Chapter 2

Dynamics of World Armaments Production, Arms Transfers and Defense Markets

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Chapter 2

Dynamics of World Armaments Production, Arms Transfers and Defense Markets

The most important macroeconomic force acting on the defense industries of the West is the general decline in military expenditures and procurement levels that began in the United States and Western Europe in 1987, and is expected to continue despite the recent crisis in the Persian Gulf. The most prominent macroeconomic force is the rapidly rising cost associated with weapons research, development, and production. The demand for capital to finance new weapons programs will exert increasing pressure on most prime contractors to engage in corporate fiances and joint ventures, and in many cases, to enter into mergers and acquisitions. Some defense firms may also be expected to close.

This chapter provides both an overview of the defense marketplace and a comparative analysis of the defense industries of the United States, Western Europe, and Japan. The United States, of course, remains by far the largest market for armaments, and this is unlikely to change over the next 5 years. However, decreasing levels of procurement in the United States and NATO-Europe will create severe challenges for firms that serve national defense establishments; the prognosis for Japanese procurement is less clear.[1]

In drawing comparisons among countries, this chapter describes the defense marketplace in terms of five key indicators: military expenditures, defense procurement, defense R&D spending, defense industry employment (not military employment), and arms exports. Military expenditures and procurement levels provide the microenvironment for defense firms. Defense R&D spending indicates the degree to which countries seek to retain an option to engage in the production of modern weaponry. Defense industry employment trends suggest industry expansion or contraction. Finally, arms export trends reveal the extent to which cyclical downturns in defense spending may be offset by overseas sales. Each of these indicators is examined in the analysis of the United States, Western Europe, and Japan that appears below, but first a brief overview of the defense marketplace is presented.

THE DEFENSE MARKETPLACE

The defense marketplace mainly consists of governments that purchase military equipment for their national armed forces from public and private sector armaments manufacturers. The extent to which this equipment is purchased domestically or imported varies widely from country to country.

U.S. and world defense spending peaked in 1987, and has declined in each subsequent year. Particular segments of the defense industry have already felt the contraction. Shipments of U.S. military aircraft peaked in 1987, when 1,199 units, at a value of $24 billion, were delivered to the armed services and to foreign customers. Since then, sales have fallen by 25 percent; in 1989 the industry shipped 1,110 units with a value of $17 billion. According to the U.S. Department of Commerce, aircraft orders are projected to continue their fall until 1992, after which a modest upturn is expected.[2]

In principle, decreases in domestic levels of procurement could be offset by arms transfers. The recent crisis in the Persian Gulf, for example, may result in arms sales for U.S. defense firms of nearly $24 billion over the next 5 years. However, the overall volume of the arms trade has been contracting since 1987.

The United States and Soviet Union supply 65 percent of all armaments in world trade (see figure 1-12 inch. 1). The armaments they sell have become increasingly sophisticated, while the terms of trade have changed over time. Whereas in the past the major arms producers sold only end items off the shelf (often older weapons sold out of inventories), they now engage in licensed coproduction, codevelopment, and offset arrangements that enable smaller states to build indigenous armaments industries.[3] In

[1] See ch. 6 on Japan.

[2] U.S. Department of Commerce, *Industrial Outlook 1990* (Washington DC: U.S. Government Printing Office, 1990) pp. 25-26.

[3] U.S. Congress, Office of Technology Assessment, *Arming Our Allies: Cooperation and Competition in Defense Technology,* OTA-ISC-449 (Washington, DC: U.S. Government Printing Office, 1990).

turn, these emerging industries, as in Brazil and Israel, have found market niches, allowing them to become exporters in their own right.

Although the arms trade assumes tremendous importance as a public policy issue, in macroeconomic terms it remains relatively small. During the 1980s, world trade averaged around $2 trillion per year; of that amount $1.4 trillion were manufactured goods. Arms exports constituted about 2.2 percent of all exports. Even for a country like France, which many regard as highly dependent on arms sales for export revenues, the numbers provide a different view. In 1986, France had export sales of $133 billion, and arms sales made up only $4.6 billion of the total. Of all the major exporters, it appears as if the Soviet Union may be most seriously damaged by a decline in export sales.

Of course, arms sales are more important when viewed from the perspective of particular firms or regions within arms-exporting nations. For aerospace manufacturers in particular, exports are often viewed as critical to industrial health. The French firmm Dassault, for example, exported over 70 percent of its production, and 32 percent of total French defense production was exported in 1988.[4] With the overall contraction of defense spending and export markets, narrow interest groups may seek the easing of export and arms transfer restraints.

