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Japanese High Technology, Politics, and Power

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CONTENTS

TABLES

INTRODUCTION

The 1988 Toronto summit provided the world with yet another glimpse of its own future in the era beyond American hegemony. At previous summits, Prime Minister Yasuhiro Nakasone had symbolically asserted Japan's new role in the world by edging his way from the fringes of summit photographs toward a more central position alongside U.S. President Ronald Reagan. At Toronto, newly-elected Prime Minister Noboru Takeshita tried to give Japan's new status as a major player some substance, announcing a bold plan to deal with middle-income countries' outstanding foreign debt. The United States ultimately rejected the initiative, but not without taking note of the Japanese delegation's new-found assertiveness.

Japan now has so much economic and technological power that it is surprising that Japanese leaders still choose so infrequently to wield this power in the open. A report commissioned by the Economic Planning Agency suggests that Japan in 1985 had already surpassed the Soviet Union and the major European powers to become the world's No. 2 power in terms of "ability to contribute to the international community."[1] (See Table 1.) Japanese leaders insist, however, that while Japan may be an international economic power, it will never be a military power.[2] Japan may demand more influence within the Asian Development Bank or the International Monetary Fund, but it will never claim to have much impact on the East-West correlation of forces.

This paper suggests, on the contrary, that Japan is already a military power in the sense that it has the ability to tip the global balance of power—in either direction.[3] For one thing,

1. For three perspectives on Japanese power from the popular press, see Takashi Sakuma, "How Strong a Japan?," *Journal of Japanese Trade and Industry* (June 1987), pp. 48-51; "From Superrich to Superpower," *Time*, Far East Edition (4 July 1988), pp. 6-9; and "Japan's Clout in the United States," *Business Week* (11 July 1988), pp. 64-75.

2. Japan Defense Agency Director-General Tsutomu Kawara, for example, spent a tour of Southeast Asia in July 1988 trying to convince his Asian neighbors that Japan will never become a military power. See *Far Eastern Economic Review* (14 July 1988), p. 34.

3. For present purposes, power can be defined as "the ability of a state to influence international events, or outcomes." This paper will not dwell on the problems of defining Japanese power, however, but will focus on an assessment of Japanese technological

TABLE 1

MAJOR COUNTRIES' ABILITY TO CONTRIBUTE TO THE INTERNATIONAL COMMUNITY

	JAPAN		U.S.		U.K.		W.GERMANY		FRANCE		U.S.S.R.	
Area	1975	1985	1975	1985	1975	1985	1975	1985	1975	1985	1975	1985
1. Economic power	31	50	100	100	21	17	42	34	30	17	30	30
2. Financial power	27	57	100	100	5	11	32	37	7	11	0	0
3. Science/technological power	39	47	100	100	14	13	22	21	13	13	89	79
4. Fiscal strength	76	72	86	81	100	100	78	79	95	89	105	93
5. Foreign policy consensus	53	54	68	52	86	66	100	96	97	100	31	24
6. Ability to act internationally	60	63	100	100	68	67	63	67	63	67	67	62
OVERALL RATING	47	61	100	100	45	43	54	54	43	43	35	50

NOTE: 100 = score for Western country rated highest in the area

Source: Economic Planning Agency (1987)

Japan already spends more on defense than any other country except the United States and the Soviet Union.[4] And if Japan remains the world's No. 3 defense spender, it is bound to become a major regional military power by the turn of the century. In any case, Japanese leaders can use the country's enormous economic power to promote national security interests. Japan, for example, manages to "pay" Korea and the Philippines for helping to defend Japan by providing economic aid to these countries.[5] Japanese leaders can also use the country's technological power to promote national security interests. As Japanese technology advances even further, and as Japanese firms further explore the military uses of their commercial technology base, Japan will play a more central role in the global military technology race. By transferring its dual-use technology, Japan could help the United States and its NATO allies achieve long-term military superiority over the Warsaw Pact. At the same time, however, Japan could undermine U.S. efforts to maintain a technological edge with even a few technology transfers to the Soviet Union. Furthermore, Japan now has an economic and technological base which could enable it to become a military superpower in its own right within the not-too-distant future (10-25 years)—if Japan were to choose to accelerate its present defense build-up. Japanese ambitions for a return to power in the world are no longer constrained by technology, but only by politics.

