the United Kingdom accounted for virtually all of the net employment decline, 1980-92, having shed over 100,000 aerospace jobs during that period (from 249,000 to 149,725) (European Commission 1994, 187,233, 249). British Aerospace, mimicking McDonnell Douglas's global search for new capital, entered into negotiations with Taiwan Aerospace to jointly produce aircraft, while shedding British workers.

European Union aerospace employment declined by 14% between 1990 and 1992.

While the aerospace industry is usually divided for statistical purposes among the five segments mentioned above, it is useful to think of it in terms of three distinct sources of demand: defense, civil space, and civil aircraft.

FIGURE 3
European Aerospace Employment, 1970-92



Source: European Commission, European Aerospace Industry, Trading Position, and Figures (1994, 233).

TABLE 4
Total Aerospace Employment in Europe, Canada, Japan and the United States,* 1974-93

	United Kingdom	Other EU	Total EU	United States*	Canada	Japan
1974	**210,100**	**199,541**	409,641	**666,000**	**28,400**	**29,814**
1979	**196,566**	**227,071**	**423,637**	**775,000**	**37,700**	**31,666**
1980	**229,821**	**241,874**	471,695	**830,000**	**46,800**	**32,991**
1984	**203,202**	**262,318**	**465,520**	**817,000**	**42,300**	**34,216**
1989	189,911	**295,829**	**485,740**	**992,000**	**63,632**	**38,329**
1990	186,337	**297,635**	**483,972**	**946,000**	**63,962**	**39,131**
1991	167,614	**281,396**	**449,010**	**879,000**	**61,717**	**40,221**
1992	149,725	**259,774**	**409,499**	**783,000**	**59,172**	—
1993	—	**239,132**	—	**680,000**	**58,715**	—

***Figures for U.S. employment include only companies in SICs 372, 376, 366, 381, and 382 and exclude other aerospace-related companies and their employees.**

Source: European Commission, European Aerospace Industry, Trading Position, and Figures (1994,233)

Defense Spending and the Aerospace Industry

Obviously, much of the aerospace industry owes its existence to military and other governmental spending. During the 1980s, defense expenditures (including aircraft, missile systems, and military space applications) may have accounted for as much as 75% of all aerospace production worldwide.[4] However, in the early 1990s, as military budgets declined, nondefense aerospace production (including space) exceeded 50% of all aerospace production in both the United States and Europe (European Commission 1994,195; Aerospace Industries Association 1994a, Table II). In the United States, aerospace sales to the Department of Defense plunged 40.9% in real terms from 1987 to 1994, and are projected to decline an additional 9.1% during 1995.

Although it appears unlikely that military aerospace sales will continue their steep decline, major growth in real terms seems equally unlikely. And while Defense Department-funded R&D has remained fairly constant, procurement has declined by about 50% from its peak in 1990. Even with the election of a Republican majority in Congress in 1994, significant increases in aerospace defense procurement are unlikely in the face of other budgetary constraints (Standard & Poor's 1994a, 2; *Washington Post* March 3, 1995, A17).

Most defense aerospace firms have apparently opted against diversify-

ing into nondefense activities. This decision partially explains the growing wave of defense industry mega-mergers in the United States, a trend that is likely to continue and has its counterparts in Europe. There is an ever-accelerating wave of consolidation in the industry worldwide. For example, key U.S. aerospace executives are openly arguing that the number of US. prime contractors in virtually every aerospace sector must be reduced by at least one-half, from missiles to satellites to rocket motors to fighters to civil aircraft, even in the aftermath of the Lockheed-Martin-Marietta and Northrop-Grumman mergers. Industry analysts also argue that, if anything, European aerospace manufacturers are even more fragmented, and they project sweeping consolidations in every sector of the European aerospace industry. These analysts point especially to the six European military aircraft manufacturers, 14 missile manufacturers, seven regional aircraft manufacturers, and nine engine manufacturers as major targets for a "rationalization" and consolidation of European production facilities.

The number of US. ***prime contractors in virtually every aerospace sector must be reduced by at least one-half.***

Internal market barriers within the EU, which are being reduced under the European Community's (EC) 1992 initiatives, have slowed consolidation there as compared with the United States. If consolidation accelerates in the EU, governments there will be under increasing pressure to maintain employment levels in these industries, which could result in an increase in direct and indirect subsidies to Airbus Industrie. As a consequence of consolidation in the EU, the U.S. industry may face severely restricted market access.

Within the United States, there are two issues working against further consolidation. First, consolidation will reduce employment levels, putting further strain on workers. Second, the Justice and Defense Departments oppose further mergers on antitrust grounds. These concerns suggest that it is important to develop industrial policies in the United States that are designed to maximize demand for aerospace products, while allowing the industry to achieve the most efficient structure possible. Such policies must recognize that the aerospace industry has a very small number of participants on both sides of the market (buyers and sellers). This structure is very different from a consumer product industry, such as motor vehicles. Hence supplier concentration, in the context of an industry with global excess capacity, is unlikely to lead to consumer exploitation in the aerospace markets. Consolidation on both supply and demand sides of the market is likely to lead, instead, to an increase in the importance of bargaining and long-term market relationships. These issues are addressed in more detail in the final section of this report.

Civil Space Vehicles, Satellites, and Related Equipment

In the 1960s and 1970s, space-related activities were dominated by NASA, which accounted for 60% to 80% of industry revenues, with military expenditures accounting for most of the rest (a half-dozen other U.S. agencies and the burgeoning commercial sector accounted for a small portion). During the 1980s, however, military space expenditures quickly surpassed civil expenditures, reaching $14 billion in 1987 or about two-thirds of all U.S. government outlays on space. Industry revenues for 1994 were $28.5 billion, of which about 50% were military-related (Aerospace Industry Association 1994a, Table II; 1994b, 66). Commercial applications, while still relatively small at $3.6 billion in 1994, have grown rapidly. The Department of Commerce projects commercial space revenues will grow at a 25% to 30% annual rate through the rest of the decade, implying revenues in the $14 billion to $17 billion range by 2000 (Standard &Poor's 1994b, A23). It seems likely that government space-related spending will decline somewhat over the next few years.

In 1994, Boeing had 55% of global commercial jet revenues, its lowest share since the 1950s.

The emerging post-Cold War economy is producing a broad range of new competitive pressures and alliances in the commercial space market. To date, United States and European firms dominate the market, but they are increasingly competing with (as well as entering into joint ventures with) Russian, Chinese, and Japanese firms and government agencies.

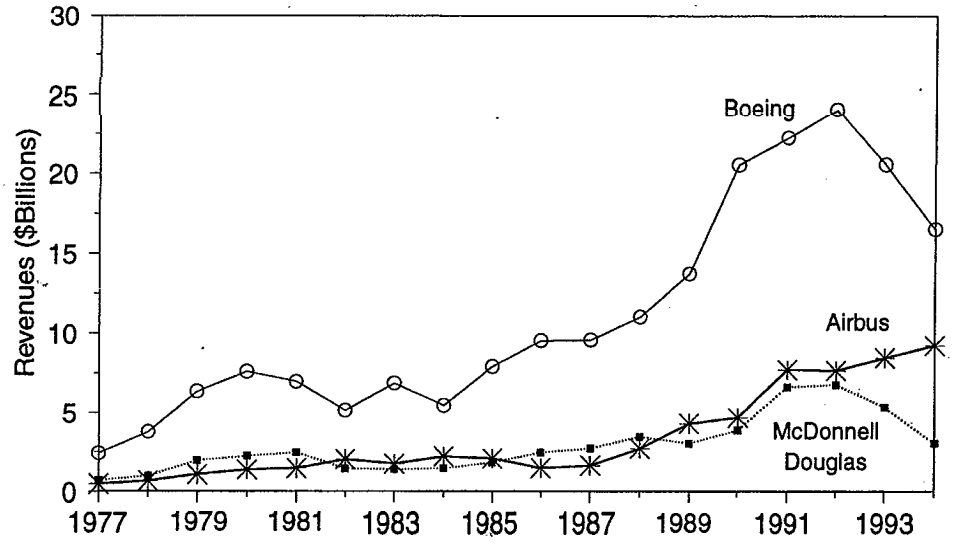
The Commercial Aircraft Industry and the Airline Industry

The civil aircraft industry is dominated by sales of commercial transports, engines, and parts that, combined, accounted for about 90% of the industry's 1994 revenues of $26 billion. The balance of industry sales is derived from general aviation (i.e., private jet and propeller aircraft) and helicopters (Aerospace Industries Association 1994a, Tables I and IV).

There are three dominant competitors in the commercial aircraft market: Boeing, Airbus, and McDonnell Douglas **(see Figure** 4). Shipping its first aircraft in 1974, Airbus has captured about one-third of the global market for commercial jetliners, mostly at the expense of McDonnell Douglas, and has publicly stated its intention to obtain a 50% or greater global market share *(Aviation Week & **Space Technology*** January 23, 1995, 52).

In 1994, Boeing had 55% of global commercial jet revenues, its lowest share since it began selling the 707 in the 1950s. Airbus's revenues reached a record 30% market share, and McDonnell Douglas's share was 10%, a record low (Friedman et al. 1992, 1994a).

FIGURE 4
Top Three Aircraft Manufacturers' Revenues From Commercial Jet Transport Shipments, 1977-94



Source: Friedman et al. (1992; 1994a).

Many engine manufacturers are entering domestic and international partnerships when designing new engines.

The aircraft engine market is also dominated by three manufacturers, General Electric, Pratt & Whitney, and Rolls-Royce. The American manufacturers each account for about 30% of engines shipped, while Rolls-Royce has about 15% of the market. As with the large transport market, large engine manufacturers also use small engine manufacturers as partners and subcontractors to spread program costs and risks. In this context, the Japanese engine manufacturers are becoming ubiquitous. Engine subcontractors also participate in offset programs. Because of the cost of research and development, many engine manufacturers are entering domestic and international partnerships when designing new engines. The most important of these, CFM International, is an equal partnership between General Electric and the French company SNECMA. CFM engines account for almost one-quarter of commercial shipments, and dominate the mid-size engine market (it is the sole option available on the Boeing 737) (European Commission 1994, 88).

Obviously, the health of the airline industry is of critical importance to the manufacturers. U.S. carriers lost over $10 billion between 1990 and 1993, and European airlines lost over $2 billion in 1991 and 1992 alone. Demand for air travel-or more precisely, the price customers are willing to pay—has been deeply depressed, although it is starting to recover. While the U.S. airline industry basically broke even in 1994 and may generate modest prof-

its in 1995, the industry remains one of the financially weakest in the economy (Standard & Poor's 1994a, A3-4). With industry-wide debt exceeding $35 billion, only one major carrier (Southwest) has an investment grade rating (National Airline Commission 1993, 12). Moreover, industry profits have historically lagged far behind that of US. industry as a whole; in the 17 years prior to airline deregulation in 1978, the industry averaged 2.4% compared to 4% to 6% earned by the rest of U.S. industry, and from 1978 through 1992, the industry had an average profit margin of negative 2.3% (Dempsey 1993).

The U.S. airline industry will need to spend $100 billion or more over the next 15 years.

The severity of the global aerospace recession can be traced through its stark impact on the industry's orders, deliveries, revenues, and backlogs:

- Worldwide commercial jet transport orders peaked in 1989 when airlines placed orders for 1,702 aircraft. In 1993, when there was an avalanche of cancellations for previously ordered jets, there were only 68 net new orders. Orders are normally placed for multiple aircraft to be delivered over a number of years in the future.
- Worldwide commercial jet transport *deliveries* peaked in 1991 at 849 aircraft. In 1994, deliveries fell below 500, and deliveries could fall to little more than 400 in 1995. Deliveries are not expected to exceed 500 until the end of this decade.
- Worldwide commercial jet *revenues* peaked at $40 billion in 1992, but fell to about $30 billion in 1994 (Friedman et al. 1994a).
- At year-end 1990, the three largest commercial jet transport manufacturers, Boeing, Airbus, and McDonnell Douglas, had a backlog of almost 3,200 aircraft on order. As of September 30, 1994, their backlogs had shrunk over 40% to slightly more than 1,800 aircraft, representing about three full years of production at current rates. From year-end 1990 to September 30, 1994, Boeing's future production backlog declined by 38% (from 1,563 to 969), Airbus's backlog declined by 42% (from 1,038 to 601), while McDonnell Douglas's fell by 70% (from 575 to 171) (Standard & Poor's 1994a; Aerospace Industries Association 1994a; Merrill Lynch 1994a).

The U.S. airline industry is confronted by many external and internal challenges that in turn affect the aerospace manufacturers. Since airline deregulation unleashed a host of new competitors and fundamentally transformed the way the airlines marketed their product, air travel became a commodity, with the attendant downward pressure on prices. However, the industry has an aging fleet and will need to spend $100 billion or more over the next 15 years to replace aging aircraft, meet regulatory requirements, and meet anticipated increases in demand for air travel.[5] This enormous capital

requirement, for an industry with weak balance sheets, poses a fundamental problem for the aerospace manufacturers.[6]

The industry has enormous fixed costs: relatively small changes in "load factors" (the percentage of seats, on average, an airline fills with paying passengers) can generate hundreds of millions of dollars in profits or losses. The recession of the early 1990s, combined with Gulf War-related travel fears, caused demand to decline and forced carriers to drop their prices in order to maintain their load factors. In the end, the entire industry found itself awash in a sea of red ink.

For the aircraft and engine manufacturers, the airlines' woes caused a dramatic decline in future sales. Unfortunately, airlines order new aircraft when times are good and begin to take deliveries when times are bad. As a result, the airlines were accepting deliveries of record numbers of new aircraft just as their losses reached record heights in the early 1990s. In response, they canceled tens of billions of dollars in orders, causing, in part, the current deep decline in commercial aerospace production.

Through fhe year 2010, the Chinese will purchase 850 new aircraft with a value of about $47 billion.

When the aircraft manufacturers project demand for new aircraft, they must look 20 or even 30 years into the future, the expected model life. The Boeing 737 was first introduced in the 1960s, and its latest revision will go into production in 1996 with a hoped-for run of at least a decade.

For the next two decades worldwide air travel is projected to grow 4.5% to more than 5.5% per year. Therefore, demand for air travel will increase by 50% to 70% in 10 years, and 140% to 200% by 2015. International travel (both among and within other nations) is projected to grow more rapidly than domestic U.S. travel, and the global share of U.S. airlines is expected to decline from about 40% in 1993 to about 35% in 2010 (see **Table 5).**

Asia is the most rapidly growing area of the world and represents significant opportunities for new sales. If the Chinese economy continues its current rapid growth, it will become the largest economy in the world in less than two decades. Boeing has estimated that, through the year 2010, the Chinese will purchase 850 new aircraft with a value of about $47 billion.

To put into perspective China's projected growth of 100 billion in domestic revenue passenger miles (one paying passenger flying one mile) for 1995 to 2010, it is helpful to realize that it is equivalent to either of United or American Airlines' total traffic in 1993, or about 22% of the RPMs of the major US. carriers in that year. It also represents about one-fourth of the projected ***increase*** in domestic U.S. RPMs during that period. Japan's projected growth of 91 billion RPMs from 1990 to 2010 in domestic ***and*** inter-

TABLE 5
Historic and Projected World Airline Traffic

	Revenue Passenger Miles (Billions)					Percentage Contribution				
	World Airline	U.S. Airlines			Non-U.S. Airline	World Airline	U.S. Airlines			Non-U.S. Airline
Year	Total	Total	Domestic	Int'l	Total	Total	Total	Domestic	Int'l	Total
1990	1,158.3	472.2	345.8	126.4	686.1	100%	40.8%	29.9%	10.9%	59.2%
1993	1,267.0	507.3	359.7	147.6	759.7	100'	40.0	28.4	11.6	60.0
2000	1,894.3	717.8	498.0	219.8	1,176.5	100	37.9	26.3	11.6	62.1
2005	2,428.9	888.5	600.5	288.0	1,540.4	100	36.6	24.7	11.9	63.4
2010	3,070.3	1,082.1	714.9	367.2	1,988.2	100	35.2	23.3	12.0	64.8
2013	3,518.5	1,214.9	791.5	423.4	2,303.6	100	34.5	22.5	12.0	65.5

Note: Revenue passenger mile represents one paying passenger transported one mile. These data exclude airlines of the former Soviet Union.

Source: Boeing Commercial ***Market*** Outlook (1994, Appendix B).

national traffic is about 15% of the projected increase in U.S. carriers' RPMs during that period (Boeing Company 1992, 1994).

The United States has much more air travel per capita than anywhere else in the world. For example, in 1990, per capita travel in the United States was over 1,700 RPMs. The next closest area was Europe, with less than 500 RPMs per capita (National Airline Commission 1993, 3). While the North American market will grow much more slowly than much of the rest of the world, it starts out with a much larger base. In absolute numbers, the US. market is still, by far, the world's largest. Boeing's projections for growth by major travel market through 2013 reveal that, taken as a whole, incremental traffic increases associated with travel to, from, and within North America will still exceed that of Asia in absolute numbers **(see Table 6).**

As a group, US. airlines are projected to remain by far the most important customers for commercial aircraft manufacturers. Boeing projects that, of the $980 billion (1994 dollars) that will be expended on new commercial jet aircraft through 2013, U.S. airlines will account for $322 billion, or 33% **(see Table 7).**

These forecasts are based, in turn, on projections that US. airlines will experience more than a doubling in traffic between 1995 and 2000, as shown in **Table** 8. US. airlines are expected to capture 3 1% of the projected global growth in air traffic in this period, which is only slightly less than their share of 1995 traffic levels (39.5%). Non-US. airlines are expected to grow somewhat faster than US. carriers through 2013, according to Boeing, but the

TABLE 6
Projected Growth by Major Air Travel Market and Region
. (Billions of Revenue Passenger Miles)

	Total Projected Traffic increases 1994-2013	Percent of Total Projected World Traffic Increases
Total Asia-Related	**691**	. 35.4%
Intra Asia Pacific	470	24.1
Trans Pacific (a)	133	6.8
Asia Europe (b)	88	4.5
Total North America-Related	761	39.0%
Intra North America	454	23.3
Trans Pacific (a)	**133**	**6.8**
North Atlantic (c)	98	5.0
N. America-Latin America	**76**	**3.9**
Total Europe-Related	**498**	25.5%
Intra Europe	224	11.5
North Atlantic (c)	98	5.0
Asia-Europe (b)	88	4.5
Europe-Latin America	50	2.6
Europe-Africa	**38**	**1.9**
Total Projected World Increases	1,950	100.0%

Notes: These data exclude airlines of the former Soviet Union.
(a) One-half of travel between North America and Asia is allocated to each region, in order to avoid double counting.
(b) One-half of travel between Asia and Europe is allocated to each region, in order to avoid double counting.
(c) One-half of travel between North America and Europe is allocated to each region, in order to avoid double counting.

Source: Boeing *Commercial Market Outlook* (1994, 5, Appendix B).

domestic firms will remain a very important source of demand for U.S.-built aircraft in the future. Despite these trends, U.S. aerospace manufacturers are behaving as though the domestic market will be far less important than that of Asia or other parts of the world.

A major threat to the U.S. economy would occur if, in the name of increasing sales to Asia, U.S. aircraft and engine manufacturers agreed to move significant amounts of production abroad. The continued demand for air travel in the United States (even if growing at a slower rate) implies that the United States would have to *import* increasing amounts of aerospace products. The industry could turn from generating significant trade surpluses to trade deficits.

TABLE 7
Historic and Projected Global Commercial Jet Market, 1970-2013
(Billions of Constant 1994 Dollars)

Customer	1970 to 1993	Percent	1994 to 2013	Percent
U.S. Airlines	$190	37%	$322	33%
Non-U.S. Airlines	319	63	658	67
Total	509	100	980	100

Note: These data exclude airlines of the former Soviet Union.

Source: Boeing *Commercial Market Outlook (1994, 27).*

TABLE 8
Projected Growth in Air Travel, 1995-2013
(Billions of Revenue Passenger Miles)

	World Airlines	U.S. Airlines	U.S. Airline Share	Non-U.S. Airlines	Non-U.S. Airline Share
1995 Traffic	1,428	564	39.5%	864	60.5%
Projected Traffic Growth 1995-2013	2,091	651	31.2	1,439	68.8%
Projected Growth as % of 1995 Traffic	146.4%	115.6%	—	166.6%	—

Note: These data exclude airlines of the former Soviet Union.

Source: Boeing *Commercial Market Outlook* (1994, Appendix B).

COMPETITION PRESSURES THE U.S. AEROSPACE INDUSTRY TO OUTSOURCE JOBS AND PRODUCTION

Aerospace represents the leading edge of technological and organizational achievement. The ability to design, manufacture, and integrate aircraft, engines, rockets, satellites, missiles, avionics, and related systems is viewed by many nations as emblematic of first-class citizenship in the high-technology industrial economy. However, the aerospace industry is confronted on all sides with increasing surplus capacity. Few nations seem prepared to exit any segment of the industry they have already developed (although Israel and Brazil may prove the exceptions), and many are set to embark on ventures into new market niches.

The aerospace industry is confronted on all sides with increasing surplus capacity.

For example, the world's commercial manufacturers delivered a record 849 jet transports in 1991, and fewer than 500 in 1993 (Friedman et al. 1994a). None of the 1991 capacity has been eliminated despite forecasts that it will go largely unused for another decade or more (Boeing 1994). Boeing argues that it alone could meet this future increased demand with its existing capacity (Baker 1994). However, since the industry's last peak, three completely new products have been introduced (the Boeing 777 and the Airbus A330 and A340) and two major derivatives have begun deliveries (the McDonnell Douglas MD-90 and the Airbus A321). Moreover, a half dozen or more new jet aircraft are being studied by existing and potential new manufacturers around the world. In addition, there are already 10 manufacturers producing or developing 27 regional jet or turboprop commuter aircraft of different types, even though manufacturers cannot sell their current output (*Aviation Week & Space Technology* October 3, 1994, 39).

In the face of defense budget reductions and precipitously declining commercial aircraft orders, hundreds of thousands of Western aerospace workers have already been laid off, and additional hundreds of thousands face the prospect of permanent job loss in the near future. Aerospace employees are among the best-compensated workers in their respective countries, but the gap between aerospace wages and salaries in developed nations and developing nations is enormous. In Europe, Japan, and North America, wages alone range from $15 per hour to more than $30 per hour (with fringe benefits adding up to 100% on top of cash compensation), while aerospace workers in India average about $100 per month and those in China about $40 per month.