The changing economics of defense are forcing firms to restructure operations in preparation for leaner times. One indicator of this change is employment.[5] Between 1987 and 1989, the U.S. military aerospace industry shed 34,000 workers, or 5 percent of its workforce. Notably, this is far less than the 25-percent cut in sales that the industry experienced during the same period, suggesting that layoffs were postponed. Indeed, in 1990, McDonnell Douglas alone dismissed nearly one-third of its 40,000 workers in St. Louis. Shipbuilding employment has fallen steadily since 1985, and it is projected that over 40,000 workers will be laid off by 1995. The leading European defense firms have similarly shed workers. British Aerospace reduced its military workforce by 13 percent between 1988 and 1989, when 6,000 employees were let go, and the French firm Matra decreased its defense-related workforce by 10 percent. Aerospatiale reports that it has reduced its workforce every year since 1982, with the exception of 1989, when 300 new workers were hired, most of whom were engineers and managers.[6] Of the Western allies, only Japan appears to have increased its defense industry workforce in recent years.[7]

Yet another manifestation of excess capacity in the defense industry is the increased level of merger and acquisition activity (this will be discussed in greater detail below). In 1989 alone the European defense industry witnessed over 30 mergers and acquisitions, while several major deals also occurred within the United States, such as Loral's purchase of Ford Aerospace. To the extent that mergers and acquisitions bring efficiencies to the restructured operations, it is almost certain they will also result in layoffs.

There is, however, an important exception to this portrait of excess capacity--defense R&D. Public officials in the United States, Western Europe, and Japan continue to view certain key technology areas as having insufficient capacity. In Western Europe many new technology programs and projects have been undertaken collaboratively, such as JESSI, ESPRIT, EUCLID, and EUREKA. Technologies targeted for growth include those associated with the aerospace industry (e.g., avionics, propulsion, and acoustics), computation, and electronics. The Japanese have also targeted specific technologies, including superconductivity, optics, advanced polymers, artificial intelligence, and biotechnology. In the United States, the Department of Defense (DoD) has recently published a list of 20 critical technologies, and a plan for promoting development in these areas is now being established.[8] Among the critical technologies are advanced materials, semiconductors, artificial intelligence, and biotechnology. These

[4] Avions Marcel Dassault, *Annual Report 1989*; Republic of France, Ministry of Defense, *French Defense Statistics, 1989* (Paris: La Documentation Francaise, 1990).

[5] The problems of this indicator, however, should be made explicit. Decreases in overall employment levels may signify greater operating efficiencies rather than reductions introductive capacity. This is especially apparent in Western Europe, where many defense industries have recently been privatized.

[6] Aérospatiale, "Annual Report," 1989.

[7] Society of Japanese Aerospace Companies, *Japanese Aerospace* in *Figures* (Tokyo: Society of Japanese Aerospace Companies, 1989).

[8] U.S. Department of Defense, Office of the Secretary of Defense, "Critical Technologies Plan," March 1990.

lists, and the policies associated with technology promotion, provide evidence that public officials seek to build new R&D capacity in many defense-related areas, while shrinking the amount of excess capacity in the production of end items.

Overall, however, the macroeconomic environment has not been favorable to the defense industry since 1985, and further contraction is likely for the next 5 years. With scarcer resources available for defense, public policy decisions will play a large part in determining which firms and sectors survive, and which fail. The following section discusses the strategy and structure of the defense industries in the United States, Western Europe, and Japan. Each region has particular strengths and weaknesses as it faces the new economic and security environment.

DEFENSE INDUSTRIES: STRATEGY AND STRUCTURE

The ability of individual companies to survive and prosper varies greatly. This section briefly describes the defense-industrial structures found in the United States, Western Europe, and Japan. Notably, American defense firms are the most dependent on defense contracts for their livelihood, while those in Western Europe and Japan are better diversified across commercial and military sectors. At the same time, U.S. military R&D spending dwarfs levels found elsewhere in the Western alliance, suggesting that American firms will not face many foreign competitors in the production of next-generation defense technology.