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capabilities and a discussion of how the advances in Japanese commercial technology give Japan more actual and potential military power. Japan's economic prowess and technological leadership "translate" into military power not only through linkage between issues, but also because they are important components of military power. (See Chapter IV).

4. Japan's fiscal 1988 defense budget totaled 3.700 trillion yen, or $28.5 billion (at 130 yen = $1). The figure would be closer to $40 billion, however, if it included the Self-Defense Forces' retirement benefits and other items normally included in NATO calculations of defense budgets. *The Military Balance 1987-88* uses the official budget figure and an exchange rate of 146.55 yen = $1 to rank Japan ($24.00 billion) in sixth place for defense spending in 1987, behind the United Kingdom ($30.50 billion), France ($29.26 billion), and West Germany ($27.91 billion).

5. In 1983, for example, Japan offered South Korea a $4 billion package of loans and credits, partially as a repayment for Korean defense efforts. See Cumings (1987-88), p. 81. In 1984, when Japan suffered a rice shortage, it paid for Korean rice which was really only the repayment of a previous loan. A Liberal Democratic Party (LDP) official explained that this, too, was meant as payment for defense. Dietman Sohei Miyashita (interview, 13 July 1988) argues for similar reasons that Japan should give more aid to the Philippines.

CHAPTER I: JAPAN'S TECHNOLOGY BASE

Basic Technology

Japan's economic power, and its actual and potential military power, are ultimately rooted in the strength of its commercial technology base. Japan built up this technology base through a gradual process of adoption of foreign technology and constant innovation in methods of production.[1] Although U.S. corporations invented much of the important new technology in the postwar period, Japanese firms have been more successful in developing efficient manufacturing systems. Japanese technology expert Masanori Moritani uses RCA as a paradigm for American companies' failure to maintain a technological lead. RCA led the way in the development of television, yet Sony perfected trinitron technology.[2] RCA was an early innovator in video tape recorders, but Sony and the Japan Victor Company refined the video recorder into a product small enough and inexpensive enough for the household consumer.[3] And RCA produced the first amorphous solar cell in 1976, but Sanyo was the first to develop it into a marketable product.[4] The United States still makes the world's best satellites, Moritani concedes, but you cannot erase a trade imbalance with satellites when Japan only needs about one a year. "In terms of commercial technology," he concludes, "we don't have anything left to learn from the Americans."[5]

1. See Tyson and Zysman (1987) for a brief overview of the prevalent explanations of the Japanese "miracle" and for an alternative approach which focuses particularly on production innovation.

2. Moritani (1986), pp. 126-30. See Hart (1988) for an overview of the decline of the U.S. consumer electronics industry; and see James E. Millstein, "Decline in an Expanding Industry: Japanese Competition in Color Television," in Zysman and Tyson, eds. (1983), pp. 106-41, for an analysis of the decline of the U.S. television manufacturing industry that focuses on Japanese firms early conversion to all solid-state technology (1971 for most Japanese producers vs. 1973-74 for RCA and Zenith).

3. Ampex, another U.S. firm, came out with the first video tape recorder in 1956. See Moritani (1986), pp. 145-50, and Rosenbloom and Cusumano (1987).

4. Moritani (1986), pp. 204-10.

5. Moritani interview (20 July 1987).

Japanese producers only really assaulted the heart of the U.S. high technology advantage, however, when they began to export semiconductors. Japanese manufacturers' innovations in production technology made them particularly successful in the mass-production market for dynamic random-access memories (DRAMs).[6] From 1978 to 1986, the Japanese share of the world semiconductor market grew from 28 to 45 percent, while the U.S. share declined from 54 to 43 percent.[7] By 1986, Japan had 65 percent of the world market in metal oxide semiconductor (MOS) memories.[8] A Defense Science Board Task Force on Defense Semiconductor Dependency in 1987 estimated that Japan leads in both silicon and non-silicon products, and Japan and the U.S. are on the same level in processing equipment.[9] (See Table 2.)

A U.S. Panel on Materials Science in 1986 concluded that Japan now has the edge in the all-important area of processing materials for electronic devices. The panel judged that the United States holds a lead in ion implantation, thin film epitaxy, and film deposition and etching, while the Japanese lead in optical lithography, microwave plasma processing, lithographic sources, electron and ion microbeams, laser-assisted processing, compound semiconductor processing, optoelectronic integrated circuits and three-dimensional device structures.[10] An executive from a major U.S. defense contractor complains that although the Department of Defense forced his firm to order electron-beam lithography equipment from an American manufacturer, the manufacturer was never able to produce the machine to specifications—at any cost. His company ended up doing just what it had originally planned to do: buying from Hitachi.[11]

6. *The New York Times* (2 August 1988) reported that Japanese companies controlled 70 percent of the DRAM market in 1987, and estimated that they would seize 88 percent of the one megabit DRAM market for 1988.