Beyond the havoc wrought by secular and cyclical declines are two even

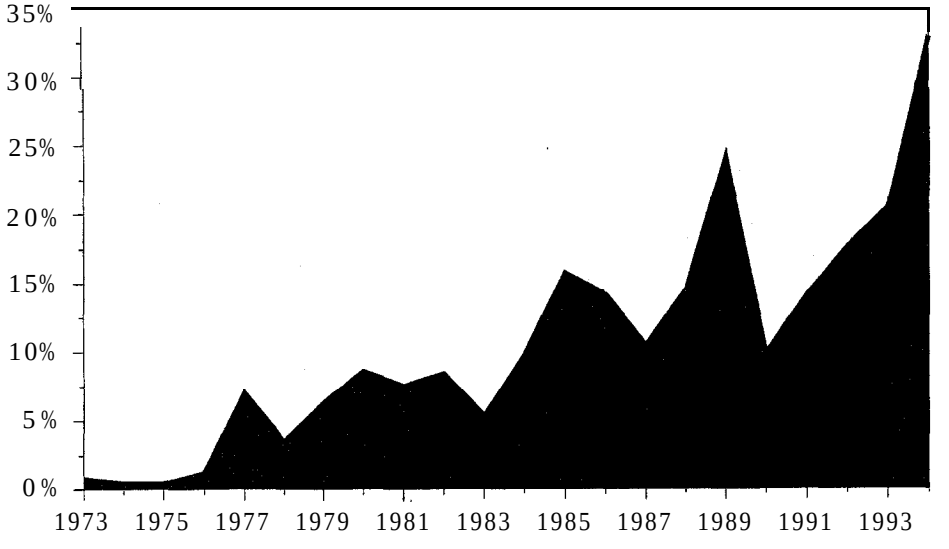
greater challenges and threats to aerospace jobs in developed economies: the rapidly changing nature of aerospace companies themselves and the evolution of new competitors, primarily in Asia. The Western aerospace industry is in the midst of a massive reorganization and consolidation even as it seeks out new partners, suppliers, and subcontractors, especially those with access to non-market incentives to expand their presence and scope of involvement in the industry.

Much of the industry's decline over the past decade can be attributed to declining domestic demand in the form of reduced defense procurements and, more recently, cancellations by U.S. carriers. However, the future threat to U.S. aerospace employment and production lies primarily in a combination of growing import penetration along with increasing success by non-U.S. firms in the international marketplace.

The future threat to U.S. aerospace employment and production comes from a growing import penetration and increasing success by non-US. firms in the international marketplace.

U.S. commercial aircraft manufacturers have historically enjoyed a dominant position in the U.S. domestic market. However, imports of complete aircraft have steadily grown, and during the past two years have actually increased even as the domestic market shrank dramatically. **Figure 5** demonstrates the steady rise of imports in the domestic market until, by 1994,

FIGURE 5
Market Share of Imports in U.S. Commercial Aircraft Market, 1973-94



Source: Aerospace Industries Association *Facts and Figures* and *Year-End Review and Forecast,* Statistical Series 23-01, 21-01, and 21-02, various years.

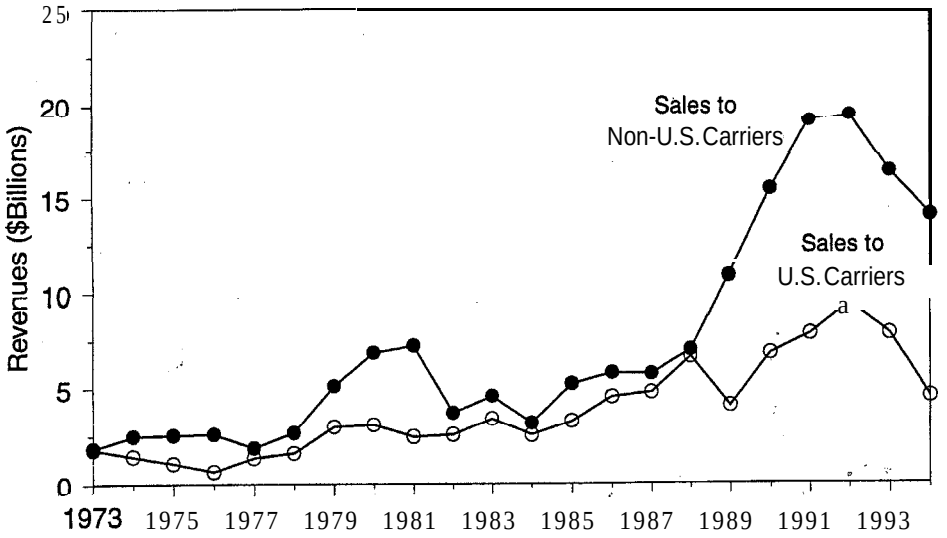
imported aircraft had captured about one-third of sales to U.S. carriers. Imports have been increasing their share of the domestic market by about 1.1 percentage points per year (based on trend analysis).

The commercial aircraft industry is fundamentally export-driven, and during the early 1990s U.S. exports of aircraft rose to around $20 billion. These exports significantly reduced the U.S. trade deficit. The airline recession has been worldwide, however, and, as can be seen in **Figure 6,** aircraft exports fell as precipitously as did sales to U.S. customers after 1992, Indeed, exports fell slightly more in dollar terms than did domestic shipments. However, as shown above, imports continued to rise.

Airbus is capturing a growing share of the market for non-U.S. carriers.

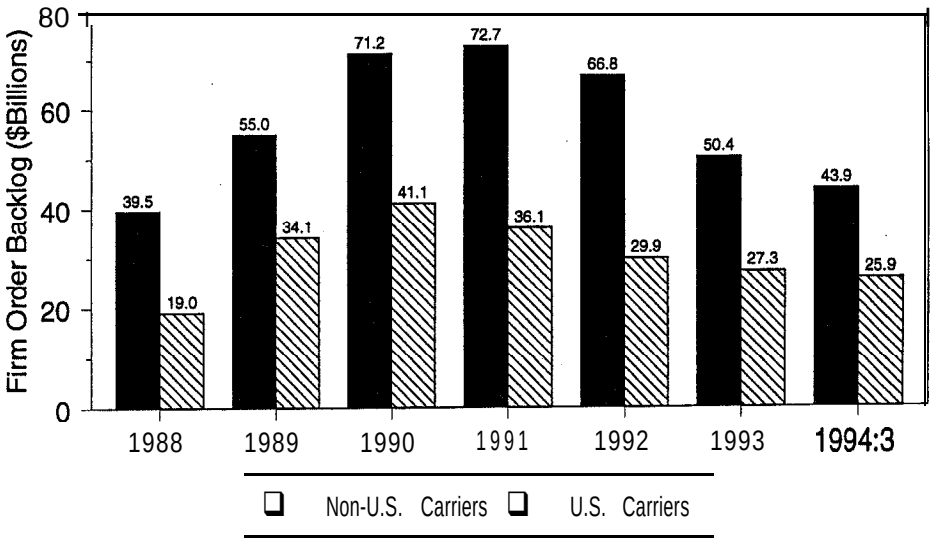
It is important to note that domestic manufacturers' order backlogs for non-U.S. carriers fell much more rapidly than did their backlogs for U.S. carriers **(see Figure 7).** Indeed, between year-end 1991 and the end of the third quarter 1994, backlogs for non-U.S. airlines fell about $29 billion while backlogs for U.S. airlines declined by about $10 billion. Non-U.S. customers' share of domestic manufacturers: backlogs fell from about 67% to 63%. Clearly, Airbus is capturing a growing share of the market for non-U.S. carriers.

FIGURE 6
U.S. Commercial Transport Manufacturer Sales, by Customer, U.S. and Non-U.S. Carrier Shares, 1973-94



Source: Aerospace Industries Association, Series 21-01, 23-01, 23-02, various years.

FIGURE 7
U.S. Manufacturers' Commercial Transport Firm Order Backlog, by Customer, 1988-94



Source: Aerospace Industries Association, *Year-End Review* (1994a), Facts *and Figures* (1993b).

Aerospace Companies' Response to Globalization and Competitive Pressures

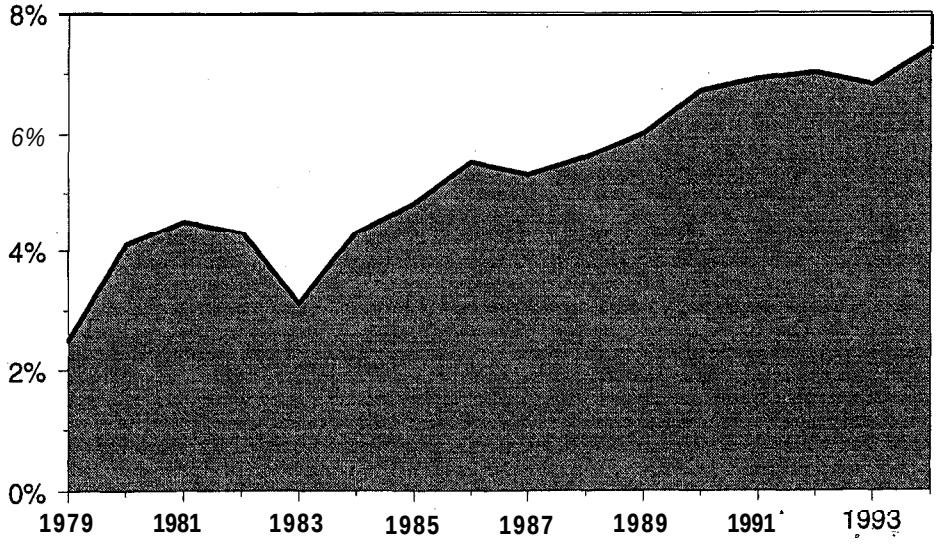
U.S. aerospace companies are under enormous strain: declining military budgets, weakened commercial airline customers, rising global competition, and increasingly restive—and mobile-capital markets. To executives and shareholders, the industry's responses to these varied pressures seem rational-even unavoidable. However, the dramatic changes in this industry may permanently destroy hundreds of thousands of high-quality jobs and cripple the U.S. premier capital goods manufacturers and leading exporters. The industry's future may very well be ceded to others with more far-sighted strategies and access to greater resources to weather the current storm and to place themselves in a position to reap the benefits of the rebounding demand for commercial aircraft.

Ultimately, the biggest threat to U.S. aerospace jobs is not the prolonged global downturn in airline fortunes, nor is it the welcome easing of the arms race and resulting reduction in military aerospace expenditures. Rather, the real threat comes from a dynamic that is encouraging U.S. aerospace companies to shed jobs and capacity with profoundly disturbing long-term implications.

An indication of this can be seen in **Figure** 8. Except for a brief dip in 1983, the value of imported aircraft, engines, and parts have steadily climbed as a share of all U.S. aerospace shipments. Components are a key source of emerging competition to U.S. aerospace jobs and production. Even more dramatic evidence of this trend is that the United States barely runs a positive balance of trade in turbine aircraft engines and engine parts **(Figure 9)**, in spite of the fact that the United States has the two largest engine manufacturers (General Electric and Pratt & Whitney). Accounting for 25% to 30% of the final price of a commercial aircraft, engines are the most important component of any airplane. The engine industry has been systematically targeted by Europe, Japan, and, most recently, China. Pratt and Whitney involvement in foreign ventures is about to escalate greatly. Pratt & Whitney China President Don Lang is negotiating to buy a large share of one overhaul facility that will cost $70 million to $100 million, is planning for a second, and is pursuing an equity share in two engine companies that will make parts and components (not complete engines) and ultimately integrate design and manufacturing *(Air Transport World* March 1995, 42).[7]

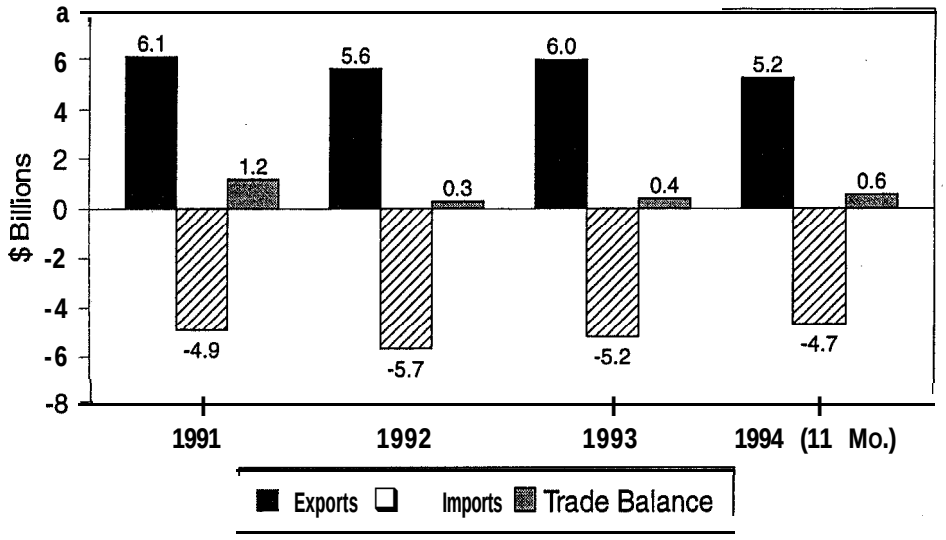
Components are a key source of emerging competition to U.S. aerospace jobs and Production=

FIGURE 8
Engine and Parts Imports as a Share of Aerospace Shipments, Engine and Aircraft & Engine Parts Imports, 1979-94



Source: Aerospace Industries Association, *facts and Figures* **(various years),** *Year-End Review and Forecast* **(1993a; 1994a).**

FIGURE 9
Turbine Aircraft Engines and Engine Parts Exports, Imports, and Trade Balance, 1991-94



Source: National Trade Data Bank, U.S. Dept. of Commerce, February 1995, Bureau of the Census merchandise trade import and export data, for various Harmonized 1 O-digit codes 8411114000 to 8411999090.

U.S. aerospace companies, for a variety of interrelated reasons, are increasingly becoming "virtual" manufacturers, retaining control over the design, integration, and marketing of their products while relinquishing an increasing proportion of the manufacturing process to others. There are four basic forces at work here:

*I) **Buying sales through local content, offset, and technology transfer agreements;***

*2) **Sharing the risk and expense of the multi-billion-dollar investments required to launch a new aircraft or major subsystems,** such as **engines or auxiliary power units;***

*3) **Gaining access to superior emerging technologies; and***

*4) **Cutting costs through the use of low-wage labor in the developing world.***

These forces could easily result in even more job losses for American workers than measures of declining U.S. aerospace market share would indicate. Below is a discussion of each dynamic.

1) Buying sales through local content, offset, and technology transfer agreements.

Although in principle prohibited by GATT (and the new World Trade Organization), the 1979 Agreement on Trade in Civil Aircraft, and a broad range of bilateral and other international agreements, dozens of countries around the world require that part of a commercial aircraft they buy be produced locally and/or that local manufacturers supply components for the aircraft's production line. Explicit technology transfer or licensing provisions are often part of these requirements. Some non-GATT signatories are blatant with their local content and offset practices. Others are more circumspect but also require local content and offset agreements.

Dozens of countries require that part of a commercial aircraft they buy be produced locally.

U.S. manufacturers and their industry association regularly complain about these practices but seem to view them as a cost of doing business; in some cases they go so far as to embrace them as a ***marketing tool.*** Boeing has clearly used offsets to gain sales in China and Japan, and Boeing Commercial Aircraft Group President Ron Woodard recently told a Canadian aerospace industry gathering that the company would direct future subcontracting work to countries that bought Boeing aircraft ***(Financial Times No***vember 8, 1994).

McDonnell Douglas has recently taken the practice to new heights, virtually offsetting an entire aircraft, the proposed MD-95, to partners in the U.K., Korea, Japan, Italy, and other countries. The company's chief executive officer, Harry Stonecipher, told the ***Wall Street Journal*** that "I'm going to play in more markets because of whom I chose as suppliers" ***(Wall Street Journal*** December 19, 1994, A8). Echoing Stonecipher, McDonnell Douglas China President Peter Chapman told the ***New York Times,*** "We're in the business of making money for our shareholders. If we have to put jobs and technology in other countries, then we go ahead and do it" (New ***York Times*** February 25, 1995).

In the military sector, offsets have become more the rule than the exception, and in many ways set the stage for offsets in the commercial arena.

2) Sharing the 'disk and expense of the multi-billion-dollar investments required to launch a new aircraft.

It can easily cost $1 billion or $2 billion to launch a derivative of an existing aircraft, and the launch of an entirely new aircraft can cost $5 billion to $10 billion (the new Boeing 777 is estimated to have cost between $5 billion and $6 billion). From the time the initial investment is made on a

new aircraft, it can take up to 14 years for manufacturers to recover their sunk costs on a successful model-four or five years to design, test, and certify the aircraft and as many as 10 years in production (Eberstadt 199 1, 24-25).[8] Aircraft and engine manufacturers have increasingly tried to minimize and transfer some of the expense and risk of developing new products,

This is especially true for U.S. companies, who are under constant pressure from the capital markets to produce high-current returns in the short term. This has had the effect of pressuring companies to seek out projects with greater, more immediate returns instead of those that promise longer-term, even if more lucrative, rewards. "The U.S. system of allocating investment capital is threatening the competitiveness of American firms and the long-term growth of the national economy," argues Harvard Professor Michael E. Porter in a 1992 report for the Competitiveness Council (Porter 1992, 3).[9]

U.S. commercial aircraft manufacturers are actively seeking out risk-sharing partners.

Both U.S. commercial aircraft manufacturers are actively seeking out risk-sharing partners, and in the process they are undermining long-term domestic aerospace employment prospects. Boeing's 777, the first deliveries of which occurred in May 1995, will have 30% foreign content (excluding engines), 21% of which will be accounted for by Boeing's Japanese risk-sharing partners, who invested $2 billion in developing the aircraft.[10] Not only will this be the highest foreign content of any U.S. commercial aircraft ever produced, but a significant number of American Boeing jobs have been transferred to the Japanese, who will fabricate virtually the entire fuselage along with other important components. It would appear that the 777, when it is fully ramped up, will require only about 40% of the U.S. production jobs of Boeing's other current aircraft.

McDonnell Douglas has been even more actively seeking risk-sharing partners. In its effort to launch a competitor to Boeing's 747 (the Airbus A340), it agreed to sell 40% of its commercial aircraft division to a government-coordinated consortium of companies in Taiwan. In exchange for a $2 billion investment, the deal would have permitted the Taiwan Aerospace Corporation to fabricate up to 70% of the proposed MD-12 jumbo jet (Los Angeles Business *Journal* November 25, 1991, 1). Ultimately, the agreement fell apart not because of U.S. opposition but because of skepticism about the financial health of McDonnell Douglas by the Taiwanese. The manufacturer is continuing to shop a similar proposal to other potential partners (Airline *Financial* News September 12, 1994).[11]

For the next-generation aircraft, Boeing is leading a feasibility study with

an international grouping that includes the individual Airbus partner manufacturers (Daimler-Benz Aerospace, Aerospatiale, British Aerospace, and the Spanish firm Construcciones Aeronauticas SA (CASA)). The so-called "superjumbo" or "very large commercial transport" (VLCT) would carry 500 to 800 passengers on high-density, long-range routes and help ease congestion at the world's busiest airports. It is currently being studied by several different groupings of manufacturers and potential airline customers.

Airbus is leading its own study, and has announced that it will compete with any Boeing-led project. In addition, Boeing, McDonnell Douglas, and Daimler-Benz Aerospace have drawn up separate proprietary plans for a VLCT, all of which envisage international risk-sharing consortia of some type *(Aviation Week & Space Technology* November 7 and 2 1, 1994).

Other countries are now technology leaders in a number of areas.

The conventional wisdom is that no one company (or even nation) can afford the estimated $8 billion to $15 billion price tag for developing such an aircraft. While an argument could be made that a consortium of U.S. airframe, engine, and component manufacturers could indeed undertake such an effort on its own, this option is not under consideration due to perceived threats of antitrust litigation.[12] The need to relax antitrust limitations on aerospace mergers is discussed in the last section of this report.

Even though the market for such an aircraft would be relatively limited, the projected minimum 400 to 500 VLCTs to be sold would still generate at least $80 billion to $100 billion in revenues. Airbus estimates a market for up to 1,000 VLCTs *(Aerospace Daily* September 6 and 7, 1994). Whether or not competing superjumbos are launched, American participation is not likely to exceed 50% of the total value of the finished product even in a Boeing-led consortium. While Boeing will probably retain brand-name leadership with this successor to the 747, it will be at the price of a major lost opportunity for U.S. aerospace workers and for the American economy.

3) Gaining access to superior emerging technologies.

Although U.S. aerospace manufacturers have historically been the world's technology leaders, other countries are now technology leaders in a number of areas, including certain types of avionics, composite materials and structures, and aircraft control systems. Ironically, in many cases these new leaders got their boost from technology transfers from U.S. manufacturers and the U.S. government.

For example, Airbus openly acknowledges that a number of its techno-

logical advances were taken, off-the-shelf, from published NASA research (fly-by-wire control systems and the super-critical wing were first introduced on commercial aircraft on the Airbus A-320). The United States and Japan are currently in a bitter dispute over Japan's refusal to share advanced technologies that it developed as part of the FS-X fighter project (an aircraft based on U.S. technology). A number of these technologies (composites and avionics especially) have commercial applications and are being used by Japanese firms in competition with U.S. suppliers.

A number of new entrants into the commercial aerospace industry have large, cheap, and often repressed workforces.

A 1994 report by the National Research Council noted the "technological level and breadth of the structures manufacturing possessed by the [Japanese] heavy industry" that was observed by a council committee during a tour of Japanese aerospace manufacturing facilities. "Perhaps the most striking aspect of this capability is the advances the heavies have made in combining technologies transferred from the United States with the world-class manufacturing practices widely followed in other Japanese industries to create new process technologies." Boeing and other U.S. aerospace companies now regularly argue that they must rely on Japanese and other international suppliers because they have the most advanced and efficient processes in the world (National Research Council 1994). The previous generation's transfer of aerospace technologies is clearly coming back to haunt the U.S. industry and its employees.

4) Cutting costs through the use of low-cost labor in the developing world.