The United States

An examination of the prime contractors in the U.S. defense industry reveals the following industrial characteristics:

- Concentration: Overall, the U.S. defense industry is no more concentrated than many sectors in the commercial world; the top 100 firms account for about 75 percent of overall turnover.[9] However, in specific segments the industry is highly concentrated. Only one firm, for example, produces aircraft carriers; only two firms produce submarines; and only two firms produce jet engines. Seven firms, however, produce airframes, a number that may be too large as aerospace procurement shrinks. In the lower tiers of subcontractors, the industry naturally becomes more diffuse.
- Annual Budget Process: Firms make investment decisions using a long-term planning horizon; often 10 years or more. The U.S. Government, however, provides funds for defense procurement on the basis of an annual budget process. As a result, there is a mismatch between project planning and budgeting, which creates programmatic inefficiencies.
- Defense Dependence: The prime contractors depend heavily on defense work for their livelihood. Over 70 percent of McDonnell Douglas' sales come from defense, while virtually all of General Dynamics' sales were defense-related. Over $6 billion of Raytheon's $8.7 billion in 1989 sales were for defense, and for Martin Marietta the figures were $5.6 out of $5.8 billion. United Technologies was among the most diversified of the prime defense contractors, relying on government work for only $5.5 out of $19.0 billion in 1989 sales.
- R&D Intensity: The United States devoted $38 billion to defense research, development, testing, and evaluation in 1988. The major U.S. contractors each spend between $1 and $2 billion per year on defense-related R&D, about half of which is government funded. This means that firms must come up with substantial sums of cash from operating revenues in order to finance their in-house R&D activities. The ability of American firms to generate needed cash varies greatly. Taken as a whole, however, recent changes in tax policy (especially the treatment of deferred taxes) have greatly constricted cash flow, creating major challenges for defense firms as they look to fund future R&D projects.
- No Growth in Sales: This analysis is borne out by DoD projections. DoD is currently projecting real declines in several of its most important procurement categories, and only marginal growth in others.

Declines in defense spending, procurement, and arms sales mean shrinking markets for contractors. The stock market has taken into account the new economic environment, and defense stocks have underperformed the market average by a substantial margin; the outlook for most defense stocks remains

[9] Jacques Gansler, *Affording Defense* (Cambridge, MA: MIT Press, 1989), P. 245.

poor. Similarly, the bond market has given several of the prime contractors near "junk bond" ratings on their debt.[10] The low stock prices that defense firms are now experiencing create problems beyond those of shareholder value. As capital becomes more expensive for fins, it will be more difficult for them to make the investments required for future research, development, testing, and evaluation, since not all these expenses are reimbursed by government. Further, the decline in equity will make debt financing more difficult to obtain, and more expensive when loans are actually made. To the degree that interest expenses eat up operating earnings, firms will have less cash for fresh investment.

This sketch of the U.S. prime contractors suggests an industry that must shed substantial productive capacity in the future. Indeed, even during the military buildup of the 1980s, the capacity utilization rates for defense firms were well below the normal rate of about 80 percent found in commercial enterprises during periods of economic growth. Munitions and aircraft producers traditionally operate at low capacities; often it is argued that excess capacity is necessary to support mobilization requirements.[11] According to a U.S. Air Force study, those prime contractors and principal subcontractors responsible for building fighter aircraft operated at less than 50 percent capacity in peacetime, leaving idle capacity in the event of mobilization. However, capacity is most often measured in terms of utilization rates of plant and equipment. Whether defense firms could find the technical manpower required to meet a sustained surge is a separate issue, and some argue that the United States has little excess capacity in many technical areas.[12]

The Department of Defense has never issued specific guidelines concerning excess capacity; there has been an absence of documents linking military strategy with defense industrial base requirements. But the large excess manufacturing capacity (ranging from over 90 percent in the munitions industry to between 30 and 50 percent in most other segments of the defense industry) increases the costs of defense production, and its availability is a distinct discouragement to firms **that** wish to modernize the capacity actually in use, or to new firms that might wish to enter defense markets.[13]

Given these characteristics of the industry, what has been its economic response to shrinking markets? First, there has been a trend toward mergers and acquisitions. Prominent examples include Lockheed's acquisition of Sanders Associates in 1986, the leveraged buyout of Singer in 1987, and the 1989 purchase of Ford Aerospace by Loral. Second, firms have engaged in multifirm and multinational teaming arrangements. According to General Dynamics,

> [A]s a result of the increased financial commitments required for new weapon systems, the company is developing tearning agreements to compete for new programs. The company is currently teamed with the Boeing Company and Lockheed Corporation to produce two prototypes of the Advanced Tactical Fighter. The Company, teamed with McDonnell Douglas Corporation, was awarded a development contract for the U.S. Navy's Advanced Tactical Aircraft (A-12). Teaming arrangements with companies in other countries are in place for the Ml tank, U.S. Army's Single Channel Ground and Airborne Radio System and for the FSX fighter aircraft.[14]

The objective of such teaming arrangements has been to share the technological and financial risks associated with R&D and prototype construction and, in the case of multinational teaming, to enter foreign markets.