7. Howell et. al. (1988), p. 217.

8. *Ibid.*, p. 56.

9. On U.S.-Japan competition in semiconductors, see Michael Borrus, James E. Millstein, and John Zysman, "Trade and Development in the Semiconductor Industry: Japanese Challenge and American Response," in Zysman and Tyson, eds. (1983), pp. 142-248; Okimoto et. al., eds. (1984); Borrus (1985); Howell et. al. (1988); and Borrus (1988).

10. National Materials Advisory Board (1986), pp. 1-2.

11. See Stowsky (1987) on U.S.-Japan competition in semiconductor manufacturing equipment.

TABLE 2
RELATIVE STATUS AND TRENDS OF U.S. AND JAPANESE SEMICONDUCTOR TECHNOLOGY

	U.S. Lead	Parity	Japan Lead
SILICON PRODUCTS			
DRAMs			▼
SRAMs			▼
EPROMs		●	
Microprocessors	▼		
Custom, Semicustom Logic	▼		
Bipolar			▼
NONSILICON PRODUCTS			
Memory			▼
Logic			▼
Linear	●		
Optoelectronics			▼
Heterostructures			▼
MATERIALS			
Silicon			▼
Gallium Arsenide			▼
PROCESSING EQUIPMENT			
Optical lithography		▼	
E-beam lithography	▼		
X-ray lithography		▼	
Chemical vapor deposition		●	
Deposition, diffusion, other		●	
Energy-assisted processing			▼
Assembly		●	
Packaging			▼
Test			▼
Computer-aided engineering		●	
Computer-aided manufacturing		▼	

NOTE: ▲ U.S. position improving
● U.S. maintaining position
▼ Japanese position improving

Source: Department of Defense (February 1987), p. 8.

The U.S. industry, led by the Semiconductor Industry Association (SIA), countered the Japanese challenge in June 1985 by filing an unfair trade petition under section 301 of the Trade Act of 1974. U.S. users were not happy about the prospect of higher chip prices, but the producers finally had their way as the U.S. and Japanese governments reached an accord in July 1986. The Semiconductor Agreement stipulated that Japanese producers would be subject to price regulation based on Ministry of International Trade and Industry (MITI) estimates of production costs.[12] The marginal relief provided by the agreement has not prevented a number of the smaller producers from going out of business, and Fairchild from going up for sale.[13] The U.S. government and manufacturers decided in 1987 to respond to the Japanese challenge by forming their own research consortium on semiconductor manufacturing technology, Sematech.[14]

With their successful advance in semiconductor technology, the Japanese have essentially surpassed the Europeans and caught up with the Americans in the overall high-technology race. Evaluating an entire country's technology base is by nature an imprecise art. The results of any evaluation will vary depending on how it values the different "qualities" of technology, such as scientific novelty, technical complexity, endurance and ease of maintenance. Nevertheless, most recent attempts to compare the overall technology base of Japan and the United States have shown rough parity between the two countries. If there is a significant "technology gap" today, it is not between the United States and Japan, but between these two high-tech superpowers and the rest of the world.[15]

Even the "modest" Japanese recognize this new situation of parity in the U.S.-Japan high-technology race. An April 1984 survey by the Science and Technology Agency, for example, showed that 76.0 percent of representatives of Japanese private enterprises feel that the level of technology in Japan in their

12. On the politics of the trade agreement, see Sherrerd (1987) and Borrus (1988), pp. 185-189.

13. Fujitsu was originally interested in buying out Fairchild, but the U.S. government refused to approve the deal because this would give a foreign producer control of an American company that does important defense work. Japanese commentators noted with some irony that the previous parent company, Schlumberger, was French.