A number of the most aggressive new entrants into the commercial aerospace industry have large, cheap, and often repressed workforces, along with concerted strategies to evolve into major aerospace manufacturing players. Principal among these nations are China, Taiwan, South Korea, and Indonesia. U.S. aerospace manufacturers are increasingly sourcing work to these countries and claiming that, beyond any offset or other requirements, significantly lower costs make them attractive. For example, McDonnell Douglas projected that it would be able to reduce the cost of the proposed Taiwan Aerospace coproduced MD-12 by some 30%, strictly on the basis of much lower labor rates. The China-produced MD-80s were 10% to 15% less expensive even though they still had significant U.S. content and were produced at the beginning of the learning curve. (The emerging low-wage Asian aerospace nations are discussed at greater length starting on page 6 1.)

The Virtual Manufacturers

By early 1994, Gary Reich, a top aerospace analyst working for Prudential Securities; had become a strong partisan of Boeing's stock. Looking beyond the devastating reduction in aircraft orders and deliveries caused by a deep global recession and enormous worldwide airline losses, Reich foresaw a significant rise in new aircraft orders-powered both by increased (and finally profitable) passenger traffic and by widespread governmental requirements to meet heightened noise and airworthiness standards.

The key to Boeing's future profitability, as Reich saw it, was the fact that the company "is moving rapidly toward assembling an aircraft and away from being a manufacturer. Many components including the airframe are now being outsourced." Boeing's restructuring, Reich wrote in a January 1994 stock report, will particularly benefit company shareholders since this "departure from traditional manufacturing will enable the company to increase its profit margins."

"[Boeing] is moving rapidly toward assembling an aircraft and away from being a manufacturer. "

While acknowledging that precise forecasts are impossible when new orders have yet to materialize, Reich argued that "we do know that the future cycles should be far more profitable to Boeing than they have been in the past." Why was Reich so secure in this belief? Projecting that by year-end 1994 Boeing will have cut almost 50,000 employees from its 1990 peak of 162,000, Reich wrote that "as a result of Boeing's shift away from manufacturing, many of those laid-off will not be rehired. The shift from production to outsourcing will allow the company to downsize its workforce. This bodes well for future earnings growth at the company and should help Boeing increase profit margins" (Reich 1994a, 1, 4, 6, 23).

The Prudential Securities' analyst did not mention that laid-off Boeing workers have little hope of finding employment at the subcontractors to which their work had been outsourced. Seattle and Wichita jobs will now be located in Xian, China (where the 737 rear fuselage and tail sections will be fabricated), or in the Kagamigahara district in Japan's Gifu prefecture (where "new factories are springing up" as suppliers anticipate "large increases in 777 subcontracting"). Richard J. Samuels noted that "while K'agamigahara is flooded with investment for an expected surge in 777 orders, Puget Sound subcontractors have seen their work cut back so severely that many took the unprecedented step of confronting Boeing publicly" (Samuels 1994; 303-304).[13]

Boeing's shift to outsourcing is reflected in recent changes'in the relationship between total company sales and compensation costs. In 1988, sal-

aries and wages represented 32% of sales, but by 1992 this ratio had fallen below 21% (Boeing 1993, 55).[14] It is clear that Boeing-and other American manufacturers-believe that they will become more profitable through downsizing and outsourcing. After an accounting-related dip in 1992, aerospace industry profits have rebounded sharply and reached record levels in 1994 even as sales, orders, and employment continued their "downward spiral" *(Aviation Week & Space Technology* January 9, 1995, 26). It is worth noting that some of the profit recovery was due to reduced research and development outlays, as well as capital expenditures, which were at their lowest levels in real terms since 1977 (Fuqua 1994; Aerospace Industries Association 1994a, Table X). However, the benefits of these profits to the economy as a whole may well be offset by the contraction of the U.S. industrial base and its ability to generate jobs, income, and rising standards of living.[15]

Boeing is the industry leader in cost reduction and in making its suppliers absorb increasing levels of risk and cost.

In many *ways,* Boeing is the industry leader in cost reduction and in making its suppliers absorb ever-increasing levels of risk and cost. "Boeing is already the lowest cost/most efficient producer of jetliners in the Western world," notes First Boston aerospace analyst Peter Aseritis (Aseritis 1994, 20). The company has an announced goal of reducing production costs by a full 25%, and this is having a major impact on suppliers (and Boeing's choice of suppliers). Historically, about 50% of Boeing's manufacturing costs were accounted for by "bought-in" components and materials. Moreover, a British aerospace analyst noted:

> It has been apparent for some time that Boeing is re-visiting its "make or buy" policy. Traditionally, it has designed and manufactured components in-house -often giving contracts to external suppliers on a low margin "build to print" basis. Now, it is looking not only to place manufacturing orders externally but also to devolve research, development and design capability (S.G. Warburg Securities 1994, 1).[16]

For example, international suppliers of structural components for the Boeing 777 include Italy's Alenia (wing outboard flaps and the radome), Aerospace Technologies (the rudder) and Hawker de Havilland (elevators) of Australia, the three Japanese "heavies"-Mitsubishi, Kawasaki, and Fuji Heavy industries-(including the entire fuselage except the nose section, doors, the wing box, and wing ribs), a Korean Air subsidiary (flap support fairings), and Menasco Aerospace of Canada (landing gear). In addition, the U.K.'s Dowty Aerospace will provide the thrust reverser actuator system,

and Japan's Teijin Seiki will furnish the primary flight control actuators and actuator control electronics ***(Aviation Week & Space Technology*** June 3, 1991).

Often, it is difficult to determine where an offset or content requirement ends and a U.S. company's own strategy begins. Another recent trend is for U.S. manufacturers to enter into joint ventures with foreign partners, with the U.S. partner supplying expertise in design, technology, and marketing, while the foreign partner supplies a low-cost workforce and access to local markets. It would seem that US. aerospace companies are becoming "virtual corporations," with little or no manufacturing component required.

McDonnell Douglas will apparently perform no assembly and little or no manufacturing for its new 100 seat MD-95.

The combination of rapidly increasing global competition and pressures from the capital markets have led many aerospace companies to evolve strategies that call into question their commitment to permit their own employees to work on future products. The most stark example of this to emerge to date is McDonnell Douglas's recently announced plans for production of the new 100 seat MD-95, for which the company will apparently perform no assembly and little or no manufacturing.

McDonnell Douglas is projected to have a strong positive cash flow over the next few years, over $500 million in 1995 alone. This has led many on Wall Street to call for much higher dividends or a stock buyback program and to oppose any new commercial aircraft initiatives that would require significant new investments by the company (Shapiro 1994a, 1).

When, in July 1994, McDonnell Douglas announced its intention to launch the MD-95, many investors reacted negatively. In fact, Salomon Brothers almost immediately downgraded the company's stock (from a "buy" to a "hold" recommendation). "We downgraded McDonnell Douglas stock based on the board's approval" of the new aircraft, Salomon told its clients. "Although orders must be received before a formal commitment is made, the company's intent to develop a new plane will be seen as a negative by the market," the investment house continued. "The board's approval raises concern about McDonnell's intent to return money to shareholders via either an increased dividend or a major share buyback program," Salomon said that if a formal commitment to production was made it would lower its future earnings estimate for the company by 10% (Shapiro 1994b, 1).

After a meeting with McDonnell Douglas management a few weeks later, however, another investment house, Merrill Lynch, told its clients that the MD-95 "poses little risk for shareholders." The company called the meeting to respond to investor and analyst fears that it was preparing to take on

an undue "amount of risk associated with the MD-95 and that the company was more interested in spending cash on supposedly dubious development projects, instead of moving to enhance shareholder value." Investors have little to fear, Merrill Lynch said, because McDonnell Douglas "is aiming to subcontract up to 80% of the aircraft. Risk sharing with suppliers is to be heavily emphasized and the cost of development to [McDonnell Douglas] is less than $200 million" spread out over four years. Moreover, the investment house said, a final commitment to the program would depend on a weighing of its return against a share repurchase program and "would not impinge on the company's ability to use excess annual cash flow . . . to enhance shareholder value" (Merrill Lynch 1994b, 2).

The MD-95 would require McDonnell Douglas to transfer important technologies to its Asian and European partners.

In the fall of 1994, in the face of ongoing investor demands for "enhanced shareholder value," McDonnell Douglas announced a three-for-one stock split, a 7 1% increase in dividends, and a plan to repurchase up to 15% of its outstanding stock (*Wall* Street ***Journal*** October 3 1, 1994, B4). Shortly thereafter, with shareholders mollified, the company formally announced its lineup of MD-95 "risk-sharing" partners and subcontractors.[17] Total development cost of the MD-95 is projected to be about $1 billion (half of which involves the design of a new engine), and McDonnell Douglas expects to save "substantially greater" than 25% of its own normal costs by shifting development to subcontractors. In addition, it projects 15% to 20% cost savings on final assembly through its deal with Dalfort (*Wall* ***Street Journal*** November 8, 1994, B2; *Wall* ***Street Journal*** November 9, 1994, A4, ***Aviation Week & Space Technology*** November 14, 1994, 29).

It is unclear what, if any, work McDonnell Douglas plans to retain for its own employees (other than design, integration oversight, and marketing), but at least one analyst reported that the company's plans to outsource 80% of the work still assumed that it would "focus on the aircraft final assembly" (Friedman et al. 1994b, 1).

If it actually goes into production, the MD-95 would be truly a "world aircraft" and would require McDonnell Douglas to transfer important technologies to its Asian and European manufacturing partners. According to an aerospace trade publication, this would simply represent a continuation of the company's "technical transfer policy," which is designed to foster market access, as most obviously demonstrated by the coproduction of the MD-80 in China. ***Aviation Week & Space Technology*** reported that McDonnell Douglas recognizes that its past subcontracting arrangements "each represented significant technology transfer to the host nation when first implemented." How-

ever, the publication reported, the "company even would be willing to consider transfer of a unique or proprietary transport-making technology if it improves market access and the prospective supplier meets quality and cost standards" (*Aviation Week & Space Technology* November 7, 1994, 52).

Military Offsets Drive Technology Transfer and Job Loss

When American companies -with US. government encouragement or acquiescence-enter into coproduction, licensed production, and major component offset agreements, they are irretrievably transferring military technology and production know-how to another country. As the Federation of American Scientists has pointed out, such technology and know-how can be useful not only in manufacturing conventional weapons, but much of what is transferred could be applied to the development of long-range missiles and other weapons of mass destruction (Federation of American Scientists 1994).

Coproduction and licensed production deals are routinely entered into with the support of the US. government.

While it has become fashionable to scoff at the notion of dual-use technologies, the Japanese have no such doubts-already having successfully applied defense-derived technologies supplied by U.S. providers (on such programs as the F-15, F104, and F86 fighters) to civil aerospace and completely non-aircraft applications. They have also successfully applied civil technologies to advanced military and aerospace programs in Japan.

Coproduction and licensed production deals are almost routinely entered into with the active support of the U.S. government, often using U.S. taxpayer funds to help finance the transactions, yet they deprive American workers of jobs and create long-term competitors for U.S. companies. For example, several years ago Turkey agreed to purchase General Dynamics (now Lockheed) F-16s. Of the $4.3 billion purchase price, $3.2 billion was provided to Turkey by the United States in the form of "foreign military financing" (FMF) grants and loans. But Turkey demanded a coproduction agreement for these aircraft, worth $760 million in parts, components, and assembly work. The Turkish F- 16 plant is now selling F- 16s to the Egyptian military. Of course, Egypt is also using U.S. FMF funds to purchase these aircraft, all with the U.S. government's blessing.

In June 1992, at the then-General Dynamics F-16 plant in Fort Worth, members of the International Association of Machinists (IAM) and Aerospace Workers Union protested a General Dynamics F-l 6 coproduction deal with South Korea. This deal provided for South Korea to purchase a total of 120 aircraft, of which 72 would be manufactured and assembled in South

Korea, 36 would be assembled from kits in South Korea, and only 12 would actually be made by General Dynamics' workers in Fort Worth. According to IAM President George Kourpias, "While 3,000 IAM members at this facility were on lay-off, GD wanted to bring at least 500 South Koreans into the plant and train them in F-16 production techniques. The protest put a stop to this scheme . . . we thought. But then we learned that General Dynamics simply arranged for these Samsung Aerospace workers [from Korea] to be trained at the F- 16 plant in Turkey !"[18]

The U.S. policy of permitting offsets is "unique in the world."

These are not isolated occurrences. As far back as the 1970s, the U.S. government and American aerospace companies have seeded new competitors. U.S. government policy encourages defense *and* aerospace technology transfers to U.S. allies and major trading partners. During the Carter administration, defense firms were basically required to share technologies with many allies, especially Japan.

In the wake of the Second World War and as the Cold War increasingly dominated U.S. foreign and military policy, the Defense and State Departments evolved strategies to strengthen key allies' military and industrial capabilities through licensed or coproduction arrangements. Often, these transactions explicitly contemplated significant work-share and technology transfers. Many were at least partially funded with FMF grants and loans from the US. Department of Defense (DOD). Allies were often permitted, even encouraged, to use the leverage of their purchasing power (including that obtained from DOD funds) to require U.S. military contractors to enter into offset agreements.

According to a June 1994 U.S. General Accounting Office (GAO) report, four countries (Israel, Egypt, Greece, and Turkey) have recently "been allowed to use FMF grants and loans to obtain billions of dollars in offset obligations." Specifically, the GAO reported that the "largest offset obligations included agreements to allow the FMF recipient to produce parts of the weapon system it purchased [and] agreements for the U.S. contractor to buy parts from the recipient . . . ." According to the GAO, the result of these offset requirements (most of which were aerospace related) was a loss of "production work for U.S. prime contractors and subcontractors." The US. policy of permitting beneficiaries of military financing to require offsets at the same time, the GAO noted, was "unique in the world. No other arms supplier has a program that provides a combination of grant aid and allows offsets." The GAO noted that its "review indicates that offsets can also result in displacement of U.S. subcontractors and create new competitors for U.S. companies

in the world market" (General Accounting Office 1994b, 3).

More broadly, the licensing and coproduction of U.S.-designed military aircraft has helped seed competitors in both the military and commercial aerospace industries. Nowhere is this more the case than in Japan. Since the Korean War, the U.S. has encouraged Japan to manufacture a wide range of U.S.-designed military aircraft, engines, and components, including the F-86, F-104, T-33, P2V-7, F-4EJ, F-15, and F-16 (as embodied in the FS-X). While no longer funded with foreign military financing, Japan's explicit policy was to require ever-increasing local content in these aircraft as well as their components. For example, when the Lockheed F-104 fighter was selected for purchase and coproduction in the 1960s, the plan was for Japan to purchase three completed aircraft, to receive 17 "knockdown kits" to enable Mitsubishi to gain experience with assembly of the fighters, and then to coproduce 160 of the aircraft (including their General Electric designed and licensed J-79 engine). The Japanese government placed a high priority on "indigenization" of as much of the aircraft as possible, and, accordingly, allocated fully 60% of the original budget (not including engines) for this purpose. By the end of its run, the Japanese-manufactured F-104 had 70% local content, including almost 60% for the engines (Samuels 1994, 216-217).

The U.S. has encouraged Japan to manufacture a wide range of U.S.-designed military aircraft, engines, and components.

Richard J. Samuels explains this strategy as follows:

> For less than $300 million, a trivial amount in aerospace even then, Japanese industry derived enormous benefits. The arrangement between Mitsubishi and Lockheed typically receives most attention, but as in every other licensed aircraft there was a considerable transfer of technology at the vendor level as well . . . . Tie-ups between Garrett and Shimadzu for electronic actuators, between Cleveland Pneumatic and Sumitomo Precision for landing gears, and between Bendix and Shinko Electric for voltage regulators were only the start. These and numerous other subcontractor licenses brought Japan's machinery industry technology to benefit their commercial activities. (Samuels 1994,217)

Ishikawajima Heavy Industries, which "indigenized" the GE J-79. engine for the fighter, now has multiple partnership alliances with each of the world's three major jet engine manufacturers (GE, Pratt &Whitney, and Rolls Royce) (Samuels 1994,257).

Examples abound of the consequences of initial military aircraft technology transfers. As a 1983 Washington *Post* article pointed out, the agree-

ment to permit Mitsubishi to coproduce the F-15 fighter had profound implications: Japanese officials "readily acknowledge using U.S. military co-production deals to help thrust Japan into the big leagues of the global commercial aircraft industry, which has 'significant technological influences on other industries' as one Japanese government report noted." *(Washington Post,* May 4, 1983, Al)

Mitsubishi used this acquired know-how to launch its participation in the manufacture of important components for commercial as well as military aircraft, such as the final assembly of the F- 15 and the new FS-X fighter (adapted from the General Dynamics, now Lockheed, F-16). In addition, it manufactures fuselage and other sections for the Boeing 767 and 777, and it fabricates a range of advanced composite structures for the 777, the MD-80, the FS-X, and the F- 15.

There is growing evidence that U.S. component manufacturers are being replaced by Japanese suppliers who were beneficiaries of previous technology transfers.

Today, the same Japanese companies that gained access to US. aerospace technology with the F-15 deal are manufacturing important components of the Boeing 767 and are producing about 21% of the new Boeing 777. Moreover, they have used this technological jump-start to develop dozens of new processes and technologies that the United States now has to beg Japan to license back to American companies.

Moreover, there is growing evidence that U.S. component manufacturers are being replaced by Japanese and other suppliers who were beneficiaries of previous technology transfers mandated by the government or military. The General Accounting Office noted that:

> a Japanese firm that received technical and manufacturing assistance from a US. firm to produce F- 15 actuators, won the contract for the actuators on the Boeing 777 over a U.S. firm that previously supplied the component for Boeing aircraft. (General Accounting Office 1994c, 12)

Jobs on the Wing: Past and Future Declines in U.S. Aerospace Employment

In July 1994, the U.S. Department of Labor released a study, performed by DRI/McGraw-Hill and the Teal Group, that attempted to quantify the opportunities for and threats to "high-skill, high-wage" employment in the U.S. civil aviation industry-including airlines and airline services, aircraft maintenance, and aircraft manufacturing (DRI/McGraw Hill 1994). The study focused on the manufacturing sector because, of the 600,000 jobs identified in the aircraft manufacturing sector as of 1992, almost two-thirds were high-

skill, high-wage, and 20% were high-skill, high-wage production jobs. This sector, they argued, has the highest concentration of high-skill, high-wage jobs and is "the best bet for promoting additional jobs in the future" through government policies and actions.

The authors concluded that high-skill, high-wage aircraft production employment is being "negatively impacted by the growing use of foreign subcontracts work."

> These are the jobs that the airframe manufacturers are most likely to negotiate away in order to reduce costs, spread risks, and secure aircraft sales to foreign national carriers. The engineering, design, electronics, airframe integration and sophisticated systems work is kept primarily in the United States, while the high-skill, high-wage production work, as represented by the six pockets [identified in the study as those most likely to benefit from government actions], is increasingly under threat of foreign competition. (DRI/McGraw Hill 1994, 25)

Aircraft production employment is unlikely to recover in the future.

While Airbus has gained significant market share over the past two decades, the study notes, "this is only half the story. The percentage of each U.S. aircraft built abroad is also rising." The authors identified the manufacturers' traditional subcontractors as the primary victims of this trend, which they blamed in significant measure on the growth of offset requirements.

The report notes that offsets "have become such an accepted part of the business of selling planes abroad that they are often negotiated before the sale is made. Prime contractors offer work shares to potential customers in. the target markets, a practice which can be called preemptive offset." Moreover, the study's authors write:

> an examination of employment figures in previous downward business cycles reveals that the average level of non-military aircraft manufacturing has not kept pace with the considerable growth of the market. Part of the problem is the internationalization of aircraft manufacturing. Work has moved offshore as the result of efforts to move some production work to low-cost areas abroad and the need to offer offsets. (DRI/McGraw Hill 1994, 10- 11)

The DRI/McGraw-Hill study examined the impact of globalization on U.S. aerospace employment.[19] The analysis demonstrates aircraft production employment (in both commercial and military aircraft manufacturing) is unlikely to recover in the future. As can be seen in **Table 9,** this report

TABLE 9
DRI-McGraw-Hill Analysis of Factors Leading to Reduced Aircraft Industry Employment, 1994-2000
(in Thousands)

	Forecast Employment Levels			Reduction in Employment Due to:		
	Status Quo	Most Likely	Total Reduction	Reduced Defense	Foreign Competiton	Commercial Downturn
1994	561	484	77	15	23	40
1995	574	465	109	25	28	56
1996	567	456	111	38	19	54
1997	550	463	87	45	24	18
1998	563	449	114	48	62	4
1999	562	452	110	46	69	(5)
2000	554	464	90	41	61	(12)
Annual Average	562	462	100	37	41	22

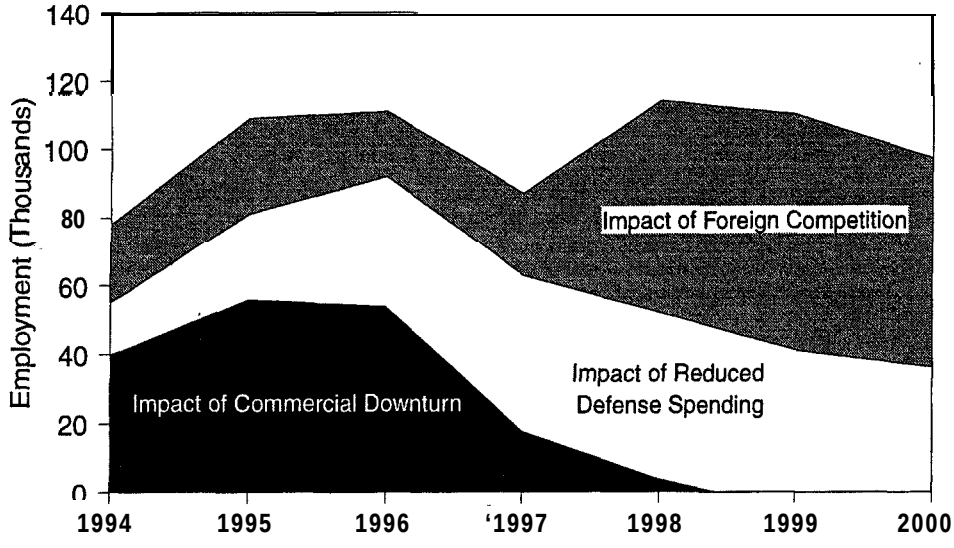
Note: "Status Quo" assumes defense and commercial production stabilize at 1993 levels, and U.S. commercial transport manufacturers maintain 1993 market share.