Third, the industry relies on global sourcing, purchasing an increasing number of components abroad. According to DoD, the import penetration of defense-related goods and services mirrors the import penetration of commercial-equivalent goods and services (with such important exceptions as aircraft). In 1989, for example, defense firms purchased 7 billion dollars' worth of semiconductors. According to DoD, $2.6 billion were imported, or 38 percent. This shift to foreign sourcing of defense goods is relatively new in the American experience.[15]

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[10] Philip Finnegan, "Industry Remains in Debt Downturn," *Defense* News, vol. 5, No. 41, Oct. 8, 1990, p. 4.

[11] John Hiller and Judith Larrabee, *Production for Defense* (Washington DC: National Defense University Press, 1980), PP. 5-6.

[12] Aerospace Education Foundation, *America's Next Crisis: The Shortfall in Technical Manpower* (Arlington, VA: Aerospace Education Foundation, 1989).

[13] Jacques Gansler, *The Defense Industry* (Cambridge, MA: MIT Press, 1980), pp. 56-57.

[14] General Dynamics Corp., "Annual Report," 1989.

[15] U.S. Department of Defense, *Defense Purchases*, n.d.

Photo credit: U.S. Department of Defense

An M1A1 Abrams main battle tank on maneuvers in Saudi Arabia. General Dynamics, producer of the MI tank series, has arranged for the MI to be produced under license in Egypt.

Fourth, defense firms have sought expanded opportunities to codevelop civilian and military products, and to reduce the existing restrictions on commercialization of defense-related technology. Indeed, most of DoD's critical technologies have both civil and military applications. Of the critical technologies receiving the bulk of DoD funding, the four highest priorities—fiber optics, simulation and modeling, turbines, and composite materials-all have "near-term, commercial applications in common. . . .' '[16]

Finally, the industry has turned **to** its traditional outlet during downturns-exports. As suggested above, however, exports are not likely to reverse the trend because a large expansion in foreign sales is not expected, and defense exports average only about 10 percent of U.S. industry's sales. The largest military export item, aircraft, has steadily declined from a 1987 peak of $3.6 billion to a 1990 forecasted level of $1.4 billion. In 1994, DoD projects Foreign Military Sales (FMS) of aircraft to total $1.5 billion, or almost zero growth.

The U.S. industry characteristics and responses described above provide a baseline with which to compare firms in Western Europe and Japan. Each of these areas has **distinct** strengths and weaknesses. On an individual firm level, it would appear **that some** foreign companies may be better able **to** withstand defense spending downturns than their American counterparts, given their relative degree of diversification.

Western Europe

With the end of the Cold War, military expenditures and procurement levels are now in decline throughout Western Europe. In fact, defense spending as a percentage of gross national product has been in decline since 1983. Expenditures in NATO-Europe have fallen from their peak of 3.7 percent of GNP in 1983 to 3.3 percent in 1988. Equipment expenditures as a percentage of military spending have also declined.