14. See Howell et. al. (1988), particularly pp. 200-204.

15. For a European perspective on the "technology gap," see Pierre, ed. (1987).

area of expertise is on par with or superior to that of the United States and Europe. In the same survey, 60.3 percent said that Japan was on par or superior in potential for technology development (see Table 3). A 1986 *Fortune* article judged that the United States was still ahead in computers, the life sciences and new materials, but was significantly behind Japan in optoelectronics. Japan outranked Western Europe in all four categories (see Table 4). The 1987 Japan Science and Technology White Paper considered Japanese "R & D capability" to be ahead of the United States in optoelectronics, mechatronics, very large-scale integrated circuits (VLSIC), and advanced high-precision processing.[16] The 1988 Ministry of International Trade and Industry (MITI) White Paper on Industrial Technology claims that Japan leads the United States in technologies ranging from memory devices to fine ceramics, and Japan leads in its "ability to develop high-technology products" in such areas as microprocessors and assembly robots. The United States only clearly leads in one of the technology areas reviewed in the White Paper: data bases.[17]

Although Japan still runs a deficit in technology trade (224 billion yen in imports vs. 262 billion in exports in 1986) due to residual payments on previous contracts, it runs a consistent surplus in new contracts (52 billion yen in exports vs. 34 billion in imports in 1986).[18] Meanwhile, Japan enjoys a significant trade surplus with the United States in the highly R & D-intensive industries ($20 billion in 1985).[19] Among OECD countries, Japan in 1985 already had a larger percent share of the export market than the United States in electronics (51.1 vs. 19.8 percent), electronic machinery (29.7 vs. 19.1), and instruments (28.7 vs. 25.8). The United States had a greater share of the export market in aerospace (60.6 vs. 0.5 percent), computers (45.3 vs. 24.6), and drugs (24.4 vs. 3.5).[20]

16. Science and Technology Agency (1988), p. 39. The Japan Economic Research Center (*nihon keizai kenkyu senta*) has published a more qualitative comparison of U.S. and Japanese industry in 13 manufacturing and 12 service sectors. See Namiki, ed. (1985). The Science Applications International Corporation has evaluated Japanese technology in computer science (1985a), mechatronics (1985b), opto- and microelectronics (1985c), telecommunications (1986a), and advanced materials (1986b). Also see Shimura (1985) and Yamaji (1988).

17. Ministry of International Trade and Industry (September 1988), p. 22.

18. Science and Technology Agency (1988), insert.

19. *STI Indicators*, No. 10 (1987), p. 20.

20. *Ibid.*, p. 20.

TABLE 3
JAPAN'S TECHNOLOGY LEVEL AND DEVELOPMENT CAPACITY RELATIVE TO THAT OF THE UNITED STATES AND EUROPE—JUDGED BY JAPANESE BUSINESSMEN
(percentage of survey response)

Japan vs. U.S.—Europe	Technology Level	Development Capacity
Far advanced	13.8%	6.2%
Somewhat superior	28.0	19.4
Average	34.2	34.7
Not quite equal	13.4	20.8
Far behind	4.7	8.7
Unsure	5.9	10.2

Source: "Survey on the Research Activities of Private Enterprises," Science and Technology Agency (1984).

TABLE 4
FORTUNE SCORES FOR HIGH TECHNOLOGY ACHIEVEMENT—JUDGED BY U.S. EXPERTS IN RESPECTIVE FIELDS

	U.S.A.	Japan	W. Europe	U.S.S.R.
Computers	9.9	7.3	4.4	1.5
Life Sciences	8.9	5.7	4.9	1.3
New Materials	7.7	6.3	6.0	3.8
Optoelectronics	7.8	9.5	5.7	3.6

Source: *Fortune* (13 October 1986). Scores are on a 10-point scale.

U.S.-Japan "parity" in the high-tech race, however, is not the same as U.S.-Japan "equivalence." In fact, Japan and the United States have very different strengths and weaknesses within what is a very tight race overall.[21] The fundamental differences in the nature of the technology which U.S. and Japanese scientists and engineers come up with follows logically from differences in the way the two countries research and develop technology. In general, researchers in the United States focus more on basic research, while their Japanese counterparts concentrate more on product development. Japanese critics themselves are fond of reminding their public that Japan has had only five Nobel Prize winners in science through 1987, while the United States has had 142.[22] These same analysts, however, typically take offense at characterizations of the Japanese as "uncreative," asserting that Japanese creativity merely manifests itself in different ways. Moritani, for example, has developed a distinction between U.S. "originality" and Japanese "creativity." While most original ideas to date have come from the West, he stresses that Japanese technicians have shown exceptional ingenuity in adapting these ideas in order to develop useful products.[23] This kind of Japanese "creativity" has been manifesting itself more and more on the marketplace. Japanese applicants were granted 11,110 patents in the United States in 1984, or 16.5 percent of the total.[24] Computer Horizons Inc. of New Jersey found that Japanese actually rated higher than Americans according to an index of innovation based on how often a country's patents are cited in applications for other patents. Japan achieved an index rating of 1.34, compared to 1.06 for the United States, 0.94 for the United Kingdom, 0.80 for France and 0.79 for West Germany.[25] Japan's "original" contributions can be expected to increase as well now that Japanese technology strategy has shifted from catching up to taking the lead.