Source: DRI/McGraw-Hill (1994, 34).

projects that an additional 100,000 aircraft industry jobs will be lost between 1994 and 2000. The study assumes that by the year 2000, the impact of the current commercial aircraft downturn will be eliminated (and that, in fact, about 12,000 new jobs will be created by a commercial upswing). On the other hand, DRI predicts that 41,000 jobs will be lost because of continued defense procurement reductions. More critically, 61,000 jobs will be eliminated in commercial aircraft manufacturing due to foreign competition. Through 1996 the commercial downturn is responsible for the majority of jobs lost in aerospace, as shown in **Figure 10.** After 1998, foreign competition is the largest source of predicted job loss.

According to the authors, the projections for the impact of foreign competition are based on historic trends plus an assumption that McDonnell Douglas's market share will continue to shrink. The report concludes that the aircraft manufacturing industry "will continue to become more global, but efforts to enhance competitiveness can reduce the amount of U.S.-based manufacturing work that is moving offshore and potentially recapture jobs already transferred to foreign operations."

FIGURE 10
DRI/McGraw-Hill Analysis of Factors Leading to Reduced Aircraft Industry Employment, 1994-2000

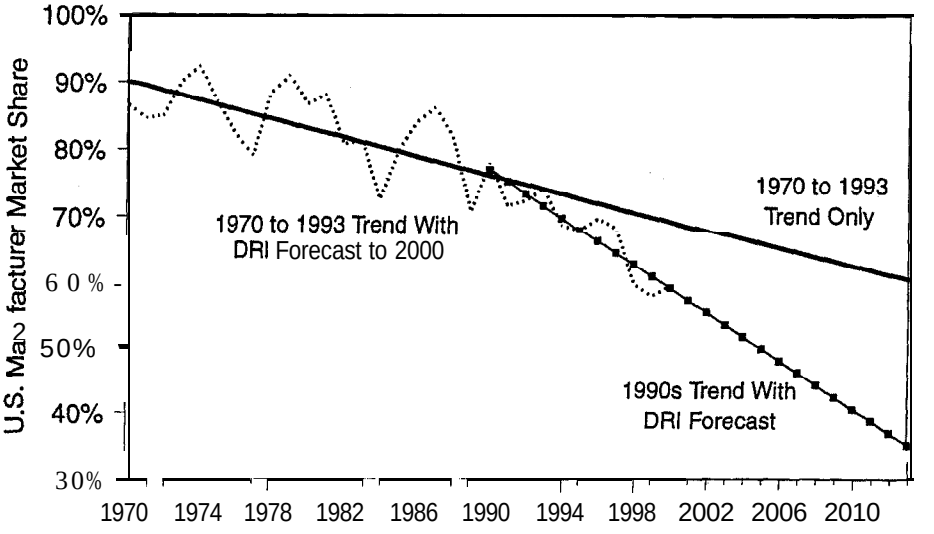


Source: DRI/McGraw-Hill (1994, 34).

A grim picture for the future of hundreds of thousands of aerospace-related jobs begins to emerge when the DRI forecast is combined with historic data and projected into the next century. As can be seen in **Figure 11,** the market share of U.S. manufacturers has been steadily declining since the 1970s. Indeed, a trend line using only historic data results in a predicted U.S. commercial jet aircraft market share of around 60% by 2013, down about 10% from the early 1990s. However, the U.S. share declined in the 1990s more rapidly than in earlier periods. Combining the results of the early 1990s with DRI's projections through the end of the decade results in a predicted US. market share of about 40% in 2010 and only 35% in 2013. Using the trend from 1970 to 1993 with the DRI forecast through 2000 yields a predicted U.S. market share of about 53% by 2013. It is important to note that these projections do not take into account any new competitors that may enter the market.

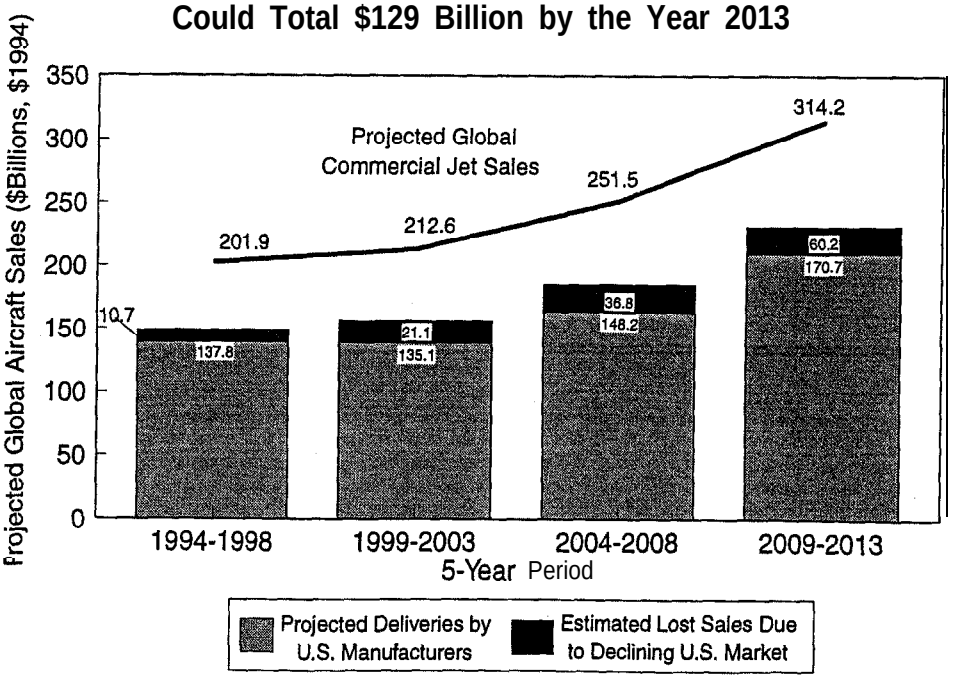
Taking the mid-range forecast 1970 to 1993 trend and the DRI forecast to 2000 (projected through 2013) and applying it to Boeing's projections for commercial aircraft sales produces an estimate of revenue losses for U.S. manufacturers resulting from declining market shares **(Figure 12).** The av-

FIGURE 11
Historic and Projected U.S. Manufacturer Market Share, Commercial Jet Transport Revenues, 1970-2013



Source: DRI/McGraw-Hill data supporting chart in DRI/McGraw-Hill (1994, 9 and 11).

FIGURE 12
Lost Commercial Jet Aircraft Sales Could Total $129 Billion by the Year 2013



Source: Calculations based on Boeing *Commercial Market Outlook* (1994) for projected commercial jet aircraft deliveries and values, 1994-2013, which project 14,054 global jet aircraft deliveries valued at $980 billion (1994 dollars); and DRI/McGraw-Hill (1994) for market share trends comparing five-year (1989-93) historic average with DRI's 1970-2000 historic/forecast trend line carried to 2013.

erage U.S. share of commercial jet transport revenues worldwide (excluding only China and the former USSR) was 73.5% between 1989 and 1993. If domestic producers maintained this market share, they would sell an estimated $129 billion more in aircraft than the forecast indicates.

These lost revenues translate into almost 240,000 direct and indirect jobs lost by the year 2013 **(Table 10).** While commercial aircraft manufacturing will still provide over 600,000 jobs during the second decade of the next

TABLE 10
'Estimate of Potential Job Losses Attributable to Declining U.S. Market Share in Commercial Jet Aircraft Sales, 1994-2013

	Average Annual Job Loss		
	Total Jobs	Direct Jobs	Indirect Jobs
1994-l 998	42,462	14,570	27,892
1999-2003	83,734	28,732	55,002
2004-2008	145,245	49,838	95,407
2009-2013	238,900	81,974	156,926

Sources: Data derived from DRI/McGraw Hill (1994, 9 and 11); Boeing (1994, Appendix C); and Steinbruner and Nation (1994, Table 5).

Note: U.S. market share trend line derived from historic data (1970-1993) combined with DRI/McGraw Hill market share projections (1994-2000) and extrapolated to 2013. Estimated lost commercial jet aircraft sales derived from difference between 1989-1993 average U.S. revenue market share (73.5%) and the projected market share described above, using Boeing forecasts for constant 1994 dollar global revenues through 2013. Estimated job losses derived from Bureau of Labor Statistics data (as reported in Steinbruner and Nation) on jobs supported by final demand for aircraft, expressed in 1987 dollars for the year 1990: these data project 24,632 total jobs (8,452 direct and 16,180 indirect) were supported in 1990 by each $1 million (1987) in final demand for aircraft. Comparable figures for constant 1994 dollars would be 19,842 jobs per $1 million in final demand (6,808 direct and 13,034 indirect). These figures were then multiplied by projected lost revenues to produce estimated lost jobs.

MEMO:

Projected Lost Revenues ($Billions)

5-Year Period	Total Lost	Average Annual
1994-l 998	$10.7	$2.1
1999-2003	21.1	4.2
2004-2008	36.6	7.3
2009-2013	60.2	12.0

Jobs Supported Per $1 Billion ($1994) in Final Demand for Aircraft.

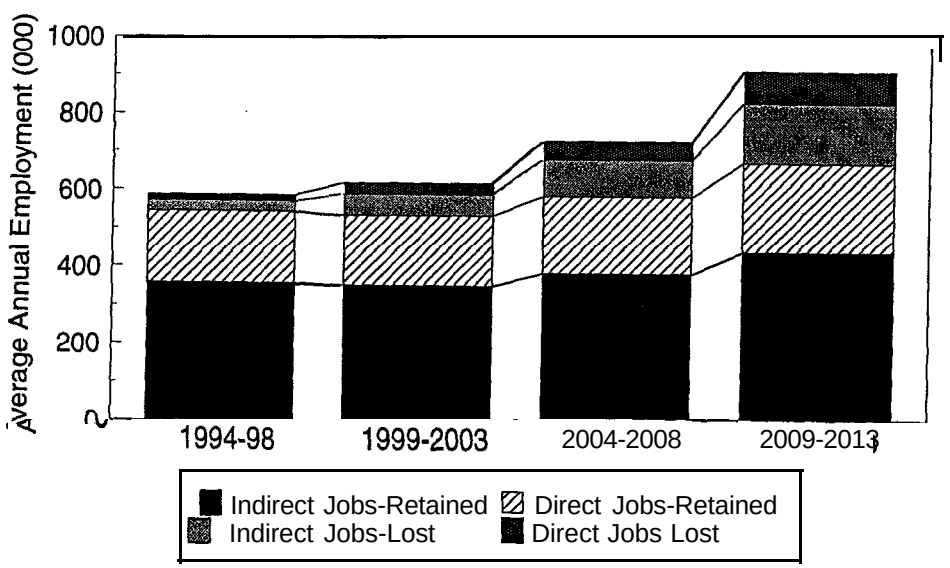
Total	19,842
Direct	6,808
Indirect	13,034

century **(Figure 13)**, a significant number will be lost to international competition.

It is important to note that these projections do not take into consideration any new entrant aircraft competitors, nor do they attempt to quantify job losses from increased reliance on imported parts and components. Employment-level projections assume that the domestic content of U.S. commercial jet aircraft is unchanged from 1990 (Steinbrunner and Nation). Clearly offsets and outsourcing could dramatically increase U.S. employment loses in the aerospace industries over the next two decades.

The impact of outsourcing and increases in parts imports can be estimated using an analysis of import trends. As shown in Table 2 (p. 10), the import share of U.S. aerospace production has been increasing steadily since

FIGURE 13
Projected Levels of Employment in Commercial Aircraft Manufacturing Compared to Projected Job Losses Due to Declining U.S. Market Share



	1994-1998	1999-2003	2004-2008	2009-2013
Indirect Jobs- Retained	357,384	352,171	386,319	444,971
Direct Jobs-Retained	186,688	183,965	201,803	232,441
Indirect Jobs-Lost	27,892	55,002	95,407	156,926
Direct Jobs-Lost	14,570	28,732	49,838	81,974

Source: Data derived from DRI/McGraw-Hill (1994, 9,11); Boeing (1994, Appendix C); and Steinbruner and Nation (1994, Table 5).

1979. Between 1984 and 1994, the import share of the domestic market increased on average of 0.5 percentage points per year.[20] If imports continue to capture market share at this rate, then by 2000 imports will equal 14.4% of domestic aerospace revenues (an increase of 3.0 percentage points over the 1994 import share). By the year 2013, the import share could increase to 20.9% of domestic revenues (an increase of 9.5 percentage points over 1994).

Thus outsourcing could reduce domestic employment in aerospace production by an additional 3.0% in 2000 and by 9.5% in 2013, assuming a constant ratio of employment to output. Using estimated 1994 employment of 836,000 workers (Table 3, above) as a base, increased imports could result in the elimination of 25,000 aerospace jobs in 2000 and 79,400 jobs in 2013. These losses are on top of those associated with lost export market shares, which are the primary causes of job loss in the DRI forecast discussed above (Tables 9 and 10).

Up to 250,000 jobs are at risk In ***aerospace and related industries in the year 2000, and up to 469,000 in 2013.***

In conclusion, relative to employment levels in 1994, between 61,000 and 86,000 aerospace jobs will be lost because of increased imports and foreign competition in 2000, if present trends continue, based on the analysis in Table 9 (increased foreign competition) and outsourcing of parts and components. [21] By 2013, aerospace job losses could reach 82,000 to 16 1,000, or 9.8% to 19.3% of total industry employment in 1994.[22]

Table 10 also shows that approximately 1.91 indirect jobs are created for each job created (or lost) in the aerospace industry. Therefore, an additional 164,000 indirect jobs could be eliminated by 2000, and 308,000 indirect jobs could be eliminated by 2013, if present trends in foreign competition and outsourcing continue into the future.[23] Thus, up to 250,000 jobs are at risk in aerospace and related industries in the year 2000, and up to 469,000 jobs could be eliminated in 20 13. Most of these positions are in manufacturing or closely related high-skill, high-wage service industries. Foreign competition in aerospace products, especially commercial aircraft and parts, could significantly impact the total level of high-skill, high-wage manufacturing jobs in the U.S. in the next two decades.

FOREIGN GOVERNMENTS TARGET AEROSPACE TECHNOLOGIES AND JOBS

The U.S. aerospace industry faces competition from nations that have staked their claim to promoting aerospace leadership and jobs. China, Japan, Indonesia, Russia, South Korea, Taiwan, as well as the Airbus consortium nations have developed strategies to maintain or enhance their role in the future of this industry. However, despite its widely recognized importance to the U.S. economy, the United States lags behind these countries in its support.

China, Japan, Indonesia, Russia, South Korea, Taiwan, as well as the Airbus consortium nations have strategies to maintain or enhance their role in this industry.

A 1985 National Research Council study of US. competitiveness and the civil aviation manufacturing industry framed the issue this way:

> The technologies that underlie the US. leadership in aircraft manufacture play a critical role in the total constellation of our technological leadership. These technologies include not only the more obvious ones that affect aircraft performance.. .but also system integration in the design and manufacture of complex, high performance equipment; project management to meet demanding targets for performance, cost, and delivery; sophisticated manufacturing techniques for fabrication, testing, and assembly; and computer integrated manufacture, factory automation and large-scale information processing. Strength in these technologies diffuses throughout industry and contributes substantially to the overall strength and competitiveness of the U.S. economy. (Eberstadt 1991, at 9 citing National Research Council 1985, 23-24)

The DRI/McGraw-Hill report prepared for the Department of Labor put the issue in a slightly different context. Noting that the Clinton administration had identified aviation as a "strategically crucial industry for America's future," the report argued that the "industry is important because of the number of people it employs, the amount of income it generates, the value of goods and services it exports, the advanced technology it develops and deploys, and the role it plays in projecting U.S. leadership in the global economy."

In some ways, the worldwide phenomenon of nurturing the aerospace industry resembles previous efforts by developed and developing nations alike to grow or protect their steel and shipbuilding industries. The increasing overcapacity in the aerospace industry is likely to exacerbate aerospace employment problems in the United States as manufacturers are forced to

compete for export sales in a buyer's market. The existence of many potential contractor/competitors with strong government backing will certainly accelerate aerospace job losses in the United States.

Airbus Industrie: U. S. Aircraft Manufacturers' Main Competitor

Despite U.S. manufacturers' initial ridicule of the notion that a multination consortium could design, market, and manufacture state-of-the-art aircraft, Airbus has introduced significant new commercial technologies (fly-by-wire, composite applications, the super-critical wing). It also achieved a multiyear lead on Boeing in two key market segments (represented by the A320/321/319 narrow-body and A330/340 wide-body product lines) that Boeing hopes to fill with the 737-X and the 777.

Between 1970 and 1990, Airbus had received government aid in the form of grants and soft loans totaling about $26 billion.

Airbus is organized under a unique French law permitting its establishment "Groupement d'Interet Economique" (grouping of economic interest)—a French business consortium that is allowed to shield its financial records from the general public—with no operating capital of its own. In effect, it operates as a joint venture with all assets and liabilities flowing back to its partners (France's Aerospatiale[24] and Germany's Daimler-Benz Aerospace[25] are each 37.9% partners, the U.K. British Aerospace[26] is a 20% partner, and Spain's CASA[27] is a 4.2% partner).

Airbus manages the development, manufacture, and marketing of its A300-600, A310, A320/A321/A319, and A340/A330 series of aircraft on behalf of its four partner companies, but performs no manufacturing itself. In many ways, it is the very model of the "virtual" aerospace company.[28]

According to a 1990 study commissioned by the Department of Commerce, from its inception in 1970 through 1990 Airbus had received government aid in the form of grants and soft loans totaling about $26 billion, including unpaid interest **(see Table 11)** (Congressional Research Service 1992, 33; also see Gellman Research Associates 1990). While some repayments have been made, they are dwarfed in scale by the magnitude of the subsidies. Moreover, according to Gellman Research's calculations, the entire Airbus enterprise would not have been commercially viable. As of 1990, the net present value of projected cash flows on all Airbus aircraft programs was -$20.951 billion in 1990 dollars (see **Table 12**).

Because of its ready access to public assistance, Airbus has nonconventional private debt. Since it has no real stockholders, it is able to ignore conventional concerns such as return on equity. These "cost-of-capital" ad-

TABLE 11
Gellman Research's Calculation of Government Support of Airbus Aircraft Programs in France, West Germany, and the United Kingdom: Funds Committed Through 1989
(Millions of Current Dollars)

Funds Committed	France	Germany	United Kingdom	Total
Launch Aid Distributed as of 1989				
A300/310	$988.4	$1,489.5	$82.9	$2,560.8
A320	755.2	790.3	393.9	1,939.4
A330/340	193.0	316.1	421.2	930.3
All Aircraft	1,936.6	2,595.9	898.0	5430.5
Launch Aid to be Distributed Subsequent to 1989				
A330/340	$682.9	$1,264.5	$325.0	$2,272.4
Total Launch Aid	2,619.5	3,860.4	1,233.0	7,702.9
Other Support Disbursed as of 1989	1,035.3	924.2	883.9	2,843.4
Other Support to be Disbursed Subsequent to 1989	—	2,985.2	—	2,985.2
Total Support Committed	3,654.8	7,769.8	2,106.9	13,531.5
Repayments Through 1989	373.2	68.5	20.7	462.4
Net Support Committed	$3,281.6	$7,701.3	$2,086.2	$13,069.1
Net Support Committed at Government Opportunity Cost*	$6,463.5	$9,099.7	$3,804.4	$19,367.6
Net Support Committed at Private Borrowing Cost*	$9,961.2	$11,589.1	$3,979.8	$25,851.5

*Calculated by applying the cost of funds of the government and private sector borrowing rate in each country as appropriate to the net balance of funds committed each year to reflect the value of support as of 1989.

Source: "An Economic and Financial Review of Airbus Industrie," Gellman Research Associates (1990). Prepared for the U.S. Department of Commerce, International Trade Administration.

TABLE 12
Gellman Research's Calculation of the Commercial Viability of Airbus Aircraft Programs
(Millions of 1990 Dollars)

Program	Launch Date	Projected Units Delivered During Program Life	NPV of Cash Flow
A300	1968	246	($7,854)
A300-600	1977	319	($5,868)
A310	1977	334	
A320	1983	886	($3,528)
A321	1989	409	
A330	1987	831	($3,701)
A340	1987	427	
All Airbus Programs			($20,951)

Source: Gellman (1990); weighted average projected prices (expressed in 1990 dollars) for each aircraft were applied to projected units to be delivered over the program life and then each of the aircraft programs' cash flows was discounted using an average real commercial interest rate of 8.7% (which was derived by Gellman by weighting the commercial lending rates in France, Germany, and the United Kingdom by their respective shares in the aircraft programs).

vantages allow Airbus to operate at very low cost and to target its activities toward maximizing market share. Its debt is considered a "governmental" credit, and thus it is able to borrow at the lowest possible rate.

To finance its aircraft sales, Airbus recently formed the new Airbus Finance Company (AFC), which secured commitments for a $1.5 billion credit facility. Although it will initially rely on the underlying credit of the partners, Airbus says that it eventually hopes AFC will become a stand-alone finance arm (Airbus Press Release, *PR Newswire* December 13, 1994).

The sponsoring governments have always judged their Airbus investment by three standards: (1) employment creation, (2) technological leadership, and (3) national prestige. Wall Street, by contrast, is the sole U.S. judge rendering verdicts on profitability and yearly performance of U.S. aerospace

firms, which must maximize shareholder returns.

As a job creation program, Airbus has undoubtedly been successful. Because it keeps its pool of workers intact, Airbus is in a stronger position to expand production rapidly than are its U.S. competitors, and because the average Airbus worker has 10 years experience, it arguably faces fewer learning-curve costs as it undertakes new projects.

As a technology development program, Airbus has been similarly successful-by some objective standards, it has outperformed Boeing, which had already sold some 2,500 commercial jet aircraft when the first Airbus craft entered service in May 1974. The introduction of the F-16 type sidestick controller (in place of conventional sticks or yokes) has been an enormous success with pilots. Similarly, Airbus was the first manufacturer to introduce computer-driven fly-by-wire control systems on subsonic aircraft, and the first to install carbon fiber fins and tailplanes. It should be noted that Airbus openly acknowledges that much of its leading-edge technology was obtained "off the shelf' from publicly available NASA technical studies.

As a job creation program, Airbus has undoubtedly been successful.

For years, Airbus has publicly maintained that its long-term goal was to capture about one-third of the global commercial jet aircraft market, arguing that there was plenty of room for the "big three" plus at least one new Asian competitor. Recently, however, the European consortium announced that it intends to capture 50% or more of the worldwide market. This goal, says Airbus managing director Jean Pierson, "should be achieved by the end of the decade thanks to Airbus Industrie's new product line," which now offers an almost complete range of aircraft sizes and ranges (excluding only jets the size of the 747 and those with less than 120 seats) (Airbus Industrie of North America 1994, 1). Pierson says Airbus' 50% market share goal presupposes that McDonnell Douglas's share will "decrease to zero" *(Aviation Week & Space Technology,* January 23, 1995, 53).