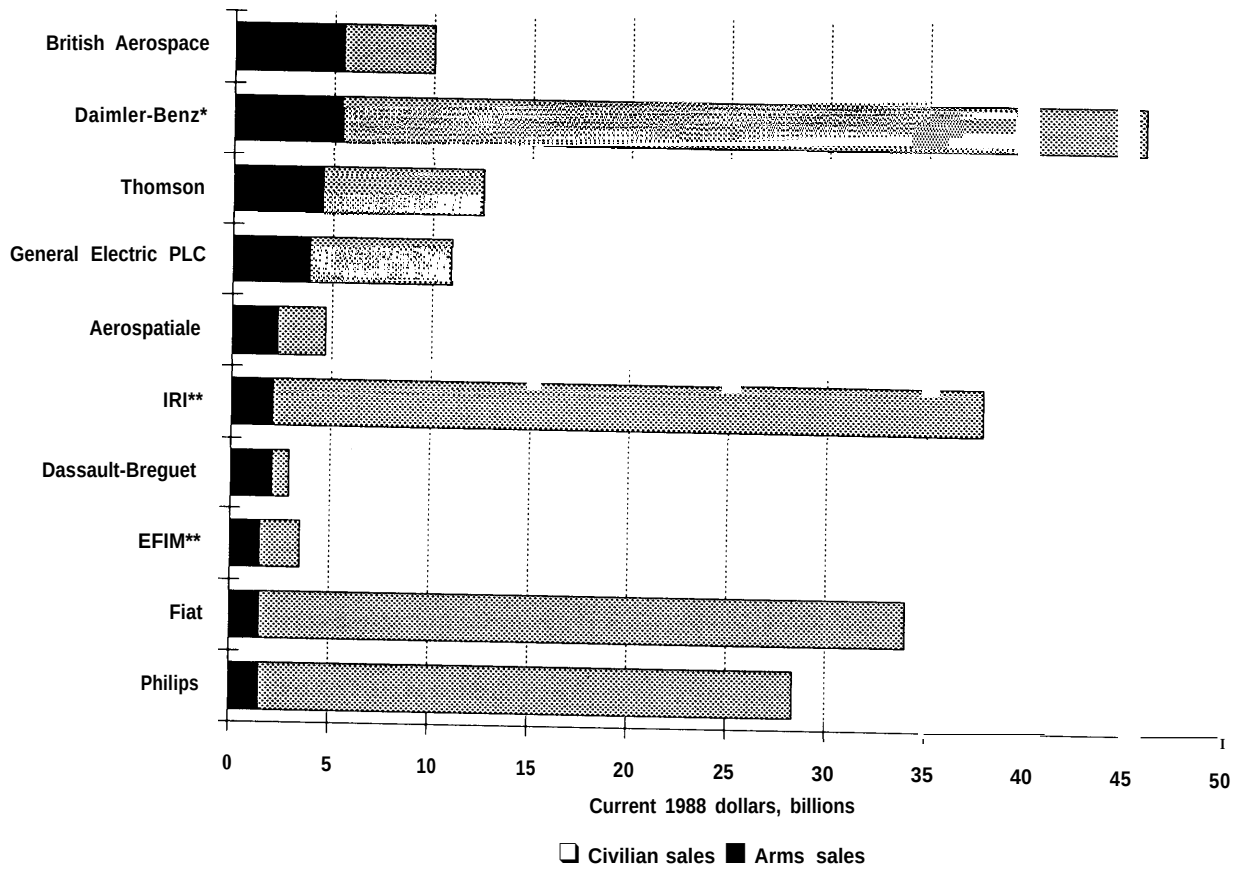
However, one fundamental difference distinguishes European defense firms from those of the United States: European firms cannot generally survive on domestic weapons procurement alone. Many American firms rely on defense for over 90 percent of their earnings. Most European companies, in contrast, are far more diversified. British Aerospace relies on defense for 40 percent of corporate sales; Thomson-CSF derives 65 percent of its revenues from defense; Matra is 70 percent defense-dependent; while Aerospatiale is only 44 percent dependent. Notably, in most firms the defense dependency has decreased in recent years; thus, in 1987 Aerospatiale relied on military sales for 55 percent of revenues, while the figure for British Aerospace was 70 percent.

A second difference is that most European defense firms remain much smaller than their American counterparts. In 1989, the largest European firm, British Aerospace, had defense sales of $5.4 billion; the largest American firm, McDonnell Douglas, sold twice that amount (see figure 2-l).

The largest European defense firms appear to spend more on R&D as a percentage of sales than do American companies. In some cases, they reach R&D spending levels that rival those found in the United States. Thomson-CSF, with defense sales of $4.6 billion, spent over $1 billion on R&D in 1989, half of which was internally financed. One explanation for this is that European firms consciously seek

[16]U.S. Department of Defense, Office of the Secretary of Defense, op. cit., footnote 8, P. 10.

Figure 2-1—Western Europe's 10 Largest Defense Companies, by Sales 1988 (current 1988 dollars, billions)



.MBB, AEG, MTU, Dornier, Mercedes

.* Holding company

SOURCE: Stockholm International Peace Research Institute, SIPRI Yearbook 1990, *World Armament ans Disarmament, 1990(Oxford: Oxford* Univeristy Press, 1990), pp. 328-328.

to promote spillovers between commercial and military technologies. Nonetheless, taken as a whole the United States dwarfs Western Europe in terms of defense R&D spending. While the U.S. Government spent some $38 billion on research, development, testing, and evaluation in 1988, the comparable European figure **was** $8.4 billion. This suggests the difficulty that European firms face in remaining competitive across-the-board in military technology, and the need for a' 'niche' strategy as they seek new market opportunities.