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21. See Uyehara, ed. (1988) for further discussion of the U.S. and Japanese R & D systems, particularly the chapter by Gary Saxonhouse, "Technological Progress and R & D Systems in Japan and the United States," pp. 29-56.
22. Science and Technology Agency (1987), p. 38.
23. Moritani interview (20 July 1987).
24. Science and Technology Agency (1987), p. 133.
25. *The New York Times* (7 March 1988).

While Japan's relative inattention to basic research may become a greater weakness in the future, its almost obsessive attention to the subtleties of product development should continue to reap generous rewards. Japanese companies' emphasis on lowering production costs and constantly improving manufacturing technology has given many of them a significant price and quality advantage over their foreign competitors. Kent Calder argues that this has led to a situation where the United States and Japan enjoy a certain complementarity of advantages in the high-technology sector.[26] The United States has maintained an advantage in the more specialized "high high-tech" areas such as advanced circuitry, software and large-scale switching equipment, while Japan has gained an advantage in the mass-market "low high-tech" areas such as calculators and video tape recorders. Even in an area of such fierce rivalry as semiconductors, a division of labor is developing in which the Japanese concentrate on memory chips while the United States focuses on microprocessors and specialty semiconductors.[27] The Japanese may be able to use their advantage in flexible manufacturing systems (FMS), however, to make inroads on the U.S. lead in small-batch production of advanced electronic components and equipment.

Western analysts have commended Japanese companies for their greater attention to "quality," yet such assessments do not mean much in the absence of a clear notion of what quality means. A more useful comparison between the United States and Japan can be made if we separate "sophistication," or the complexity and scientific novelty of a product, from "reliability," or the likelihood that a product will continually function as it should. The United States continues to produce many of the most sophisticated products in the world, but Japanese products have proven themselves more reliable. Japanese products have consistently achieved lower defect rates than their American counterparts in sectors as diverse as automobiles and semiconductors. The implications of the reliability advantage are enormous for the future of U.S.-Japan competition in commercial markets, but the implications in the

26. Calder (1985).

27. Experts disagree as to whether or not Japan is closing the gap in microprocessors. See, for example, Bob Johnstone, "RISC Has Its Rewards," *Far Eastern Economic Review* (7 July 1988), pp. 43-48.

field of military systems may be even more ominous. In the commercial market, a high defect rate can result in a severe loss of market share. On the field of battle, defects cost lives.

Japanese firms also differ from their American counterparts in that their R & D is driven almost exclusively by the commercial market. While the United States first developed carbon composite materials for use in military aircraft, the Japanese developed them initially for use in fishing rods and golf clubs. Ironically, this inattention to the military market in the short run could put Japan in a stronger position to enter the military market in the long run. In the past, the requirements of the military market were usually much stricter than those of the commercial market. Products for military procurement must be resistant to shock, heat and radiation in a way that few commercial products need be. In addition, military technology was generally considered to be more advanced than commercial technology so that one could expect considerable commercial spin-offs from military research. In recent years, however, commercial technological advances have outpaced those in the military sector to the point that commercial technology is now at the forefront in many areas. It is difficult to compare the overall level of technology in the commercial and military sectors in any comprehensive way, but the commercial sector now leads substantially in the crucial area of microelectronics. Due to the long production cycle in the defense industry, most U.S. military systems now use devices which are 5-7 years out of date. U.S. and Japanese producers introduce a whole new generation of devices every 2-3 years, whereas most military systems evolve on a 5-15 year cycle. The commercial market in many high-technology products has the advantage of greater size, which means greater incentives for producers and higher profits which can be recycled into more R & D. The commercial market also offers more immediate and more widespread feedback on product performance. This encourages producers to put a premium on cutting production costs and improving manufacturing processes. Finally, increased competition for reliability and endurance in commercial markets means that these products now have to be as reliable if not more reliable than military-use products. A 1986 Defense Science Board report on "The Use of Commercial Components in Military Equipment" judged that commercial electronic systems such as computers, radios and displays were just as durable in harsh environments, 1-3 times more advanced, 2-10 times cheaper, five times faster to acquire, and more reliable than their military equivalents.[28] In the foreseeable future, commercial-to-military "spin-ons" are likely to boom while military-to-commercial "spin-offs" decline.[29]