Airbus seems to have weathered the deep commercial aerospace recession better than its competitors. While Boeing's 1994 output declined by 42% (measured by aircraft delivered) from its 1991 peak and McDonnell Douglas's declined by 75%, Airbus suffered a relatively minor 17% drop from its 1991 peak (Friedman 1994, 2). Moreover, Airbus's revenues have continued to rise even during the current commercial market downturn, thanks mainly to the introduction of the new A330 and A340, which are larger and more expensive than Airbus's previous offerings.

Airbus argues that the reason its production schedule has not declined as much as that of its U.S. competitors is that Airbus managed its schedule

more conservatively and that it has the four newest aircraft offerings on the market. Others argue that this is because Airbus enjoys the support of government-owned European airlines and because, as a jobs program, it is willing to sell aircraft at very low prices to maintain production. Indeed, a number of Airbus's largest and most dramatic orders over the past few years (i.e., those to United Air Lines and Air Canada) have been in the form of "walkaway leases," which permit a carrier to return the aircraft with virtually no notice or further obligation. Airbus is regularly accused of producing "white tails," aircraft with no prospective purchaser but which the group then sells quietly and at even cheaper prices once they come off the assembly line. An Airbus spokesman told the *Wall* Street *Journal* that it maintains a "more stable.production rate than Boeing, in part because of European laws assuring workers of steady employment" (*Wall Street Journal* February 3, 1995, A4)

Because Airbus enjoys the support of government-owned European airlines, it is willing to sell aircraft at very low prices to maintain production.

The 1992 U.S./EC civil aircraft bilateral agreement is a direct result of U.S. pressures on European governments regarding Airbus's massive subsidies. While this agreement is only prospective (not covering any of Airbus's current offerings), it does limit future subsidies to the development stage and prohibits subsidies for the actual production of aircraft.

The United States has been involved in a number of disputes with Airbus' partners over continuing subsidies, such as a $300 million "equity infusion" from the French government to Aerospatiale and the German government's late 1980s agreement to indemnify what is now Daimler-Benz Aerospace for possible currency losses up to a total of $2.6 billion (the company's predecessors were partially owned by the German government-along with two German states-and the currency guarantee was the price for Daimler-Benz's agreement to take them over). In addition, there are ongoing arguments about the "transparency" of Airbus's finances.

Interestingly, in the 1970s and 1980s, the U.S. government was prepared to take trade action against Airbus but U.S. manufacturers strongly objected, even though they were bearing the brunt of Airbus's competitive pressures. The U.S. manufacturers did not want any action taken because they were afraid of offending (and losing) European customers.[29]

Moving into the military cargo and troop transport market, Airbus has been tapped to coordinate the development of a new, all-European "future large aircraft" (FLA), which will be designed to replace the Lockheed C-130 and is projected to go into service around the year 2002. In this context, Airbus and its British Aerospace partner lobbied heavily against a British

government acquisition of 25 updated Lockheed C-130J Hercules military transports, arguing that the British should refurbish existing C-130s while Airbus and its partners continue work on the all-new FLA. British Aerospace, which manufactures the wings for all Airbus products, argued that its ability to participate in the FLA (and create some 7,500 jobs related to FLA wing manufacture) would be threatened by a U.K. selection of the updated Lockheed transport (*Wall Street Journal* November 22, 1994, A6; Insiders *Report,* 1). In December 1994, the British government announced that it would purchase the Lockheed aircraft for about $1.6 billion, but added that it would consider purchasing twice as many of the FLA aircraft once they go into production. As part of the package, Lockheed agreed to provide the United Kingdom with offsets worth 100% of the value of the transaction (*Wall Street Journal* December 19, 1994, B4).

There are suspicions within the U.S. government that Airbus continues to receive significant assistance from member nations.

Despite the U.S./EC aircraft subsidies agreement (described below) and the potential beneficial impact of some new GATT features, there are deep suspicions within the U.S. government that the Airbus continues to receive significant direct and indirect assistance from member nations,

Recently, Airbus has blanketed U.S. newspapers and magazines with ads touting the "800 companies in 40 states" manufacturing a "significant proportion of vital components" for Airbus aircraft. The ads call Airbus's claimed $5 billion in purchases from U.S. suppliers "a clear demonstration of the massive scale of our commitment to America." Airbus's 1977-93 revenues totaled $51.1 billion. The $5 billion Airbus says it has spent in the United States represents only 9.7% of its revenues, hardly a "significant proportion."[30] Moreover, by all accounts, Airbus's actual expenditures have dramatically exceeded its revenues-to-date, even though it now claims to be profitable (*Aviation Week & Space Technology,* January 23, 1994, 52).[31]

Despite all of the trade agreements in place, as a jobs and technology program Airbus clearly still enjoys strong support and may well be able to call upon European governments for additional support, particularly for the development of the superjumbo or second generation supersonic aircraft. Moreover, European nations are much more willing than the United States to subsidize the airline industry and are not precluded from providing additional subsidies to Airbus for its current line of aircraft.

In a new round of subsidies to money-losing European airlines last summer, the European Community approved $7.3 billion in grants broken down as follows: about $3.5 billion to Air France, $2.3 billion to Greece's Olympic Airways, $1.1 billion to Portugal's TAP, and $400 million to Ireland's

Aer Lingus. These injections represent 45% of total European airline industry losses over the past four years (Friedman et al. 1994c, 11). Stabilizing major European Community airlines also has the effect of bolstering the prime purchasers of Airbus products.

While many in the U.S. aerospace industry are concerned with the prospects of heightened competition from both Europe and Asia, Europeans are also worried about their ability to compete with the United States. Recently, the governments of seven countries formed the Association of European Research Establishments (AERA) to combat "the U.S. technology threat." AERA's membership will comprise the aeronautics agencies of the United Kingdom, Germany, France, the Netherlands, Spain, Sweden, and Italy. Its mission will be to pave the way for a coordinated European aerospace technology base and to help Europe compete with the United States, as well as with other emerging aerospace powers (***Aviation Week & Space Technology*** November 7, 1994, 24).

French and British aerospace have begun promoting intensified and coordinated research for a global supersonic transport.

NASA's decision to fund a new phase of research into commercial supersonic aircraft technology has heightened European fears that their aerospace companies will not be able to maintain their technological strengths (derived from production and operation of the Concorde) at sufficient levels to enable them to participate equally in any new "high speed commercial transport" that may be built. French and British aerospace have begun promoting an intensified and coordinated research agenda to ensure that Europe plays a major role in the launch of a global supersonic transport (***Aviation Week & Space Technology*** November 21, 1994, 62).

The Emergence of Other Global Aerospace Competitors

Beyond the steady growth of Airbus, a number of other competitors are entering the field: Russia, Japan, Greater China (including Taiwan, Hong Kong, South Korea, Singapore, and Indonesia), and possibly one or more of the Airbus partners on its own.[32] Looking beyond the turn of the century, it seems safe to predict that a group of Asian nations, with China providing the largest market and labor platform, will emerge with its own line of commercial aircraft. The combination of heavy government involvement in industry, booming economies, cheap labor, and a huge internalmarket would seem to make the evolution of a Greater China or Asian "Airbus" aerospace consortium a 2 1 st century reality.

The most significant competitive threats to U.S. commercial aerospace jobs can thus be viewed along a continuum in time: near-term (l-5 years),

Airbus is clearly the most important competitor; mid-term (5-10 years), Japan and Russia are likely to emerge as very effective competitors; and long-term (1 O-20 years), Greater China could become a very aggressive competitor.

The Aerospace Industry in the Commonwealth of Independent States

The future competitive impact of the massive-if massively inefficient—aerospace industry in the Commonwealth of Independent States (CIS) of the former Soviet Union is completely unknown. While some observers believe that most CIS and Eastern European aerospace firms will soon sink into oblivion, many others believe that, in time, they will become formidable competitors, able to draw upon a skilled, low-wage workforce and a huge internal market.

The former Soviet Union makes military airframes at least equal to the best manufactured by the United States.

The former Soviet Union makes military airframes at least equal in aerodynamic capabilities to the best manufactured by the United States. Also, it should be noted that CIS military and commercial aircraft and engines are produced on the same assembly lines. According to experts, while its commercial airframes are adequate-if spartan and heavy-its main weakness lies in the areas of engines and avionics. Finally, the very existence of these facilities means that a significant potential competitor is waiting in the wings.

Russia has aircraft ready to sell as soon as it can be provided with upgraded engines and avionics and receive certification from the U.S. Federal Aviation Administration and the European Joint Aviation Authority. Currently, its industry is in a deep depression: in 1980, Soviet aircraft manufacturers delivered 153 passengerjets; in 1990, they delivered 80; and in 1992, they delivered only eight (European Commission 1994, 77). Moreover, from 1975 to 1992 the airlines from the Russian Federation saw their share of global passenger traffic decline by half, from 18% to 9%, with a precipitous real drop in traffic of almost 27% from 1990 to 1992. Even so, the former Soviet Union still represents almost 10% of the world's airline traffic, a proportion that will increase substantially over the next decade.

By the late 1990s, it is likely that Russia will be actively (and successfully) marketing a broad range of commercial aircraft, especially to Third World and industrializing nations. A number of European and American companies are pursuing joint ventures with Russian manufacturers to bring their offerings up to international standards.

These joint ventures illustrate a contradiction for U.S. aerospace companies and subcontractors. Pratt &Whitney requested Ex-Im Bank funding for

U.S. engines to be exported to Russia's airframe manufacturer, Ilyushin. Both Boeing and McDonnell Douglas have opposed the financing, claiming competition in .a weak global market from the low-cost Russian aircraft will be damaging. Pratt &Whitney is also a Boeing and McDonnell Douglas subcontractor who, as a result of the engine exports to Russia, might lose US. market share, and therefore may end up with no net gain in business.

There are also joint ventures between U.S. companies and Russian design bureaus in commercial space projects. NPO Energia, the lead Russian contractor for national and international human spaceflight programs, worked with Rockwell Space Systems on the docking mechanism that allowed the Space Shuttle Atlantis to hook up with the Mir space station. Aerojet has signed its third agreement with Russian companies for engines that could be used to upgrade current U.S. launchers and applied to a new-generation booster (***Aviation Week & Space Technology*** October 3, 1994, 28).

In September 1994, Russian President Boris Yeltsin met with Boeing Chairman and Chief Executive Frank Shrontz to discuss potential partnerships. Boeing is hoping to sell planes and has established a technical research center in Moscow that is funding work for more than 100 Russian scientists and engineers and is using the Russian-built Tu-144 "Concordsky" supersonic plane in work it is doing on the U.S. High Speed Civil Transport program (***Reuter European Business Report*** September 28, 1994).

Japan has perfected policies to acquire industrial technologies from abroad and diffuse them throughout the economy.

Japan's Aerospace Industrial Policy

Following World War II and the end of the U.S. occupation in the early 1950s, Japan immediately began to revive its aerospace industrial policy. With the Ministry of International Trade and Industry (MITI) at the center, Japan has perfected policies to acquire industrial technologies from abroad, diffuse them throughout the economy, and take on competitors in one global market after the other. While Japan continues to pursue this strategy, the United States has yet to come to grips with the competitive implications of industrial targeting.

According to the General Accounting Office, MITI:

> continues to plan-and in some ways direct-the means by which Japan's largest aeronautics companies proceed in their development. MITI brokers agreements between those companies when they seek to build the same components for aircraft. MITI also arranges collective corporate agreements and favorable financial provisions that reduce the companies' financial risk. For example, the business plan for the Japan Research Development Corporation,

the consortium of Japanese aircraft companies that make parts for the Boeing 767 jet, states that the break-even point for the entire consortium shall be the point at which all of the members are profitable. In addition, some $350 million of Japanese companies' development costs on the Boeing 777 project are eligible for MITI support. MITI has also proposed a $750-million initial allocation in its 1994 budget request to the consortium for development of a jet engine to be used on their regional jet aircraft project. (General Accounting Office 1994c, 3-4)

Europeans do not enter into many licensed and coproduction deals.

In the 1950s, MITI was given jurisdiction over the industry and authorized to provide incentives, subsidies, and overall coordination to the industry. As it determines which new projects will be undertaken and which companies will perform the work, MITI has been able to ensure that the big four "heavy" industry manufacturers (Mitsubishi, Kawasaki, Ishikawajima-Harima, and Fuji) control virtually all prime aerospace contracts and together participate in each major program. It also insists that key technologies (whether internally derived or licensed from abroad) be shared among these companies. "By American standards, the stability of these partnerships and the extent of collaboration are extraordinary. Carefully orchestrated work-sharing, coordinated investment strategies, and managed competition among the leading firms-all backed by extensive state support-are prominent features of the [Japanese aerospace] industry" (Samuels and Whipple 1 989).[33]

One of the reasons Japanese manufacturers have been involved in so many licensed and coproduction deals with the United States is that Europeans do not enter into such agreements "on a scale even closely resembling that of the United States" (Shear 1994, 21). While academic observers are unanimous in their conclusions that U.S. government policy for the commercial aerospace industry has been "incidental" (Samuels 1994, 64), "indirect and unplanned" (Moran and Mowery 1992, 137), and "has occurred for almost every reason except promoting competitiveness" (Eberstadt 199 1, 14), it is clear that Japan has systematically evolved policies to capture an ever-expanding portion of the global aerospace market. MITI formally anointed aerospace as a "targeted industry" in its 1970s and 1980s "vision" pronouncements:

> The aircraft industry is a typical knowledge-intensive industry, characterized by high added value and far reaching technological spin-off. It will play an, important role in the national plan to remold Japan's industrial structure into an innovative knowledge-intensive type. . . . Development of aircraft engineering must be con-

> ducted on the initiative and assistance of the government as it involves highly sophisticated and complex technology. (Mowery and Rosenberg 1985, 16-17)

Realizing that, in part due to its forced hiatus from the aerospace industry for a decade following World War II, Japan was still far behind both the United States and Europe in aircraft design and integration skills, MITI and the Japanese aerospace industry emphasized two key strategies in the 1980s: involvement in international production partnerships and specialization in advanced component and subsystem technologies.

Boeing says it can no longer build an aircraft without the Japanese.

MITI's willingness to fund significant portions of a new project's development costs made Japanese companies quite attractive potential partners and gave them additional leverage in obtaining work-shares and access to leading-edge technologies. Japanese firms' unprecedented involvement in the Boeing 777 and the International Aero Engines V2500 engine are but two examples of how this strategy has succeeded.

There were other advantages to focusing on component manufacture. Because they have become a key supplier of critical subcomponents and assemblies, the major integrators have become so dependent on Japanese firms for certain work that Boeing says it can no longer build an aircraft without the Japanese. In addition, with the funds expended by the Japanese government in support of the big four "heavy" industry manufacturers' involvement in new aircraft and engine projects, they are able to avoid the huge risk and high overhead costs associated with full-scale design, manufacture, integration, and marketing of commercial jetliners. In effect, the Japanese big four are using their "partnering" with other manufacturers to master the dynamics of becoming a prime aircraft or engine manufacturer, so that they can draw on this in-house expertise when they go into full-scale production.

By incrementally expanding their involvement in the industry through component and subsystem manufacture, Japanese companies have emerged as major competitors: "As was the case in Apple computers, the Japanese did not mind the American label on the box, so long as 70% of the *components* were manufactured in Japan" (Shear 1994, 23).

"The structure of the Japanese aerospace industry offers producers a key advantage over Western competitors," Samuels and Whipple argue (1989, 42*ff*). Reflecting the fruition of MITI's long-term nurturing of the industry, combined with its newer emphasis on international partnering and component manufacture, they conclude that:

> the specific demands of the next generation of aircraft make virtues of the technological, organizational, and managerial characteristics of Japanese industry. Japan is on the leading edge of technology in advanced materials, microelectronics, and other relevant areas, an advantage that [MITI's civilian to military technology] spin-on strategy deliberately exploits. Organizationally, the close relationships that Japanese aerospace maintains with other industries will speed the assimilation of new technologies. Managerially, Japanese companies have 30 years of experience with interfirm cooperation, while it is a brave new world for their American counterparts. (Samuels and Whipple 1989, 42*ff*)

Japanese companies owe much of their involvement in commercial aircraft production to experience gained in licensed or co-production deals.

Japanese companies owe much of their involvement in commercial aircraft production to experience gained in licensed or coproduction deals. Shin Meiwa Industries won subcontracts from Boeing and Rohr Industries to produce various composite components on the 757 and 767 based on its previous military work (and will be one of the production "partners" in the proposed McDonnell Douglas MD-95). Toray Industries, now Boeing's biggest supplier of carbon fiber, is manufacturing key elements of the FS-X's composite wings, and Kawasaki Heavy Industries has a flexible manufacturing system that makes parts for the F- 15 and the Boeing 757 and 777 (Eberstadt 1991, 116-117).

The decision to permit Japan to produce the FS-X, a new, leading-edge technology fighter based on the General Dynamics F- 16, was a turning point in Japan's quest for premier status among the world's aerospace manufacturers. Even though Congress ultimately forced the Pentagon to withhold certain critical secrets relating to some components, the FS-X still involved unprecedented transfers of highly sensitive (and competitively useful) technology. And while U.S. suppliers did receive contracts for work on the aircraft, many of the F- 16's 4,500 subcontractors were cut out, because a minimum of 60% of the work was reserved for Japanese suppliers (Shear 1994, 248).

From Japan's point of view, the real importance of the FS-X was that it would contain technologies -and represent a level of skill and sophistication-unsurpassed in the world:

> Though, for now, Mitsubishi, Fuji, and Kawasaki have confined their broad aims to components, subsystems, electronics, and instrumentation, these are the guts of a modem flying machine. And though the whole is greater than the sum of its parts, that's what Japan expects to take away from the FS-X program, the synergy,

> known as systems integration. . . . Though Europe's Airbus Industrie consortium poses the more immediate threat to U.S. systems integrators like Boeing and McDonnell Douglas, Japan stands to profit on both continents. Perhaps when the Big Two or Three airframe companies have killed each other off, Japan will have to create an industry of its own to make use of all the parts it has manufactured. (Shear 1994,285)

Japan does not currently offer its own commercial jet aircraft, but has been openly pursuing such a capability (MIT1 has targeted this as one of its top priorities). Most likely in conjunction with European, Asian, or even American junior partners, Japan will soon begin to focus on designing and producing commercial jet aircraft (probably beginning with 80-150 seat aircraft). Boeing has been openly wooing Japanese companies with an offer to permit them to use the 737 as a basic platform for an "indigenous" commercial jet aircraft.

Chinese aerospace manufacturers are state owned defense enterprises.

Chinese Industrial Targeting

The Chinese aerospace industry looms above all others in the developing world. It already has 500,000 workers employed in the industry, primarily manufacturing older-generation copies of Soviet-designed military aircraft. Chinese aerospace workers are paid an average of $50 per month, live in units on the factory premises, and are strictly forbidden from organizing independent unions. The Communist Party-controlled All-China Federation of Trade Unions (ACFTU) functions more as a security apparatus, helping management instill "discipline" in the workforce. Moreover, the notorious *lao* gai "reeducation through labor" prison work camps serve as a practical reminder to any worker who might be tempted to agitate for employee rights that labor control is an integral part of the People's Republic of China's repressive regime.[34]

Chinese aerospace manufacturers are state-owned defense enterprises directed by AVIC (Aviation Industries of China). AVIC is a newly formed entity whose mission is to coordinate China's modernization plan for unifying Chinese commercial aerospace manufacturing, management, and operations. AVIC was created by the Peoples' Congress in August 1993 and coordinates all dealings with foreign manufacturers. AVIC and the China Aviation Supplies Corporation (CASC), coordinate marketing to all Chinese airlines. Given projections that Chinese airlines will expend $60 billion to purchase 600 to 800 aircraft over the next 15 years, AVIC and CASC will have significant leverage over potential aircraft sellers. Indeed, AVIC

President Zhu Yuli says it will seek an "equal partnership" in joint production contracts with foreign companies. AVIC's strategy is to offer potential sales to American, European, Japanese, and Russian firms in order to extract the technology and industrial infrastructure it needs to develop this industry (*China Aero Info* August 1994).

China is already working closely with McDonnell Douglas assembling Western-designed commercial aircraft as part of a coproduction arrangement to manufacture 40 MD-82s and recently finalizing an agreement for the production of 20 MD-90 "Trunkliners" in China, with dramatically increased Chinese content (reportedly 85% by the end of the production run). McDonnell Douglas estimates that Chinese-assembled MD-82s are 10% to 15% less expensive than those assembled at Long Beach, and this aircraft has relatively little Chinese content (Prudential Securities 1992; *Flight International* July *20,* 1994; *China Aero Info; New York Times* July 13, 1994, D2).

The Chinese government is determined to revamp and modernize its aerospace manufacturing industry.

One of AVIC's key "affiliates" is Xian Aircraft Company, a military enterprise where the Chinese build their strategic nuclear bomber. Xian manufactures a wide variety of Chinese military aircraft and has had a close relationship with Boeing as a supplier of parts and subassemblies, including vertical fin and horizontal stabilizers for 737s and 757s. As part of an offset agreement that was part of Boeing's sales to Chinese airlines, Xian recently signed a major deal with Boeing to manufacture 100 rear fuselage and tail assemblies for the Boeing 737, along with other work. Xian workers of the "6th segment of the Military Uniform General Factory" are producing the rear fuselage of future 737s that are currently manufactured in Wichita, Kansas.[35] Building on its military and other production experience, Xian Aircraft will reportedly fabricate most of the forward and middle fuselage of the MD-90 Trunkliner. It also has a contract with McDonnell Douglas to manufacture up to 300 bulkheads for wheel wells in MD-90's main landing gear. The three other major Chinese aerospace factories are Shanghai Aviation, Chengdu Aircraft Corporation, and Shenyang Aircraft Manufacturing Company.

China has the political desire and economic imperative to develop its own aerospace industry. For now, China lacks two key ingredients to pursue this goal: technological prowess and access to sufficient capital.

The Chinese government is determined to revamp and modernize its aerospace manufacturing industry, which reportedly employs 500,000 workers, mostly in the production of derivatives of Soviet-designed military aircraft.

To that end, China is intent on obtaining the most advanced Western technologies and organizational skills in order to develop world-class aerospace design, fabrication, production, and integration facilities.