A third characteristi of European defense industries is that they depend on exports. In 1970, France exported 18 percent of its defense production; in 1985 it was 42 percent. By 1987, that number had fallen to 32 percent, and the contraction in export markets was creating financial difficulties for prominent French defense fins, notably GIAT and Dassault (in 1988 Dassault exported 70 percent of its production). The United Kingdom has exported on average 20 percent of its armaments, though the amount decreased in 1988 to about 15 percent, and for certain firms-e.g., British Aerospace-th export dependence has been significantly higher.[17]

The economics of the European defense industry has been neatly summed up:

> . . . [R]apid and costly change, the contraction of traditional markets, the stagnation of European defense budgets in the face of the remarkable

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American R&D effort: such is the scene confronting Europe's defense industry.[18]

The responses to these economic trends have been threefold. First, Western Europe has experienced widespread privatization of defense firms. Whereas in 1975 few defense firms were in private hands, by 1988 privatization had become the norm in every major country with the exception of Italy and Spain. Recent years have seen the privatization of the giants of European defense, including British Aerospace, Matra, Thomson-CSF, and MBB. This has facilitated the ability of firms to sell inefficient or unprofitable operations, -to consolidate activities with other companies, and to engage in widespread competition in a variety of product lines. Further, it has led the firms to diversify their operations; as a consequence, the ratio of defense sales to total sales has, in general, declined throughout the European defense industry.

Second, there has been substantial consolidation. Between 1987 and 1988, 100 defense acquisitions were reported in Western Europe; as stated above, a further 30 major acquisitions occurred in 1989. Of these acquisitions, 70 percent occurred within Europe (mainly within rather than across national borders) while 30 percent were transatlantic. If one objective of European concentration is to create firms the size of their American and Japanese counterparts, this trend must continue. According to one European study, consolidation at this level would require that at least two-thirds of the companies manufacturing major systems be acquired by others. Consolidation is also made manifest in reductions in industrial employment, as reported earlier in this chapter.[19]

Current European projections suggest a possible retreat from defense business. Whereas in 1987 Western Europe's aerospace industry met 28 percent of world demand for military aircraft and missiles, this market share may fall to 23 percent by 2010. Europe's ailing shipbuilding sector has been forced to quit defense work. By necessity if not by choice, the Europeans appear to be engaged in a diversification move away from defense.

Finally, there has been collaboration. The objectives of intra-European armaments collaboration have included strengthening remaining armaments industries by promoting **a** division of labor, increasing American purchases of European equipment, and promoting the standardization of weapons systems within Western Europe. European collaboration has been institutionalized under the Independent European Program Group (IEPG), which has been vigorously led in recent years by Britain's procurement chief, Sir Peter Levene. Indeed, in November 1988, the IEPG approved an "action plan" that called for the creation of a "common European arms market."

European collaboration has also had **a** distinctively technological element. Among the collaborative ventures aimed at technology promotion are ESPRIT, JESSI, EUREKA, and EUCLID. The latter has an explicit military orientation, and collaborative projects are anticipated in such areas as artificial intelligence, satellite surveillance and verification, and aeronautics. Collaboration in basic R&D and end-item production have become well established throughout the European Community.

These three responses to the microenvironment for defense have given European defense firms a degree of flexibility that their American counterparts lack. They are poised to increase their share of civilian markets and to take advantage of the economies of scale associated with the Single European Act. At the same time, they are investing in defense R&D in order to maintain military capabilities. While these capabilities will not be as great as those found in the United States-the United States outspends Western Europe by a 3 to 1 margin in defense R&D--they appear at present to be sufficient given the easing of East/West tensions. Further, since European governments-united or separately-do not appear ready to allow U.S. defense firms to compete on an equal footing for procurement contracts, European companies can continue to enjoy protectionist walls. Indeed, they can benefit from protection not only through greater profits, but by demanding collaborative, technology-sharing agreements with American firms that seek market access; in short, the Europeans are taking a free ride on U.S. military R&D expenditures.

[18]Francois Heisbourg, "Public Policy and the Creation of a European Arms Market," in Pauline Creasey and Sirnon May (eds.), *The European Arms Market and Procurement Cooperation* (London: Macmillan, 1988), p. 68.

[19]GRIP, *Memento Defense-Desarmament 1990 (Brussels: GRIP,* 1990).

Japan

Japan appears to be the sole member of the Western alliance **that views the** defense industry as an expanding sector, although there is considerable debate in Japan on the long-term trend. Japan's defense budget has climbed inconstant 1988 dollars from a 1983 level of $22.5 billion to a 1988 level of $29.0 billion, an increase of 30 percent. Equipment expenditures have risen from 26 to 28 percent of the budget during the same time period. Among the Japanese government agencies engaged in research and development, the Japan Defense Agency (JDA) enjoyed the sharpest increase in fiscal year 1988, with a nearly 12-percent budget hike. Further, anecdotal evidence suggests that employment in the defense industry is rising. Aerospace employment, for example, has climbed by 11 percent over the past 5 years. Remarkably, defense agency purchases of aircraft increased by 55 percent over the same period.