Jacques Gansler argues that a better integration of commercial technology into military production in the United States would lead to lower costs, higher volume, greater factory automation, higher quality and increased competition.[30] In addition, this would allow for more "surge capability" because commercial production capacity could be converted to military production in times of crisis. An excessive emphasis on the military sector, in other words, is not only detrimental to commercial production capabilities but may ultimately weaken the military sector as well. Japan, with its focus on the commercial market, may be able to integrate its budding defense industry into the economy as a whole in a way that the United States has not managed to do.

In summary, Japan not only has an overall technology base that is roughly on par with that of the United States, but Japanese technology has certain distinct advantages which could be particularly important in defense-related areas. First, Japanese companies on the whole make a greater effort at creating ever more efficient and flexible manufacturing systems. Second, Japanese firms have achieved greater product reliability. Finally, Japanese firms concentrate on the commercial rather than the military market. While this obviously constrains rather than benefits defense production in the immediate future, Japanese industry's greater orientation toward cost and efficiency in production for the commercial market may eventually pay off in the defense sector as well.

28. Gansler (1987), p. 13.

29. See Samuels and Whipple (1989) for a discussion of Japanese "spin-on" technologies.

30. Gansler (1987), p.5.

Research and Development

Japan has not only caught up in the overall high-tech race, but it is closing the gap in many areas of weakness and increasing its lead in areas of strength. The Japanese government and private industry are committed to making the investment necessary to strengthen the country's high technology base. Government and business leaders will not back off from competition in any significant high-technology sector despite trade friction with the United States because they see high technology leadership as Japan's only route to long-term economic prosperity. Japanese leaders are painfully aware of the challenge that the Newly Industrializing Countries (NICs) pose to Japanese heavy industries such as steel, shipbuilding and automobiles, and to "low" high-tech industries such as consumer electronics. They are more confident of challenging the United States in "high" high-technology than they are of fending off the NICs' challenge to Japanese supremacy in "low" high technology. In any case, they would prefer to continue moving away from labor-intensive industries toward high value-added sectors.

Japan's research and development activity, though smaller in scale than that of the United States, is more focused on specific areas of industrial application and is more effectively coordinated by the government. In 1986, R & D expenditure for Japan totaled 8.41 trillion yen, compared to 19.33 trillion for the United States (at 168.5 yen = \$1).[31] The United States, however, spent 5.66 trillion yen on defense R & D, while Japan spent only 66 billion.[32] The U.S. government shouldered 48.2 percent of the country's R & D burden in 1986 while the Japanese government only covered 19.6 percent.[33] (See Table 5.)

The Japanese government has been remarkably successful in promoting research and development, particularly given its relatively small share in overall R & D spending. In part, government spending is underrepresented in spending figures because of the considerable tax incentives offered for private industry research spending. More importantly, the Japanese government has acted as an effective coordinator and facilitator

31. Science and Technology Agency (1989), pp. 400 and 402.
32. *Ibid.*
33. *Ibid.*, pp. 401 and 403.

TABLE 5
1986 R & D EXPENDITURES IN FIVE MAJOR COUNTRIES
(billion yen)

	Total R & D	Defense R & D	Government R & D	Government R & D as % of Total
Japan	8,415	66	1,652	19.6
United States	19,326	5,658	9,314	48.2
West Germany	4,153	201	1,558	37.5
France	2,796	552	1,269	45.4
United Kingdom*	2,449	724	1,033	42.2

* 1985 data for the United Kingdom.
Exchange rates used are: $U.S. = 168.5 yen, deutschmark = 77.61, French franc = 24.33, pound sterling = 309.2.

Source: Science and Technology Agency (1989), pp. 400-409.