China's strategy to obtain these technologies and skills is obvious: use whatever leverage it can obtain to force the transfer of technology and production to its factories. The leverage China uses involves what could. politely be called "commercial strong-arm tactics."[36]

Virtually every major sale by U.S. manufacturers to China (from telecommunications to aerospace to power generation and so forth) that was researched for this study contain significant requirements for investment and production in, and technology transfers to, China. While China sells the United States tens of billions of dollars in shoes, clothes, toys, and other consumer products, it is insisting that the United States transfer the ability to produce the only products the United States has left to sell to China—high technology capital goods.

China's strategy to obtain these technologies and skills is to force the transfer of technology and production to its factories.

It is also important to note that the makeup of China's exports to the United States has started to change dramatically. While low-cost consumer goods still account for the bulk of its exports, machinery (including consumer electrical goods such as telephones and washers, as well as industrial equipment) was 23% of the 1994 total, up from only 1.6% in 1985 (*Economist*, February 11, 1995, 60).

At this stage of its development, China is pursuing a strategy that relies heavily on partnerships. It has deployed three key "weapons" in the process: the allure of cheap, strictly disciplined labor; the prospects of gaining access to its rapidly growing economy; and the leverage of its potential purchasing power.

In order to sell airplanes in China, a foreign manufacturer must negotiate with state-owned entities, both for the sale of the aircraft and the production arrangements, offsets, and accompanying technology transfers. These negotiations are at the ministerial level of AVIC, CAAC (which manages the Chinese Airlines), or CASC (which coordinates aerospace purchases). There are no U.S. government officials involved in these transactions between private American companies and public Chinese government officials. The four primary aircraft manufacturing companies, all working directly under the Chinese defense industry, are the beneficiaries of the transfers. Additionally, CAAC extracts specific commitments for investments and projects ranging from the training of Chinese flight crews and maintenance workers to the building of spare-parts depots and repair centers to the estab-

lishment and construction of corporate headquarters for the American aerospace subsidiaries operating in the country.

China has a three-stage plan to develop a "stand alone" industry. China plans to promote the civil aircraft industry through international cooperation on domestic production projects. Specifically, the development will be based on:

1. McDonnell Douglas MD-80/90 coproduction agreements; and then
2. codevelopment projects to build a 100-seat aircraft allowing the industry to gain insights into the critical design process and hone other skills; and then
3. independent development of an all-Chinese 180-seat aircraft to compete in the global marketplace.

U.S. companies are not well-positioned to resist local content and offset demands.

The U.S. Response to China's Aerospace Strategy

China's cheap, strictly disciplined, and educated labor force is highly desirable for many high-tech producers around the world. Projections for the growth of the Chinese market for consumer and capital goods make it almost irresistible. These allures in combination with China's stringent and targeted local content requirements makes a virtue of a necessity for manufacturers.

Even though these deals explicitly call for important job and technology transfers from the U.S. aerospace industry, companies are under no obligation to reveal the terms of the transactions nor are they reviewed by the U.S. government. This lack of information exists despite the fact that much of the financing for such contracts is paid by U.S. taxpayers through the Export-Import Bank, which has played an increasingly active role in funding purchases of U.S. aerospace products, particularly by the Chinese.

U.S. companies are not well-positioned to resist local content and offset demands; Boeing and McDonnell Douglas not only compete with one another but with Airbus as well. Inevitably it is the long-term health and welfare of the United States and its workers that is sacrificed as more work and technology is transferred and the Chinese bargain for the best deal.

Remarkably, the Commerce Department (among other U.S. government agencies) is assisting the Chinese in this process. While Commerce is promoting the sale of U.S. goods into the China market, it is also helping U.S. manufacturers ***invest in China and develop local production.***

The Commerce Department certified an aerospace trade mission to China in October 1994 that was designed to promote investment in China. It

was sponsored by KPMG Peat Marwick (a Dutch-based international consulting firm, with offices in China). The brochure for this $9,500 trip (excluding airfare), which was distributed at a Commerce Department China Aerospace briefing, reads as follows:

> The mission will serve as an excellent business development vehicle for American firms seeking to explore investment opportunities in [China] . . . .
>
> INVESTMENT ADVANTAGES
>
> The People's Republic of China offers a variety of investment opportunities which include, but are not limited to the following:
>
> Air Traffic Control Equipment and Services
> Airframes
> Aircraft Engines and Components
> Airport Construction.

The Commerce Department is helping U.S. manufacturers invest in China and develop local production.

The Chinese government aerospace plan is being promoted by the Commerce Department, financed by the Export-Import Bank, aided by the Department of Defense, and observed by a frustrated United States Trade Representative.

Aerospace Strategies in Other Asian, Nations

The General Accounting Office released a recent Asian report on the aerospace industries. According to the GAO report, all of the Asian countries reviewed:

> acquire product and process technologies from the United States and Europe. The transfer of technology is often stipulated by Asian organizations when they negotiate to purchase Western equipment, and can be accomplished via a number of. cooperative programs, including subcontracting, licensed production, and codevelopment. . . . Carefully applied, this approach allows Asian nations to develop industrial and technological capabilities in a fraction of the time needed to cultivate them from scratch.

Each of the Asian countries surveyed (General Accounting Office 1994c) used similar techniques for developing an indigenous aeronautics industry. These strategies are characterized by:

1) Strong government support: "the national government strongly supports-and sometimes initiates-industry development";

2) Technology imports: "Asian countries usually import product and process technologies, instead of developing such technologies indigenously";

3) Strong emphasis on practical research: "Asian nations emphasize applied R&D activities over theoretical research, and almost all research activity is expected to yield downstream commercial benefits";

4) Reliance on "direct, synergistic links between military and civilian" aerospace endeavors: "the countries use acquired technologies interchangeably on military and civilian aeronautics projects." (General Accounting Office 1994c, l-2)

Taiwan is developing an aerospace industry through the use of offset requirements and significant government funding.

South Korea

South Korea's growing aerospace industry, led by Daewoo, Korean Airlines (KAL), and Samsung, has benefited from significant military-related offset production arrangements and has numerous commercial production contracts with Boeing, McDonnell Douglas, and Airbus. The South Korean government has made a determined effort to use offsets to nurture the industry and has played the lead role in an effort to organize an "Asian Airbus" commercial jet manufacturing consortium involving China, Singapore, India, and others. This project is studying the design and production of an indigenous Asian 100-200 seat commercial jet aircraft *(Aerospace Daily* October 22, 1993). Several South Korean companies are slated to become risk-sharing partners in the new McDonnell Douglas MD-95, with a Hyundai subsidiary building the wings and a KAL subsidiary fabricating the nose section *(Wall Street Journal* November 8, 1994).

Taiwan

Taiwan is developing an aerospace industry through the use of offset requirements and significant government funding. Taiwan's government helped establish and owns 29% of Taiwan Aerospace Corporation (TAC), which has attempted unsuccessfully to reach coproduction and final assembly agreements first with McDonnell Douglas and then British Aerospace. The McDonnell Douglas deal, which reportedly would have entailed a $2 billion Taiwanese investment for 40% of McDonnell Douglas Aircraft and local assembly of a proposed MD- 12 "super-jumbo," was canceled after TAC decided that the risks were too large. The British Aerospace deal, reportedly worth $775 million, called for Taiwanese manufacture of 70- to 115-seat regional jets, but fell apart over disagreements concerning technology trans-

fers and work shares. Ultimately, Taiwan settled on a much more modest effort whereby a consortium of Taiwanese companies has entered into a 50-50 joint venture with a U.S. company to manufacture six- to eight-seat corporate jets in West Virginia. Reportedly, Taiwanese companies will fabricate many of the aircraft's parts and will be involved in the design and marketing of the aircraft (***Far Eastern Economic Review*** January 19, 1995, 53).

The Taiwanese government's Committee for Aviation and Space Industry Development controls "major aerospace procurement by government or local businesses," and the committee "takes charge of signing offset credit agreements, which require the seller to provide technology transfers, parts purchases, or joint production ventures that amount to an agreed-upon percentage of the'deal's value." Taiwan had signed about $800 million in offset credit agreements as of early 1993. Of this total, Boeing had signed agreements for the purchase of $340 million in Taiwan-manufactured aircraft parts and had agreed to construct a testing laboratory to "ensure that parts manufactured in Taiwan for Boeing and other companies meet with standards set by the U.S. Federal Aviation Administration" (***Free China Journal*** February 8, 1993).

Indonesia produces numerous military and commercial aircraft under licensed production agreements.

The General Accounting Office report noted that, ***as*** the price of agreeing to purchase U.S. aircraft and engines, Taiwan insisted that U.S. companies "promise to allow Taiwan to build aircraft and engine parts, acquire U.S. technology, and receive training and other support for its developing aeronautics industry." The GAO says that these commitments total $700 million (General Accounting Office 1994c, 4-6).

Indonesia

Indonesia leverages offsets as part of a strategy to develop an aerospace industry. Indonesia's state-owned aerospace manufacturer, Industries Pesawat Terbang Nusantara (IPTN), produces numerous military and commercial aircraft under licensed production agreements, makes significant parts for all three major aircraft manufacturers, and has designed an indigenous commuter turboprop aircraft that it hopes to put into production soon. It is also notorious for its continued repression of any independent trade union activity. IPTN "says that the productivity of its Indonesian'labor force is now almost equal to that of European counterparts, having risen from 50% of European productivity level." However, skilled workers in the IPTN plant "receive about one-seventh of the pay given to U.S. aircraft industry workers with like skills" (***Air Transport World*** November 1988). A Japanese pub-

lication noted that: foreign capital "has been pouring into the country in recent years. The quest of foreign corporations for cheap, skilled labor has dovetailed nicely with the Indonesian government's need for capital and technology" (Nikkei *Weekly* September 12, 1992). The Japanese have also turned to IPTN to outsource the 767 and 777 fuselage work that Boeing had originally subcontracted to Mitsubishi.

GATT, the World Trade Organization, and Other International Trade Agreements

The 1979 GATT aircraft code bans offsets or other procurement requirements.

Many of the practices described in this study would appear to be in conflict with the letter and spirit of international trade law. This section will examine the major trade agreements and explore the ways in which they may apply to the aerospace industry.

Prior to the establishment of the World Trade Organization (WTO) in 1995, there were four key international agreements governing trade in aircraft: the GATT agreement, the 1979 GATT Aircraft Code (which its signatories have as yet unsuccessfully attempted to revise and incorporate into the WTO), a separate GATT Subsidies Code (which was incorporated and arguably strengthened in the Uruguay Round), and a 1992 agreement between the United States and the European Community on trade in civil aircraft.

The 1979 GATT aircraft code, which has been signed by 22 nations, prohibits tariffs on aircraft, engines, and most components; it established rules for standard-setting and other potentially discriminatory governmental actions; it prohibits signatories from exerting "unreasonable pressure" on aircraft purchasers and bans offsets or other procurement requirements; it also bars the attachment by governments of political or economic inducements (such as landing rights or foreign aid) and specifies that "pricing of a civil aircraft should be based on reasonable expectation of the recoupment of all costs."[37]

The 1979 subsidies code explicitly prohibits the use of export subsidies for manufactured goods. The code does not ban domestic subsidies, but it does require that signatories notify their trading partners of any subsidies in effect and to attempt to avoid damaging those trading partners. The subsidies code also contains a range of other provisions designed either to limit or prevent government actions that unfairly harm competitors.

The 1992 United States-European Community agreement basically expands on the aircraft code, plus it specifically limits government support for development of a new aircraft to one-third of the projected development

cost of the aircraft (compared to the 75% to 100% development and launch subsidy the U.S. government charges Airbus has received on its current aircraft). Engines are not covered by this bilateral accord. Under the accord, no subsidy may be provided for the actual production of aircraft. The agreement also covers interest rates that governments must charge domestic aircraft manufacturers. It should be noted that these requirements apply only to *new* aircraft projects (such as the projected "superjumbo" or a second generation supersonic transport) and not to aircraft that had been launched as of 1992. Thus, the tighter payback provisions apply to none of the commercial jets currently being sold. However, the existing contractual terms for repayment of support to these prior programs cannot be liberalized. The agreement has other technical provisions, including requirements for "increased transparency" (i.e., disclosure) of government support for commercial aircraft programs.

All of these agreements only apply to trade in "civil" or "commercial" aircraft.

In testimony before the National Airline Commission, a key aerospace official with the U.S. Trade Representative's office told commissioners that, in the USTR's opinion, the aircraft code and other agreements had not been "completely successful," and that they "may have been more effective in dealing with marketplace influencing actions, such as government inducements to purchase, than with the question of inducements or incentives'to produce" (Falken 1993, 153). In other words, tariff barriers and unreasonable regulations that can be imposed by governments have been more effectively limited than subsidies or formal or informal requirements for local manufacture, especially when those requirements involve private business activities.

Despite the existence of these international trade agreements, a broad range of practices persists that enables countries to target the aerospace industry and devote significant resources to doing so. The reasons for this include the following:

1) *All of these agreements apply only to trade in "civil" or "commercial" aircraft and not to military aircraft.* This means. that governments in the market for new military aircraft can make explicit demands for licensed production, offsets, or local content provisions while governments hoping to sell military products are free to offer inducements and subsidies. For example, in order to obtain a $1.6 billion order from the United Kingdom for 25 new C- 130J military transport aircraft, Lockheed not only felt obliged to enlist influential United Kingdom-based subcontractors as partners in the project, but it also

agreed to a *100% offset*: at least 10% of the work on the aircraft will be performed in the United Kingdom, and Lockheed agreed to subcontract additional work on other projects to British firms valued at the remaining 90% *(Wall Street Journal* 1994, B4).

2) *These agreements are replete with explicit exceptions and language that one U.S. trade expert calls "wiggle words."* With respect to aircraft, some of these include the requirement that governments not put "unreasonable" pressure on purchasers of aircraft and related parts (leaving open the question as to what is "reasonable" pressure), or the acknowledgment of the "special factors" affecting the industry (including existing widespread governmental support, the international economic interest of signatories, and signatories' desire to expand their role in the global aircraft market), which provide many avenues for exculpatory arguments.

These agreements are replete *with explicit exceptions.*

3) *Many of the practices that are limited or banned by these agreements are much easier to describe than to prosecute.* Implicit quid pro quos, secret policies, and privately asserted demands can be impossible to prove. For example, U.S. trade officials privately (and occasionally publicly) complain that the European Community is failing to live up to the terms of a 1992 agreement on civil aircraft *(see* below) (*International Trade Reporter* 1993).[38] However, they also complain that they have not been given sufficient data to make the case.

4) *Prosecuting a case under these agreements is ultimately a political decision, not only for the governments involved but for the injured parties* as *well.* For governments, other diplomatic or economic considerations may well dictate whether or not to pursue a trade case. For industries such as aerospace that are dependent on export trade, the fear of angering customers and their governments (which, in the case of the airline industry, are often one and the same) and losing future sales may outweigh the benefits gained by pursing a trade case, or even publicly complaining. On more than one occasion, U.S. aerospace companies have worked desperately *toprevent* the U.S. government from filing complaints about unfair trade practices even though those companies were the injured parties. Moreover, company interests may well diverge from the interests of their workers, especially to the extent that offset or local content agreements increase sales-and profits-at the expense of those workers' jobs.

5) *Not all aircraft-manufacturing nations are signatories to the various international agreements and codes governing the industry.* For example, the former Soviet Union, China, and Taiwan are not GATT signatories (and there was an intense dispute with China in 1994 and 1995 over the terms of its entry into the WTO). In addition, other important countries like Indonesia, Brazil, India, and Israel have ei-

ther not signed the aircraft or subsidies codes or are only observers. The 1979 GATT aircraft code has only 22 signatories. However, under the new WTO, all its signatories are obliged to be a party to the new 1994 subsidies code.

6) ***Finally, these agreements pertain only to the actions of governments and not to private parties.*** Thus, even an explicit offset or local content demand by a private airline would not be covered. In addition, governments often argue that their publicly owned companies (both airlines and manufacturers) should be treated like private entities with respect to the applicability of certain international trade rules. (Air France and Lufthansa, both of which have substantial government ownership, are cornerstone customers for Airbus.) There is also the grey area where government clearly has the ability to influence private decisions. For example, while the Japanese government has no formal offset requirements for foreign manufacturers seeking to sell into the Japanese market, it clearly exercises considerable influence over Japanese airlines. Moreover, there are very close, often government-induced, relationships between Japan's airline companies and its aerospace manufacturers. Indeed, the Japanese government has put representatives of all three Japanese airlines on the boards of directors of the MITI-sponsored consortia that is responsible for managing Japanese aerospace companies' involvement in international aircraft and engine programs (Eberstadt 199 1, 150- 153).

These agreements pertain on/y to the actions of governments and not to private parties.

The status of international trade'agreements relating to aircraft is currently in a state of flux. The new World Trade Organization agreement contains an annex on Subsidies and Countervailing Measures that expands upon the previous GATT subsidies code. However, the signatories to the 1979 aircraft code have failed to agree on the relationship between that agreement and the new subsidies code. Moreover, in anticipation of an updated aircraft code, with its own specific provisions, the new subsidies code specifically exempted civil aircraft in three areas: it excluded civil aircraft from a prohibition of a total ***ad valorem*** subsidy exceeding 5% of the cost of a product (Section 6.1 (a)); it excluded civil aircraft from a separate provision (8.2 (a)) limiting actionability of governmental support for industrial research and development to 75% of industrial research costs and subsidies for "precompetitive development activity" (basically applied R&D and prototyping) to 50%; and the civil aircraft industry was given a special exemption from the prohibition on forgiveness of government-held debt and grants to cover debt repayment (Article 6.1 (d)) or for royalty-based government financing that is not fully repaid if actual sales fall short of forecasts used to calculate

royalty payments.

The United States and the EC disagree over whether the new subsidies code should be the exclusive remedy for complaints (the U.S. position) or whether it should be applied in tandem with the 1979 aircraft code (the EC position). This dispute is reflected in the failure of efforts to rewrite the aircraft code itself. Among other things, the United States and the EC disagree on the treatment of "indirect" supports and subsidies provided by military research and development and other government-sponsored research efforts (the EC argues that the U.S. industry gains much from these measures), how aircraft engines should be treated (again, the EC argues that military R&D provides large public benefits to US. engine manufacturers), and over the "special factors" exemption for national-interest based decisions to subsidize the industry (the United States wants further tightening on this exception) .

The United States and the EC disagree on the treatment of "indirect" supports and subsidies.

Also, Japan and Canada oppose the extension of the 1992 U.S./EC agreement's provisions regarding government support for development, launch aid, and production to a revised aircraft code. The 1979 aircraft code signatories have broken off discussions over extensions to that code, and revisions are needed because of the new WTO (Inside U.S. Trade October 28, 1994, 3-4; November 11, 1994, 1, 22).

In a December 1994 report on the bilateral U.S.-European aircraft agreement, the GAO raised a series of questions that it said made the long-term viability of the agreement "uncertain" (General Accounting Office 1994a). Specifically, the General Accounting Office noted that several key provisions were the subject of actual or potential dispute: the parties have openly disagreed over the definition of "production support" and of "identifiable benefits from indirect support," and there is a potential for disagreement over increased government support for aircraft programs that had been launched prior the July 17, 1992 effective date of the agreement. Moreover, the GAO suggested that, since the bilateral accord has no formal dispute settlement mechanism (the parties are to rely on consultations), there is no way to predict the outcome of a serious disagreement.

STRATEGIES FOR SAVING AND GROWING AEROSPACE JOBS

Few if any industries have benefited as much from conscious government industrial policies throughout the world as has aerospace. Our success in aerospace reflects prowess in military production, leadership in commercial manufacturing, involvement in the new frontier of space and communications, and sophisticated industrial organization. It represents the nexus of defense, commerce, national prestige, and organizational infrastructure.

Few if any industries have benefited as much from conscious government industrial policies as has aerospace.

Since World War II, the aerospace industry has been one of the crown jewels of the American economy. During the Cold War, the nation effectively had a "shared vision" not only about the industry's role in maintaining national security, but about its importance to the country's economic security as well. Today, that vision is clouded and badly in need of correction.

If the United States is to retain its leadership position in aerospace, it must first reexamine a series of assumptions implicit in current policy. Chief among these is the presumption that the interests of the key U.S. aerospace companies naturally and inevitably coincide with those of the U.S. economy and the American workers. It is not only entirely possible, but increasingly common, for the actions of many of the U.S. major aerospace firms to directly undermine the long-term prospects for domestic employment and production. Not far behind is an antiquated policy imperative left over from the economic *realpolitik* of the Cold War era: that it is in the U.S. interest to help current and potential "allies" develop economic infrastructures parallel to those of the United States, including key elements of leading US. industries (even production facilities of leading U.S. companies).

For example, the Commerce, Defense, and Transportation Departments seem to feel that their role is to encourage U.S. investments abroad, even if such investments will clearly undermine domestic employment prospects. The United States must either ensure that offset requirements, subsidies, and other targeted industrial policy efforts are eliminated by current and potential competitors, or the US. must be willing to develop and implement such policies with equal measure and effectiveness. Policies to achieve these goals are discussed in this section.

Recently the U.S. government has shown positive moves in this direction: an emphasis on defense conversion and the development of "dual-use" technologies within the defense procurement process; more targeted avia-

tion and space research and commercialization efforts by NASA; direct involvement by U.S. officials in securing sales abroad; and the creation of a specific unit within the Export-Import Bank to finance aircraft sales.

However, the Administration is also involved in initiatives that will almost certainly lead to a further erosion of US. aerospace employment. These include the Commerce Department's encouragement of U.S. aerospace manufacturers to invest and produce in Russia, China, and elsewhere, and the White House's acquiescence to U.S. aerospace companies' demands on a range of issues from most favored nation status for China to lessening of restrictions on technology transfers.

The A dminis tra tion is involved in initiatives that wi|l almost certainly lead to a further erosion of US. aerospace employment.

The United States must develop a coherent, comprehensive, and flexible strategy to promote aerospace technology, production, and jobs well into the next century. It should be a policy that measures success by the jobs and technologies retained and created, and not just the sales logged by products bearing the label of a U.S.-based manufacturer. It must put domestic aerospace and employment jobs back on the agenda and adopt a series of interrelated policies designed to preserve export jobs and aerospace technologies. It must also provide significant incentives for U.S. manufacturers to maintain and expand their American workforce.