That Japan has increased its military capabilities cannot be doubted. By 1988, Japan had the third largest defense budget in the world. Nonetheless, Japanese defense expenditures were less than 10 percent of the comparable amount for the United States.

While Japan is not an exporter of defense end-items, its domestic industries do provide the Self Defense Forces (SDF) with over 80 percent of their equipment needs. The largest defense contractor, Mitsubishi Heavy Industries, now derives 17.4 percent of its sales from the military, while the second largest contractor, Kawasaki, has military sales equal to 21.5 percent of sales. In comparative perspective, however, Japanese firms are much less dependent on defense work than their American or European counterparts (see table 2-l).

Although Japan's defense industry has only received close scrutiny in recent years, public policy has been directed toward increasing its capabilities for quite some time. In 1970, the director general of the JDA (and later Prime Minister), Yasuhiro Nakasone, published a blueprint defense industrial policy entitled "Basic Policy for Development and Production of Defense Equipment." In this document, Nakasone outlined five objectives for the industry:

- to maintain Japan's industrial base as **a** key factor in national security,
- to acquire equipment from Japan's domestic R&D and production efforts,
- to use civilian industries,
- to have a long-term plan for R&D and production, and
- to introduce the principle of competition into defense production.[20]

In the same year, 1970, the Ministry of International Trade and Industry designated "aerospace as one of three key technologies for the twenty-first century."[21]

Over the past 30 years, Japan has sought to develop its aerospace defense capabilities on the basis of collaborative projects with the United States. Mitsubishi Heavy Industries undertook the coproduction of two fighters in the 1970s, the F-4J and F-15J (both designed by McDonnell Douglas), and in the late 1980s it signed an agreement with General Dynamics for codevelopment and co-production of a new airplane, the Fighter Support/ Experimental (FSX). This last project generated substantial controversy in the United States over the costs and benefits of technology sharing with a leading economic competitor.

A distinguishing characteristic of the Japanese military-industrial complex is the dual-use nature of

Table 2-l-Japan's 10 Largest Defense Companies, by Sales 1989 (1988 dollars, millions)

Firm	Defense sales	Defense sales as percent of total sales
Mitsubishi Heavy Industries	3,054	17,4
Kawasaki Heavy Industries	1,463	21.5
Mitsubishi Electric	938	4.7
NEC	596	2.6
Toshiba	573	2.2
Ishikawajima Harima industries	527	9.9
Nihon Seikosho	261	26.4
Hitachi Shipbuilding	230	8.5
Komatsu	198	3.8
Fujitsu	182	3.8

SOURCE: Office of Technology Assessment estimates, derived from Japan Defense Agency and corporate annual reports.

[20] Cited in Gansler, *Affording Defense*, op. cit., footnote 9, p. 312.

[21] Richard Samuels and Benjamin Whipple, "Defense Reduction and Industrial Development,' Chalmers Johnson et al., *Politics and Productivity* (Cambridge, MA: Ballinger Press, 1989), p. 275,