TABLE 6
FISCAL 1988 RESEARCH AND DEVELOPMENT BUDGET
(million yen)

Agency/ministry	Budget
Ministry of Education	812,954
Science and Technology Agency	430,955
Ministry of International Trade and Industry	221,226
Defense Agency	82,700
Ministry of Agriculture, Forestry and Fisheries	66,642
Ministry of Health and Welfare	44,059
Ministry of Posts and Telecommunications	30,279
Ministry of Transport	14,627
Environment Agency	7,752
Ministry of Foreign Affairs	6,417
Others	14,894
TOTAL	1,706,504

Source: AIST.

of research projects without necessarily serving as the primary source of funding. The government avoids inefficient duplication of research and promotes the diffusion of the results of research by aggressively promoting inter-firm cooperative research. Cooperative research forces private companies to share information and allows them to standardize parts more easily. In addition, joint research projects create personal networks which facilitate future cooperation.[34]

The Science and Technology Agency (STA) is officially designated in the role of overall coordinator of research and development. In fact, however, it does not have enough status nor enough control over the R & D budget to play such a role effectively (see Table 6). The STA takes the lead in setting broad guidelines for R & D activities, but it must defer to the Ministry of Education (MoE) in matters of university research and to MITI in matters directly related to industrial applications research. The STA, however, does control two of the largest national research programs, those of nuclear energy and space development. The STA promotes nuclear energy development through two public corporations, the Japan Atomic Energy Research Institute (JAERI) and the Power Reactor and Nuclear Fuel Development Corporation (PNC). The STA coordinates space research through another public corporation, the National Space Development Agency (NASDA).[35] In addition, the STA resides over yet another public corporation, the Research Development Corporation of Japan (JRDC) which runs the Exploratory Research for Advanced Technology (ERATO) program. The ERATO projects, begun in 1981, are designed to bolster Japanese capabilities in original basic research. According to Genya Chiba, ERATO's director, the research projects "aim for nothing discrete, while trying not to differentiate science from technology."[36] A noted scientist and 15-20 researchers, none of whom may be older than 35, are given 5 years and 1.5-2 billion yen to work on each project. The project team members and the JRDC share results, including

34. See Samuels (1987) on Japanese research collaboration; and see Peter H. Lewis, "Are U.S. Companies Learning to Share?," *The New York Times* (7 February 1988) on the U.S. response.

35. Bloom (1985), pp. 19-23.

36. Stuart M. Dambrot, "Japanese R & D: a New Model," *Business Tokyo* (July 1988), pp. 24-27.

patents. Five projects have been completed, focusing on such varied areas as ultra-fine particles and bioholonics, and ten more projects are in progress.[37]

MITI conducts the bulk of its research through an internal agency, the Agency for Industrial Science and Technology (AIST). The AIST has sixteen laboratories, nine of which are located in the Tsukuba Science City, including such highly reputed laboratories as the Electro-technical Laboratory (ETL). (See Table 7.) MITI has had some of its greatest success through its program of engineering research associations which join two or more private firms for cooperative research under MITI's guidance and support. A number of these have been designated national projects, the most visible national efforts at research and understandably the most harshly criticized as evidence of industrial targeting (see Tables 8-10). It is impossible to discern to what extent these projects are responsible for Japan's success relative to purely private-sector research efforts, but clearly they have contributed to Japan's technology base.[38]

In 1981, the AIST launched its own long-term exploratory research program, the Research and Development Project on Basic Technologies for Future Industries. This program originally focused on three fields—new materials, biotechnology and new electronic devices—and has since added a fourth: superconductivity. The AIST budgeted 6.368 billion yen for fiscal 1988 for seven research projects in new materials, three projects in biotechnology, three in new devices, and one in superconductivity, all of which are expected to run ten or more years.[39] The superconductivity project illustrates just how powerful MITI is in its role as a "signaler." Within weeks of MITI's announcement of the new project in 1987, more than 100 Japanese firms had declared their intention to begin research on superconductivity. Masanori Moritani cites this as an example of Japanese "Me-Too-ism" (bandwagoning) at its worst, or perhaps, at its fearful best.[40]

37. See Science and Technology Agency (1988), pp. 264 -66, for a list of the ERATO projects.

38. A number of authors have suggested that the impact of these national technology projects is often overrated. See, for example, Heaton (1988).