Our policy makers must also recognize that the industry reached its preeminent position as the result of aggressive public policies and public expenditures, and that success in the future will require comparable levels of support, even if that support must be implemented in new ways. While there are many steps that can be taken that do not require major new expenditures of public funds, others will carry a large price tag. It is worth bearing in mind that European countries invested about $20 billion (net) to create an industrial consortium that is now the world's No. 2 commercial aircraft manufacturer and supports over 100,000 jobs.

To be effective, a U.S. aerospace policy must address the entire range of issues impacting the industry: the deep airline industry recession, targeting by global competitors, and the reluctance of the U.S. capital markets to support long-term investments by aerospace firms.

Such a policy, however, must also deal with the actions of U.S. manufacturers that undermine domestic aerospace production and employment. A reinvigorated U.S. aerospace policy must distinguish between pressures on companies that are real (offset requirements, short-term oriented capital markets) and those that result from foreign governments' offset agreements, subsidies, and industrial policy inducements. Those that are within the con-

trol of U.S. aerospace companies must be challenged directly. as well. It makes no sense for the United States to assist these companies in obtaining sales for products that are increasingly manufactured elsewhere.

Pressures outside of these companies' control must be dealt with either through trade agreements or other governmental actions. The United States will need to adopt a mix of strategies designed to neutralize or counter other nations' industrial targeting. Some of these strategies will involve aggressive trade negotiations and actions, while others will clearly require the United States to engage in its own industrial planning.

The United States needs to adopt strategies designed to neutralize or counter other nations' industrial targeting.

Difficult choices and uncomfortable conclusions will inherently accompany any process leading to the creation of a new, shared vision for this critical industry. A truly effective aerospace strategic policy will have something for everyone to dislike, and any number of "sacred cows" will have to be sacrificed.

Conservatives will abhor the echoes of industrial policy and active government involvement in a key economic sector. They will also recoil at defense procurement policies designed to foster commercial innovation and synergies. But they will have to decide whether they indeed are willing to stand by while this strategic industry, in pursuit of short-term gains, comes to resemble something of a high-tech garage sale.

Liberals will be deeply uncomfortable with the prospects of "corporate welfare" for some of our largest and most prosperous firms, companies at the core of the "military-industrial complex." And they will find it more than a little difficult to accept the changes in antitrust laws that must be enacted if U.S. aerospace firms are to maintain the economic benefits upon which aerospace workers, their communities, and our economy have come to depend. They will need to recognize that traditional antitrust concepts are becoming not only less relevant in the context of a globalizing aerospace industry replete with joint ventures and other extensive "partnering" relationships, but also exceedingly counterproductive.

For differing reasons, conservatives and liberals alike will have difficulty accepting the need for increased government expenditures on aerospace procurement, research, and development, along with the range of targeted tax benefits, guarantees, and direct capital investments that a truly effective strategic aerospace policy would require.

Moreover, "free traders" will find it difficult to accept a more-or-less explicit rejection of exclusive reliance on multilateral trade agreements as the cornerstone for protecting the U.S. aerospace industry against other coun-

tries' unfair trade practices and targeted industrial policies. Advocates of reinvigorated defense spending must be willing to support "dual-use" and "off the shelf' acquisitions -along with a determined effort to promote interchangeable production techniques and the maintenance of the supplier chain-to a much greater degree than is now practiced. The military procurement system simply must be overhauled, not only to make it less expensive but to make it more broadly useful to the commercial aerospace industry as well.

The direction of the commercial aircraft industry has been fundamentally affected by government policy since fhe days of piston engines.

Those who are suspicious of government support of big business, and especially defense contractors, must come to grips with the fact that there is a stark choice to be made in a globally competitive industry such as aerospace: either nurture the industry (which means providing tangible support to domestic firms with appropriate conditions attached) or cede the industry's future to countries that already have clear and aggressive policies in place to expand their existing roles and capture new markets.

Impatient investors who look to aerospace companies for quick and easy profits may have to look elsewhere. Capital markets may simply be unwilling to support the long-term investment horizon that is so clearly necessary for sustained leadership and success in the global aerospace industry. If so, U.S. policy makers will have to decide whether to permit the industry to permanently decline in importance or to devise new ways to help aerospace firms attract sufficient capital to meet their investment requirements.

Aerospace firms themselves will find much to dislike, since they will have to enter into a partnership in fact as well as in name. They will have to recognize the legitimate interest of their workers, communities, and our nation in their actions. The industry is fond of highlighting its importance and is not shy about suggesting ways in which public policy can make it more competitive. However, the industry must be willing to not only acknowledge the interests of their shareholders but their stakeholders as well. It must be willing to take concrete steps to accommodate those interests.[39]

The aerospace defense industry, which drinks so deeply from the public well, must acknowledge its obligation to promote U.S.-based production and employment in all of its activities, civil as well as military. The industry will need to recognize that it cannot expect to receive tens of billions of taxpayer dollars annually (including billions to fund development of products the industry then hopes to sell to the government at a profit) at the same time it is in the process of systematically transferring jobs and technology in pursuit of the latest sale.

As Tyson (1992) has thoroughly documented, the direction of the commercial aircraft industry has been fundamentally affected by government policy since the days of piston engines. She argues, for example, that Airbus's very existence can be attributed, in part at least, to the actions-or lack thereof-of the U.S. government. The U.S. government had arranged (indeed forced) and provided loan guarantees for a merger of the financially strapped Douglas Aircraft Company into military-dependent McDonnell Aircraft in 1967; several years later, the United States rescued Lockheed from bankruptcy with a $250 million loan guarantee; and the government-funded design competition among Boeing, Lockheed, and McDonnell Douglas for the contract to build the C-5A military transport induced all three manufacturers to apply the knowledge they had gained in the process to the production of a large, civil, widebody aircraft.

The intense competition between the Lockheed L-107 1 and the McDonnell Douglas DC-IO weakened both companies.

When Boeing got to the market first, with its 450-seat long-range 747, Lockheed and McDonnell Douglas chose to compete head-to-head with somewhat smaller, long-range jets, even though the real potential widebody market demand was known to be for an even smaller, medium-range aircraft. Both companies were willing to take on this risk, in part at least, because they had a "life preserver" from their very profitable military aerospace business. The intense competition between the Lockheed L-101 1 and the McDonnell Douglas DC-10 further weakened both companies, driving Lockheed out of the commercial market entirely and depriving McDonnell Douglas of profits with which to fund new aircraft development.[40] In the meantime, however, Airbus had launched its smaller, shorter-range A-300, establishing it as a viable competitor and setting the stage for seven subsequent aircraft introductions.

"Whatever its intent, the defense industrial policy of the U.S. government had a significant influence on corporate conduct in the commercial aircraft industry at this critical moment in its history," Tyson writes. "Despite its pervasive and varied influence, however, the US. government foreswore the role of market coordinator," she argues. "And in the absence of such coordination the American firms embarked on a mutually destructive competition that provided a critical opening for a successful and intentional industrial policy by the Europeans." The result was that the American companies "unintentionally left a market gap between the narrow bodies and the jumbos" to the Airbus A-300 (Tyson 1992, 188).

The Japanese coordinate development of aerospace through MITI programs. MITI ensures that Japanese aerospace companies participate in each

major project and share important technologies and skills. Members of the European Community have formed the Association of European Research Establishments explicitly to coordinate new research and development programs for near-term commercialization. The Chinese government has an explicit aerospace plan and vision. Every other serious aerospace nation has a coordinating body charged with nurturing and advancing domestic aerospace manufacturing, technology acquisition, and, of course, employment. The United States should do no less.

Every other serious aerospace nation has a coordinating body charged with nurturing and advancing domestic aerospace manufacturing.

Policy Recommendations

Coordinating U.S. Aerospace Policies and Actions

Recommendation #1

An interagency task force should be designated (or created) with final responsibility for coordinating all U.S. government aerospace-related policies and actions. The task force should be attached to the President's National Economic Council. The head of this task force should be empowered to coordinate and have final authority over:

- all aerospace research and development funding by the Departments of Defense, Transportation, Energy, and Commerce as well as by NASA, the FAA, and other government agencies;
- all trade negotiations affecting aerospace and all trade actions and cases that may be appropriate to initiate;
- export sales marketing by such agencies as Commerce and financing by the Export-Import Bank and the Department of Defense;
- the review and approval process for domestic corporate mergers, acquisitions, and divestitures, as well as review and approval of any joint ventures entered into by U.S. aerospace companies with foreign firms;
- the regulation of technology sales and transfers, and licensed production and coproduction agreements proposed by U.S. aerospace firms; and
- the award of international airline route authorities as well as the development or promulgation of international aviation and aerospace regulatory standards and procedures.

This task force should create a work group to assess critical aerospace technologies, identifying strengths, weaknesses, and threats posed to U.S. manufacturers and domestically based development and manufacturing.

This parallels a recommendation made by the National Research Council and should be addressed immediately. The transfer of U.S. aerospace

technologies is accelerating every year. Already, some critical technologies have been "shared" with enough other countries as to render them generic.

Recommendation #2

Form an aerospace industry advisory board to guide the actions of this task force. The members of the advisory board should include representatives of 1) major aerospace firms; 2) aerospace suppliers, including engine manufacturers; 3) aerospace employees; and 4) the government.

This board should immediately begin to develop policy recommendations for and provide advice to the head of the task force, including specific actions to:

- maintain U.S. technological leadership in aerospace;
- revitalize U.S. manufacturing processes and facilities;
- identify and protect critical U.S. aerospace technologies; and
- promote fair international competition.

U.S. taxpayer funds should not be used to facilitate the transfer of aerospace technology and employment abroad.

Promoting Aerospace Production and Employment

Recommendation #3

US. taxpayer funds should not be used to facilitate the transfer of aerospace. technology and employment abroad.

- Foreign military financing should not be available on projects that involve required offsets, coproduction, licensed production, or technology transfers. Restrictions should be attached to sales that include the movement of U.S. work to a foreign subcontractor. Also, foreign aerospace companies should have only restricted access to technologies developed at taxpayer expense (especially NASA research, which Airbus openly acknowledges it acquired simply by asking). Moreover, the tax code should be thoroughly examined and necessary changes made to eliminate tax benefits and incentives that encourage the transfer of production to foreign sources.
- The Department of Commerce should eliminate the programs it initiates or supports that encourage US. companies to make direct foreign investments in facilities that could compete with U.S.-produced goods and services.
- U.S. aerospace exports that are directly or indirectly contingent on foreign content requirements, or U.S. 'technology transfer, should be prohibited. Additionally, US. companies that are downsizing their American employees, while increasing their foreign employment or subcontracting, should be ineligible for funding.

Recommendation #4

U.S. airframe, engine, and component manufacturers should be encouraged to enter into domestic joint ventures (rather than those with foreign "partners"). They should be exempted from antitrust regulations for these joint product development, marketing, manufacturing, and risk-sharing agreements so long as the joint ventures are first approved by the government. Antitrust restrictions on manufacturers must be relaxed so that U.S. manufacturers will be able to team with other U.S. aerospace firms for research and development, new product development, and production. This would enable them to more adequately spread their costs, reduce risks, and build the domestic capital, technology, and employment base while reducing the outflow of such to foreign concerns.

Major *domestic component manufacturers should be encouraged to enter into a superjumbo aircraft design and manufacturing consortium.*

Recommendation #5

Boeing, McDonnell Douglas, Pratt & Whitney, General Electric, and other major domestic component manufacturers should be encouraged through the use of incentives to enter into a "very large commercial transport" superjumbo aircraft design and manufacturing consortium with the goal of maximizing the U.S. content of such an aircraft (rather than the European consortium Boeing is working with at present).

We are at the cusp of the next generation's aircraft, and whether or not a very large transport, a high-speed transport (supersonic transport, or SST), or other new technology aircraft emerges, significant resources must be devoted now to ensuring that these will be U.S. manufactured as well as initiated. Both the new WTO subsidies code and the U.S./EC bilateral aircraft agreement permit certain forms of direct financing in the development of new commercial aircraft. The most interesting form of such financing-one favored by the Europeans themselves—is royalty financing. In effect, a lender agrees to accept repayment out of future sales proceeds. As long as the assumptions about those sales are "reasonable" (and reasonably designed to provide for repayment on terms more or less equivalent to a loan), significant monies can be advanced by a government in support of a new aircraft program. However, from an accounting perspective, royalty financing is *contingent* and should not have a major impact on the borrower's balance sheet. In effect, it is near-equity.

Recommendation #6

In its procurement activities, the Department of Defense must put a much greater emphasis not only on dual-use technologies, but on dual-use production facilities as well.

The United States must adopt a much more aggressive, publicly funded research and development program designed to promote commercialization and not just "enabling" technologies. And it must be designed to assist defense manufacturers and their employees to convert their important skills to commercial aerospace uses, which requires an expanding, robust civilian aerospace industry. Dual-use, off-the-shelf products and manufacturing techniques must be supported by the Department of Defense along with a conscious procurement policy designed to maintain the supplier chain and enhance the competitiveness of commercial aerospace producers.

At the top of U.S. trade negotiators' aerospace agenda should be much more effective prohibitions against demands for production, technology, and jobs in exchange for sales.

Promoting Fair International Trade in Aerospace Products

Recommendation #7

U.S. trade negotiators should aggressively work to obtain complete prohibitions on "offset," "local content," "compensation trade," and other forced technology transfers.

Current trade law has too many loopholes to be effective against targeted aerospace industrial policies. At the top of U.S. trade negotiators' aerospace agenda should be much more effective prohibitions against what amounts to extortion: demands for production, technology, and jobs in exchange for sales. These restrictions must apply to the activities of both governments and private firms.

Recommendation #8

The United States should open negotiations with the European Union designed to obtain a new bilateral civil aircraft trade agreement that prohibits firms based in either region from using the export of jobs and technologies as a marketing tool.

Boeing, McDonnell Douglas, and Airbus Industrie should be prohibited from entering into offset, local content, and compensation trade agreements. Absent such a legal restriction, aerospace firms have almost no choice but to accede to potential customers' demands to trade technology and jobs in exchange for sales. This agreement, if carefully constructed, can solve the prisoner's dilemma that haunts aerospace marketing and save jobs and output in both markets. Such an agreement could become the basis for a new multilateral aerospace agreement.

Recommendation #9

U.S. trade officials should pursue trade actions (both under international and U.S. laws) against countries that have unfairly targeted the U.S. aerospace industry.

If the United States is to pursue a "free trade" regime, it must first act to ensure that U.S.-based and operating companies do not become the instruments and victims of other nations' industrial policy targeting. It must recognize that it is difficult for U.S. companies involved in export trade to file trade cases and aggressively protect their interests through trade actions because of the risk of offending potential customers. U.S. trade officials should develop a strategy to press actions against any other nation or company that agrees to offset, local content, or compensation trade agreements to the competitive disadvantage of U.S. aerospace manufacturers.

U.S. trade officials should pursue trade actions against countries that have unfairly targeted the U.S. aerospace industry.

Recommendation #I 0

If McDonnell Douglas appears on the verge of exiting the commercial aircraft market, the United States should consider invoking the 1992 U.S./EC temporary abrogation provision to shore up the company's commercial operations, perhaps by brokering a "marriage" with another U.S. firm (including Boeing).

As Laura D' Andrea Tyson noted, the 1992 U.S./EC bilateral agreement on trade in civil aircraft contains some important "loopholes" that explicitly permit signatories to temporarily abrogate its terms if an aircraft manufacturer's existence and viability is threatened. However, Tyson, writing in support of these exceptions, argues: "[B]ecause of the industry's underlying economics, government support for the development of new aircraft cannot and should not be ruled out altogether. Rather the challenge is to specify parsimonious and precise rules that permit subsidies for beneficial innovation and competition while precluding rent-shifting subsidies that injure all parties" (Tyson 1992, p. 209).[41]

McDonnell Douglas still has an important franchise and has clearly been injured by competition with Airbus. Rumors already abound that the company is considering a suspension of MD-1 1 production for up to six months (although McDonnell Douglas denies it at this point). Within a few years, the United States may be faced with the choice of directly intervening or permitting the company to close down its commercial operations, or, worse, sell its product line and technology "off the shelf' to a foreign bidder. (Taiwan and China already have a clear interest in parts of the company's business.)

Recommendation #1 I

U.S. trade negotiators should press for the adoption of meaningful international labor rights standards by the World Trade Organization, including enforcing conventions contained in the International Labor Organization (ILO) Conventions on worker rights.

It is probably no accident that a number of the most important emerging competitors in the global aerospace industry are also among those that most systematically repress their own citizens' labor rights. The mounting competitive pressures in the global aerospace industry make the attraction of repressive economies almost irresistible to Western aircraft and component manufacturers. It is both patently unfair and practically impossible for U.S. aerospace workers to compete with labor performed under such repressive conditions. Internationally recognized standards for labor rights already exist, and are embodied in the IL0 Conventions.[42] Acceptance of these labor rights conventions should be mandatory for all WTO signatories and enforceable through the IL0 or, alternatively, through a separate WTO body.

U.S. trade negotiators shouid press for the adoption of meaningful in terna tional labor rights standards.

Promoting Airline Industry Health and Employment

A good deal of the decline in aircraft manufacturing employment can be attributed to the global airline recession and the ongoing financial weakness of most carriers throughout the world. Below are policies that should be adopted to promote the health of U.S. carriers and employment in both industries.

Recommendation #12

The United States should provide loan guarantees and interest subsidies to U.S. carriers to help finance legislatively mandated fleet upgrades.

U.S. carriers are required by law to replace or modify all of their noisier "Stage 2" aircraft in their fleets by 1999. Stage 2 aircraft include all 727s, DC-9s, and older 737s. The conversion to an all Stage 3 fleet will require carriers to hush-kit, re-engine, or retire some 1,800 aircraft. The FAA has estimated that, at a minimum, this will cost about $4.5 billion. This would be an expensive proposition for any industry, much less one that has only one investment grade company. A federal loan guarantee and interest subsidy program should be enacted, not only to assist the airlines in making this conversion, but to encourage them to purchase newer, more efficient aircraft rather than modify older ones that are more expensive to operate and maintain. A federal guarantee will provide access to the lowest available borrowing rates. The aviation trust fund (which is supported by an 8% ticket tax and

has a current surplus of several billion dollars) should be used to provide an interest subsidy to further ease the carrying cost of the loans. The program could be structured similarly to the Government National Mortgage Association, where fully collateralized guaranteed loans are packaged and sold to institutional investors.

Recommendation #13

Airlines should be exempted from antitrust restrictions to the extent that they can coordinate their schedules at congested airports,

A federal loan guaranfee and interest subsidy program should be enacted.

As virtually any experienced traveler knows, there are certain times during the day when it is highly desirable but almost impossible to avoid flying in or out of certain airports (e.g., Chicago O'Hare, Atlanta Hartsfield). These "hub" airports experience tremendous peaks and valleys during the day. Carriers have asked the Justice Department for permission to coordinate their schedules in such ways that their peaks do not overlap. These requests, however, have been denied on the grounds that it could lead to collusion and anticompetitive practices, The Justice Department should reconsider its position and permit carriers to smooth traffic flows in congested airports, with the Justice Department observing the process.

Recommendation # 14

Changes in FAA regulations that permit U.S. carriers to perform regularly scheduled maintenance at foreign facilities should be revoked.

Prior to 1988, FAA regulations required U.S. carriers to perform all regularly scheduled maintenance at domestic facilities. Such procedures range from simple one-day checks to taking an aircraft apart once every five to seven years for a complete structural overhaul. This is both a labor- and skill-intensive activity. Unfortunately, there is currently a global surplus of maintenance facilities, and large new complexes have been opened in Mexico and the Far East over the past few years. A return to the pre-1988 regulation would provide employment opportunities for thousands of U.S. aircraft mechanics and engineers.

Recommendation #15

Bilateral air services agreements should be replaced with multilateral, regional agreements, and air services should be brought into the WTO.

U.S. carriers are the world's low-cost producers, and their international routes are among their most profitable. However, international airline com-

petition is controlled by a number of bilateral agreements among nations, each of which is intent on protecting its own airlines. U.S. carriers compete effectively wherever they are permitted to fly, but are almost always subject to significant market access restrictions. Even where bilateral negotiations have produced theoretically equal rights for carriers from both countries, there is an inherent imbalance in the benefits conferred. Since the U.S. market is so much larger than any other in the world, other nations' carriers have much more to gain from open access to U.S. markets than American carriers do from open access to theirs. The only way to correct this imbalance is for the U.S. to insist on negotiating regional, multilateral air services agreements that could provide U.S. carriers with access to markets that are roughly comparable to ours.[43] Ultimately, however, air services should be brought into the WTO (from which they are currently excluded), since regional accords will provide more access to the U.S. markets than can be offered in exchange. (European and Japanese internal markets were only about 10% the size of the domestic U.S. market in 1994.)

Prior to 1988, FAA regulations required U.S. carriers to perform all regularly scheduled maintenance at domestic facilities.

ENDNOTES

1. Countries with significant or growing aerospace industries include Canada, Brazil, the United Kingdom, France, Italy, Germany, Russia, China, Japan, the Netherlands, Spain, Indonesia, India, Taiwan, South Korea, Singapore, the Ukraine, the Czech Republic, Turkey, Egypt, Sweden, Norway, Denmark, Israel, Australia, Northern Ireland, Belgium, Argentina, Jordan, Pakistan, the Philippines, and Thailand.

2. Around 17% of total aerospace industry sales are not identified by customer and are thus excluded from these calculations.

3. Comment by Virginia Lopez, executive director, Research Center, Aerospace Industries Association, speaking at panel discussion sponsored by the Center for National Policy, September 8, 1994.

4. The military share of aerospace revenues (by destination of final output) peaked at 75% in 1987 for the United States, 71.6% in 1982 for the European Union, and 65.5% in 1985 for Japan. Reliable comparable figures for China and the former USSR are unavailable, but were certainly higher as a proportion of total aerospace output (European Commission 1994,195196).

5. Sandra Pianalto, commissioner. Comments to the National Airline Commission. Hearing transcript, June 24, 1993, 29.

6. During the National Airline Commission hearings, investment banker and commissioner Felix Rohatyn calculated that the three largest U.S. carriers (United, American, and Delta), which all had debt-to-equity ratios in excess of 80%, would need to raise an additional $15 billion in *new* equity in order to achieve a 50% ratio, which Rohatyn described as a "respectable ratio for a capital intensive" business. Expressing deep concern about the industry's ability to finance its huge future capital requirements, Rohatyn noted that "this is an industry which has never earned $15 billion in its history." (National Airline Commission. Hearing transcript, proceedings, June 3, 1993, 129).