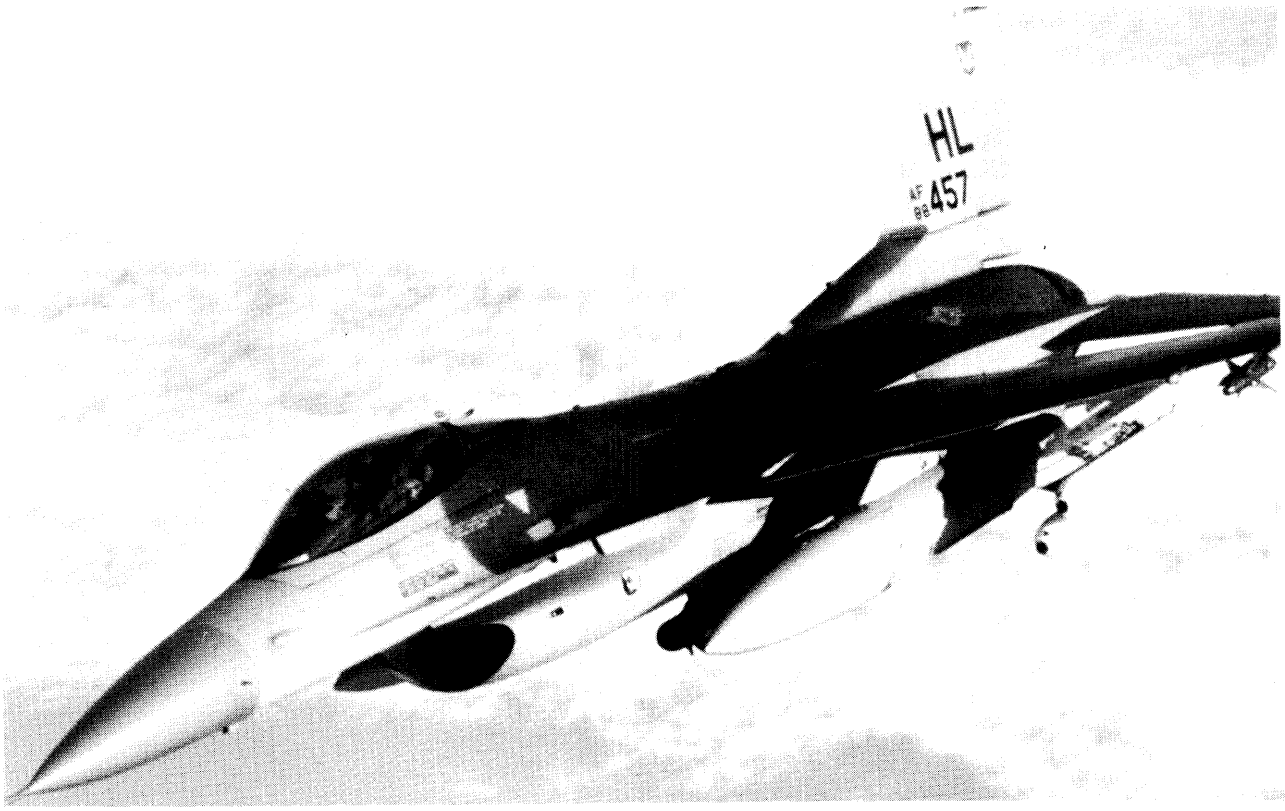

Photo credit: General Dynamics Corp.

The General Dynamics F-16 will serve as the foundation for the Japanese Fighter Support/Experimental (FSX) aircraft, which Mitsubishi Heavy Industries of Japan will produce in injunction with General Dynamics. FSX improvements will include large-scale composite wing structures and an advanced phased array radar.

basic research and technological development. The Japanese Government has targeted certain technologies that are viewed as *key* **to** both commercial and military enterprise, including those associated with aerospace, artificial intelligence, advanced materials, and superconductivity. As a result, Japanese firms are now important suppliers of high technologies for Western military hardware. For example, the modular technology used in ship rehabilitation is borrowed from Japan, and the bulk of commodity microprocessors are now produced by Japanese fins.

Some American officials and military officers emphasize Japan's contribution to the ''arsenal of democracy." One retired U.S. Navy admiral stated in 1987, ''all the critical components of our modern weapons systems . . . come from East Asian industries. . . . Certainly, the East Asian industries have really become an extension of our own military-industrial complex. "[22] While this statement is clearly an exaggeration, it highlights the growing U.S. military dependence on dual-use, high-technology products as opposed to technology transfer or licensed production of Japanese-made defense components by U.S. companies. Indeed, there are very few examples of the latter.

Despite the dual-use nature of Japanese technology, and the relatively small sums (under $1 billion) that JDA devotes to military R&D, the impact of military procurement on key sectors should not be minimized. Nearly 80 percent of Japanese aircraft (in value) were purchased in 1987 by JDA, for a total of $3.7 billion. Indeed, in the aerospace realm, many of the technological spinoffs that result from research, development, and production can be ex-

[22]Cited in James Kurth, "The U.S. and the North Pacific," in Andrew Mack and Paul Keal (eds.), *Security and Arms Control in the North Pacific* (Boston, MA: Allen& Unwin, 1988), p. 35.

pected to come from the military rather than the commercial side.

In sum, the Japanese defense industry is uniquely positioned to profit from the future economic and security environment. Should the Japanese continue to view defense as a growth industry, the firms have developed the infrastructure necessary for production across a wide range of armaments and components. Should contraction occur, the industries can easily diversify away from defense. Further, with their strength in electronics and other technological areas, the Japanese are well equipped to maintain existing markets overseas and to tap new ones (e.g., Eastern Europe and the Soviet Union) as possibilities arise. While it is unlikely that the Japanese will soon be producing cutting-edge military hardware, this may prove to their advantage as the Cold War becomes history.