7. Note that employment of unionized machinists declined 22% at GE Aerospace between 1990 and 1995 and 39% at UTC-Jet Engines (personal communication, International Association of Machinists, June 2, 1995).

8. See also March (1989, 11-12).

9. See also Shiller (1992).

10. Interestingly, some of Boeing's Japanese subcontractors will further subcontract some of their Boeing work to manufacturers in China.

11. As noted elsewhere, McDonnell Douglas has co-produced MD-80 series aircraft in China; it will shortly coproduce MD-90s in China as well, and it has formed a consortium to produce the MD-95.

12. Beyond the financial constraints, there are also questions associated with potential antitrust problems such a consortium would encounter, as noted above. Ironically, it appears easier for U.S. companies to enter into such arrangements with foreign partners than with domestic companies.

13. Samuels goes on to observe that, "The cutbacks prompted one of the luckier first-tier Boeing subcontractors to note that Boeing expects 'us to take over and maintain the links with second-tier companies. But my [subcontracting] shops are going bankrupt so fast that soon we'll have one to subcontract to up here [in Puget Sound]."'

14. Wages and salaries increased slightly in 1993 to 22.7% of sales, which probably reflects increased work on the 777, for which sales will not be recorded until the first aircraft is delivered in mid-1995.

15. Reich says that his projection that Boeing would not re-hire many of those currently laid off even when Boeing production ramps up again evoked little reaction. However, he says, "once the orders start coming in, production grows again and earnings ratchet up, people will appreciate what Boeing is doing." Boeing will be outsourcing work previously done by Boeing employees "all over the world," observes Reich (Reich 1994b).

16. Another British analyst noted that Boeing's decision to have a U.K. supplier manufacture the new-generation 737-700 wing leading edge "is the first ever incidence of Boeing outsourcing in-house aerostructures manufacturing." Smith New Court Securities said that Boeing's strategy is to outsource increasing amounts of work "to specialized shops that have a considerably lower cost base . . . . This is part of Boeing's overall strategy to use the manufacturing process as a source of competitive advantage, by reducing both the cost and time to manufacture aircraft" (Smith New Court Securities 1994, 7).

17. The engine would be made by a Rolls-Royce-BMW consortium, Italy's Alenia would manufacture the fuselage sections, Hyundai's Halla Engineering & Heavy Industry would build the wings, a Korean Airlines subsidiary would make the nose section, and ShinMaywa Industries of Japan would build the horizontal stabilizers. Other participants in the program will include a division of British Aerospace (manufacturing the empennage), a division of Israel Aircraft Industries (making the landing gear), Honeywell (supplying the guidance and avionics), an AlliedSignal unit (making the environmental control systems), and Sundstrand (providing the electrical power system). In a step presaged by McDonnell Douglas's MD-80 coproduction in China, the company announced that final assembly would be performed by Dalfort Aviation (a company with major maintenance experience on the DC-9) at Dallas' Love Field.

18. Author's interview with George Kourpias, July 1994.

19. The study was promised by the Clinton administration as part of its response to the National Airline Commission's report.

20. Linear time trend estimated with data from sources listed in Table 2, above.

21. These estimates combine the effects of increased imports (discussed in the previous paragraph) with DRI estimates of job loss from foreign competition (Tables 9 and 10, above). This analysis assumes that foreign competition in the DRI analysis reduces export markets for U.S. products, while outsourcing results in increased imports. This approach may include some double counting to the extent that foreign competition results in increased imports (e.g., Airbus sales in the United States). However, the import share could grow more rapidly in the future than it did in the past two decades (Figure 5) because of the rapid growth in the offset and technology transfer agreements described in this report. Therefore, this would appear to be a reasonable forecast range for total future employment losses in this sector.

22. Based on the analysis in Table 10 and on the outsourcing of components from foreign sources, as described in the previous paragraph.

23. Indirect job losses are estimated on the basis of the maximum employment losses given in the preceding paragraph, in each year.

24. Aerospatiale was formed and owned by the French government in 1970 through the merger of several French manufacturers and has financial interests in Helibras (Brazil); Samero (Singapore), and MarocAviation (Morocco). About half of its non-Airbus activities are in tactical and ballistic missiles; the balance is distributed between fixed-wing aircraft and helicopters. Aerospatiale performs final assembly (along with other work) on all current Airbus offerings except the A-321 (and the announced but not yet in production A-319). Over the years, it has received significant subsidies from the French government, beyond the direct assistance it has received in connection with the Airbus programs.

25. A subsidiary of the giant manufacturing conglomerate Daimler-Benz and recently renamed Daimler-Benz Aerospace (it was previously Deutsche Aerospace) is the result of multiple mergers among German aircraft and engine manufacturers and the acquisition of the outstanding shares of the Netherlands' Fokker Aircraft. The company manufactures a wide range of structural components for all Airbus aircraft, integrates most of its fuselages, and performs final assembly on the A-321 and eventually the A-3 19 narrow-body as well.

26. British Aerospace PLC has a 20% stake in the A-300, A300-600, and A-3 10 civil transports, a 25% stake in the A-320/A321/A3 19 program, and a 25% stake in the A330/340 program. BAe's primary responsibility on Airbus aircraft is the design and fabrication of the wings, a critical technology that the company has fought hard to maintain.

27. CASA manufactures various components for all Airbus aircraft. In addition to its Airbus activities, CASA manufactures various parts for McDonnell Douglas and Boeing.

28. Additional European work is generated through associations with Fokker (Netherlands, and now owned by Daimler-Benz Aerospace), Belairbus (Belgium), and various Italian aerospace companies.

29. Author's background interview with U.S. government official, February 1994.

30. Calculations derived from data in Friedman 1994a and Friedman 1992.

3 1. When Airbus made previous claims about the number of U.S. suppliers from which it purchased goods and services, Airbus North America officials were unable to document such claims. Indeed, Airbus public relations officials acknowledged that the purported list was drawn up during the 1980s and could not be verified by Airbus itself in the early 1990s (author's discussions with Airbus North America personnel, 1992 and 1993).

32. For example, it seems clear that Germany is moving most aggressively to consolidate its aerospace manufacturers, while at the same time it is expanding the breadth of their activities. If for some reason the Airbus alliance weakens, Germany would appear to be in the best position to "go it alone," since Deutsche Aerospace already owns a full-fledged manufacturer of smaller commercial jet aircraft (Fokker) and has been in discussions with a number of other potential partners for the development of new transports.

33. Also see Samuels (1994, 143, 204, and 212) for discussions of early aircraft industry-related legislation.

34. See International Confederation of Free Trade Unions (1994), Jendrzejczyk (1994), and U.S. Department of State 1994.

35. An August 8, 1994 Xinhua domestic radio 'service broadcast reported the signi ng of the contract for Chinese manufacture of the 737 Section 48 fuselage sectionand that the "China Aviation General Administration of China [CAAC] made a formal proposal to Boeing to subcontract the production of

Boeing aircraft in China through compensation trade in June 1992" (Foreign Broadcast Information Service, FBIS-CHI-94-153, August 9, 1994, 34).

36, The *Wall Street* Journal reported that the world's major automotive manufacturers have been told by the Chinese government that "they must start making parts in China before being considered for a license to put in an assembly plant. The government also insists that China retain majority control of any assembly plant regardless of what each partner contributes to a joint venture." The *Journal* also reported that the Ford Motor Company was ready to invest as much as $1 billion in new manufacturing facilities in China, but notes that Ford Vice President Wayne Booker "doesn't know when, where, how or even if the Chinese will let it. 'China is large enough to write its own rules,' he shrugs" (*Wall Street Journal*, December 2, 1994, 1).

37. Quotations in this paragraph are from the Agreement on Trade in Civil Aircraft, as cited by Falken (1993, 150-151).

38, Europeans also complain that they are not being given sufficient data regarding "indirect" U.S. support for the aircraft industry through military research and development and NASA-funded technology research. (See, for example, *European Report*, June 2, 1993.)

39. During the two years 1989 and 1990 alone, federally funded aerospace research and development totaled almost $39 billion (much of it on military aircraft systems and "star wars" technology), three times the amounts expended by aerospace firms out of their own resources. This amount was equal to the total paid-in capital and retained equity of all U.S. aerospace firms combined (Aerospace Industries Association 1994a, Table XI; and 1994b, 104).

40. "By its actions, the government influenced who the competitors were, what they competed on, and how they competed. First-through loan guarantees to Lockheed, an arranged merger between McDonnell and Douglas, and indirect assistance channeled through military R&D proposals and procurement-the government determined who the competitors would be. Second, through its regulation of fare and route structures and through its development support for the new engine technology embodied in the design of both the L-101 1 and the DC-10, the government influenced the terms of competition for both the carriers and the producers. Third, the government influenced the incentives of both Lockheed and McDonnell Douglas to engage in mutually destructive head-on competition in their commercial activities, by providing a life preserver in their military activities" (Tyson 1992, 188).

41. See pages 207-210 for Tyson's discussion of the basic terms contained in the 1992 U.S./EC Bilateral Agreement on Civil Trade in Aircraft.

42. These international standards for labor rights include the IL0 Conventions on the Right to Organize (No. 87), Collective Bargaining (No. 98), Forced Labor (No. 29) and its Abolition (No. 105), Equal Remuneration (No. 100), Employment and Occupation (No. 111) and Child Labor-Minimum Age (No. 138).

43. See generally National Commission to Ensure a Strong Competitive Airline Industry 1993.

BIBLIOGRAPHY

Aerospace Industries Association. 1993a. 1993 Year-End Review and Forecast. Washington, D.C.: Aerospace Industries Association.

Aerospace Industries Association. 1993b. ***Facts*** & ***Figures*** 1993-1994. Washington, D.C.: Aerospace Industries Association.

Aerospace Industries Association. 1994a. 1994 Year-End ***Review*** and *Forecast.* Washington, D.C.: Aerospace Industries Association, December 14.

Aerospace Industries Association. 1994b. ***After The Cold War: The U.S. Aerospace Industry in the International Marketplace.*** Washington, D.C.: Aerospace Industries Association.

Aerospace Industries Association. 1994c. ***Facts & Figures 1994-1995.*** Washington, D.C.: Aerospace Industries Association.

Airbus Industrie. 1993. ***Market Perspectives for Civil Jet Aircraft.*** France: Blagnac Cedex.

Airbus Industrie of ***North*** America. 1994. ***Insiders Report.*** Herndon, Va.: Airbus Industrie of North America, October.

Aseritis, Peter. 1994. *Aerospace/Defense* ***Electronics Quarterly.*** New York: The First Boston Corporation, July 18.

Aviation Week & Space Technology. Various issues. New York: McGraw-Hill.

Baker, Gerald. 1994. "Boeing Warns of Battle for Clients." ***Financial Times.*** November 8.

Boeing Company. 1992. ***Commercial Market Outlook,*** 1992. Seattle: Boeing Company.

Boeing Company. 1993. ***1993 Boeing Annual Report.*** Seattle: Boeing Company.

Boeing Company. 1994 ***Commercial Market Outlook,*** 1994. Seattle: Boeing Company.

China Aero Information. Various issues. Beijing, China: China Aero Information Centre.

Congressional Research Service. 1992. *Airbus* ***Industrie: An Economic and Trade Perspective.*** Washington, DC.: Congressional Research Service, February 20.

Dempsey, Steven Paul. 1993. Submission to National Airline Commission. June 1.

DRI/McGraw-Hill and the Teal Group. 1994. "High-Skill, High-Wage Production Jobs in the U.S. Aviation Industry." Report prepared under contract with U.S. Department of Labor, July.

Eberstadt, George. 1991. "Government Support of Large Commercial Aircraft Industries of Japan, Europe and the United States." Contractor Report. Washington, DC.: U.S. Congress, Office of Technology Assessment, May.

European Commission, The. 1994. ***The European Aerospace Industry, Trading Position and Figures,*** 1994. Brussels: The European Commission.

Falken, Steve. 1993. "Testimony" in National Airline Commission Hearing Transcript, May 26, pp. 147-162.

Federation of American Scientists. 1994. Sweet ***Deals and Low Politics: Offsets in the Arms Market.*** Washington, D.C.: Journal of the Federation of American Scientists, January/February.

Fitzgerald, Gerry. 1994. ***The Global Aviation Repair Shop.*** Aviation Week Group. Washington, D.C.: McGraw-Hill.

Free China Journal. 1993. "Boeing Signs for Joint Project to Build Aerospace Testing Lab," February 8.

Friedman, Phil. 1994. ***Airbus - Industry Report. New*** York: Morgan Stanley & Company, July 16.

Friedman, Phil et al. 1992. ***Commercial Jet Quarterly.*** New York: Morgan Stanley & Company, May 4.

Friedman, Phil et al. 1994a. ***Commercial Jet Quarterly.*** New York: Morgan Stanley & Company, November 30.

Friedman, Phil et al. 1994b. ***McDonnell Douglas - Company Report.*** New York: Morgan Stanley & Company, August 18.

Friedman, Phil et al. 1994c. ***Commercial Jet Quarterly.*** New York: Morgan Stanley & Company, August 17.

Fuqua, Don. 1994. Prepared Remarks. Aerospace Industries Association. December 14.

Gelman Research Associates. 1990. "An Economic and Financial Review of Airbus Industrie." Contractors Report. Washington, D.C.: U.S. Department of Commerce, September 4.

General Accounting Office. 1994a. ***International Trade: Long-Term Viability of U.S.-European Union Aircraft Agreement Uncertain.*** Washington, D.C.: General Accounting Office, December.

General Accounting Office. 1994b. ***Military Exports: Concerns Over Offsets Generated with U.S. Foreign Military Financing Program Funds.*** Washington, D.C.: General Accounting Office, June.

General Accounting ***Office.*** 1994c. ***Asian Aeronautics, Technology Acquisition Drives Industry Development.*** Washington, D.C.: General Accounting Office, May.

International Confederation of Free Trade Unions. 1994. "Behind China's Economic Miracle: Workers' Repression," ***ICFTU Briefing,*** June.

Jendrzejczyk, Mike. 1994. "Statement," Washington, D.C.: Human Rights Watch/Asia. Unpublished manuscript, April 21.

March, Artemis. 1989. "The U.S. Commercial Aircraft Industry and Its Foreign Competitors." In ***Working Papers of the MIT Commission on Industrial Productivity.*** Volume 1. Cambridge, Mass.: MIT Press.

Merrill Lynch. 1994a. "Aerospace and Plane Talk." November 28.

Merrill Lynch. 1994b. ***McDonnell Douglas Company - Company Report.*** New York: Merrill Lynch, August 11.

Moran, Theodore H., and David C. Mowery. 1992. "Aerospace." In Raymond Vernon and Ethan B. Kapstein, eds., ***Defense and Dependence in*** a ***Global Economy.*** Washington, D.C.: Congressional Quarterly, p. 137.

Mowery, David C., and Nathan Rosenberg. 1985. ***The Japanese Commercial Aircraft Industry Since 1945: Government Policy, Technical Development, and Industrial Structure.*** Stanford, Calif.: The International Strategic Institute at Stanford, pp. 16-17.

National Airline Commission. 1993. ***Change, Challenge, and Competition, A Report to the President and Congress.*** Washington, D.C.: The National Commission to Ensure a Strong Competitive Airline Industry, August.

National Commission to Ensure a Strong Competitive Airline Industry. 1993. Hearings transcripts, May-August.

National Research Council. 1994. ***High-Stakes Aviation: U.S.-Japan Technology Linkages in Transport Aircraft.*** Washington, D.C.: National Academy Press.

National Research Council. 1985. ***The Competitive Status of the U.S. Civil Aviation Manufacturing Industry: A Study of the Influence of Technology in Determining Industrial Competitive Advantage.*** Washington, D.C.: National Academy Press.

Porter, Michael R. 1992. ***Capital Choices: Changing the Way America Invests In Its Industry.*** Washington, D.C.: Council on Competitiveness.

Prudential Securities. 1992. "McDonnell Douglas Company Report," January 30.

Reich, ***Gary.*** 1994a. ***Boeing Company Report.*** New York: Prudential Securities, January 13.

Reich, Gary. 1994b. Personal Communication.

Samuels, Richard J. 1994. ***Rich Nation, Strong Army, National Security and Technological Transformation of Japan.*** Ithaca, N.Y.: Cornell University Press.

Samuels, Richard J., and Benjamin C. Whipple. 1989. "The FSX and Japan's Strategy for Aerospace." ***Technology Review,*** October.

Shapiro, ***G.*** D. et al. 1994a. ***McDonnell Douglas Corporation Company Report.*** New York: Salomon Brothers, September 27.

Shapiro, ***G.*** D. et al. 1994b. ***McDonnell Douglas - Company Report.*** New York: Salomon Brothers, July 28.

Shear, Jeff. 1994. ***The Keys to the Kingdom, The FS-X Deal and the Selling of America's Future to Japan.*** New York: Doubleday.

Shiller, Robert J. 1992. "Background Paper." In Twentieth Century Fund, eds., ***The Report of the Twentieth Century Fund Task Force on Market Speculation and Corporate Governance. New*** York: Twentieth Century Fund Press.

Smith ***New Court*** Securities, PLC. 1994. ***Aerostructures Hamblé Holdings.*** London: Smith New **Court** Securities, PLC, July 13.

Standard & Poor's 1994a. ***Aerospace & Air Transport, Current Analysis.*** Standard & Poor's Industry Surveys. New York: Standard & Poor's, December 1.

Standard & Poor's. 1994b. *Aerospace & Air Transport, Basic Analysis.* Standard & Poor's Industry Surveys. New York: Standard & Poor's, June 30.

Steinbruner, Maureen, and Joe Nation. 1994. *Up in the Air: The Impact of the Aerospace and Air Transportation Industries on National Compensation.* Washington, D.C.: Center for National Policy, September.

Twentieth Century Fund. 1992. *The Report of the Twentieth Century Fund Task Force on Market Speculation and Corporate Governance:* New York: Twentieth Century Fund Press.

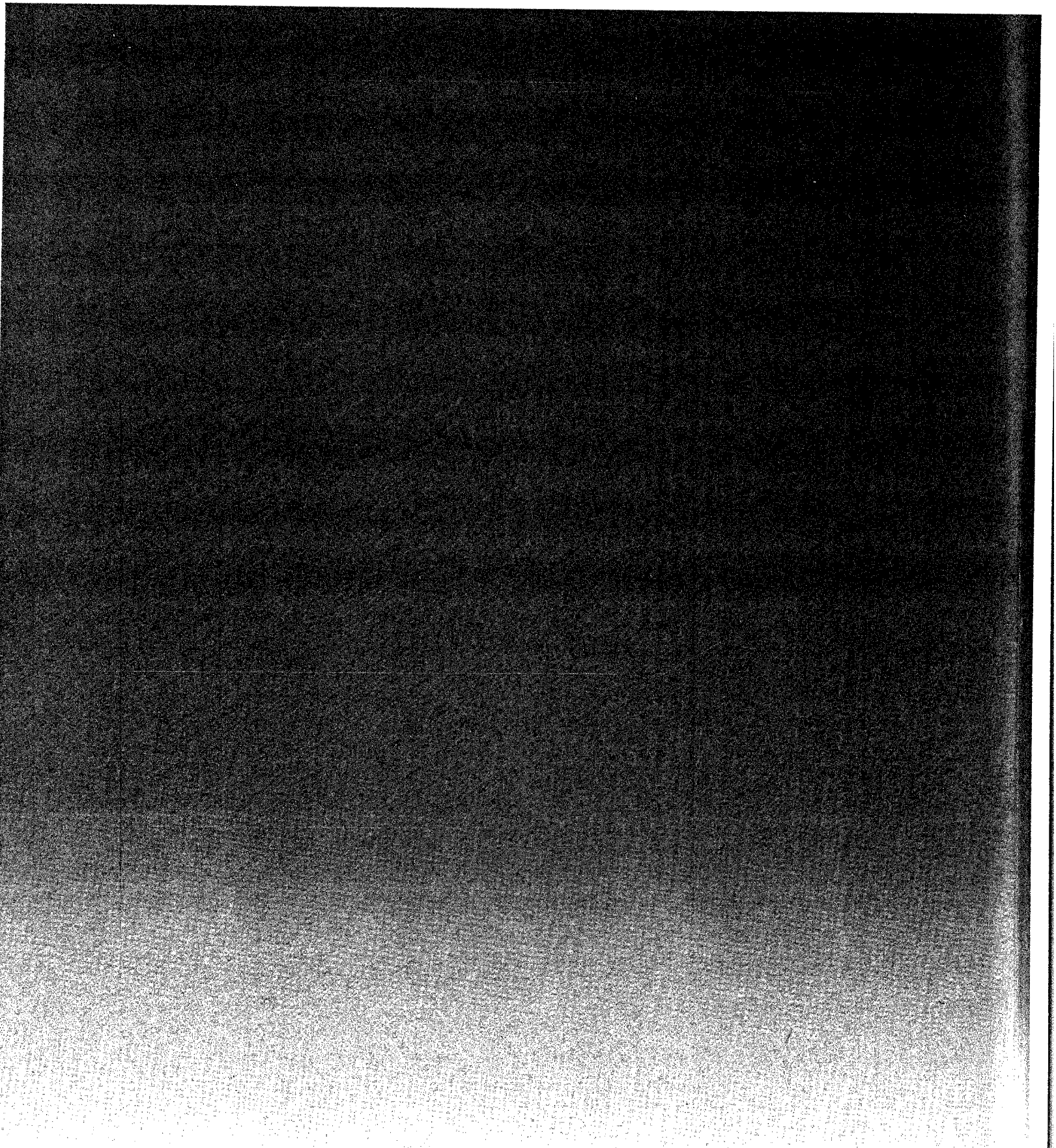
Tyler, Patrick E. 1995. "Western Lift for China's Air Plans." New *York Times,* February 25, p. 37.

Tyson, Laura D' Andrea. 1992. *Who's Bashing Whom? Trade Conflict in High-Technology Industries.* Washington, DC.: Institute for International Economics.

U.S. Department of State. 1994. *Analysis of China's Human Rights Violations.* Washington D.C.: U.S. Department of State.

Wall Street Journal. 1994. "Britain to Order 25 Lockheed Aircraft; Says it May Buy 50 Airbus Planes Later," December 19.

Warburg Securities, S. G. 1994. Aerospace *Outlook, U.K. - Industry Report.* London: S.G. Warburg Securities, September 12.



Economic Policy Institute

1660 L Street, NW, Suite 1200, Washington, D.C. 20036

ISBN: O-944826-64-4