39. Ministry of International Trade and Industry (January 1988), p. 13.

40. Moritani interview (20 July 1987).

TABLE 7

FISCAL 1988 BUDGET AND NUMBER OF PERSONNEL AT AGENCY OF INDUSTRIAL SCIENCE AND TECHNOLOGY (AIST) LABORATORIES (million yen)

	Budget	Personnel
National Research Laboratory of Metrology	2066	222
Mechanical Engineering Laboratory	3085	283
National Chemical Laboratory for Industry	3658	360
Fermentation Research Institute	1085	89
Research Institute for Polymers and Textiles	1675	127
Geological Survey of Japan	4429	367
Electrotechnical Laboratory	8989	693
Industrial Products Research Institute	1423	128
National Research Institute for Pollution and Resources	3727	330
Government Industrial Development Laboratory, Hokkaido	1096	98
Government Industrial Research Institute, Tohoku	509	55
Government Industrial Research Institute, Nagoya	2420	249
Government Industrial Research Institute, Osaka	2442	223
Government Industrial Research Institute, Chugoku	682	52
Government Industrial Research Institute, Shikoku	466	44
Government Industrial Research Institute, Kyushu	903	90

Source: AIST.

TABLE 8
COMPLETED AIST NATIONAL TECHNOLOGY PROJECTS

Project	Purpose
SUPER HIGH PERFORMANCE ELECTRONIC COMPUTER 1966-71, (10 billion yen)	To develop a large-scale, super high-performance computer system.
DESULFURIZATION PROCESS 1966-71, (2.6 billion yen)	To remove sulfur oxide from the gas exhaust of power plants and to remove sulfur directly from heavy oil.
OLEFIN PRODUCTION 1967-72, (1.1 billion yen)	To economically produce olefins by direct cracking of crude oil instead of naphtha.
REMOTE-CONTROLLED OIL DRILLING RIG 1970-75, (4.5 billion yen)	To develop remote-control oil drilling rigs for use underseas.
SEA WATER DESALINATION AND BY-PRODUCT RECOVERY 1969-77, (6.7 billion yen)	To economically produce fresh water and to develop by-product recovery technology.
ELECTRIC CAR 1971-77, (5.7 billion yen)	To develop various types of electric cars to replace ordinary vehicles in urban areas.
COMPREHENSIVE AUTO CONTROL TECHNOLOGY 1973-79, (7.3 billion yen)	To develop integrated control technology to relieve traffic and reduce automobile pollution.
PATTERN INFORMATION PROCESSING SYSTEM 1971-80, (22 billion yen)	To develop computer technology for the recognition and processing of pattern information.
DIRECT STEELMAKING PROCESS 1973-80, (13.7 billion yen)	To develop steelmaking technology using high-temperature reducing gas to limit pollution.
OLEFIN PRODUCTION FROM HEAVY OIL 1975-81, (13.8 billion yen)	To manufacture olefins from heavy oil (asphalt) which is difficult to desulphurize.

TABLE 8 (continued)

Project	Purpose
JET AIRCRAFT ENGINES 1971-81, (19.9 billion yen)	To develop a large-scale turbofan engine for use in commercial transport.
RESOURCE RECOVERY 1973-82, (12.6 billion yen)	To research technical systems for the disposal of solid urban waste.
FLEXIBLE MANUFACTURING SYSTEM 1977-84, (13.7 billion yen)	To develop a production system using lasers capable of rapidly producing small batches of diversified mechanicalcomponents.
SUBSEA OIL PRODUCTION 1978-84, (15 billion yen)	To research a subsea oil production system for small-scale oil fields that will not adversely affect the fishing industry.
OPTICAL MEASUREMENT AND CONTROL 1979-85, (15.7 billion yen)	To develop a system to measure and control massive amounts of data in adverse environments.
CHEMICAL MANUFACTURING TECHNOLOGY 1980-86, (10.5 billion)	To develop technology for the production of basic chemicals from coal and natural gas.

Source: AIST (Total budget figures have been estimated)

TABLE 9
ONGOING AIST NATIONAL TECHNOLOGY PROJECTS

Project	Purpose
MANGANESE NODULE MINING SYSTEM 1981-91, (20 billion yen)	To develop a hydraulic mining system for harvesting large quantities or manganese nodules from the deep-ocean floor.
HIGH-SPEED COMPUTER 1981-89, (23 billion yen)	To develop high-speed computer systems for scientific applications.
AUTOMATED SEWING SYSTEM 1982-90, (10 billion yen)	To develop an automated continuous sewing system for the textile industry.
ADVANCED ROBOT TECHNOLOGY 1983-90, (20 billion yen)	To develop advanced robot technology to replace humans in dangerous work
OBSERVATION SYSTEM FOR THE ERS-1 1984-90, (23 billion yen)	To develop, with the STA, an observation system for the earth resources satellite ERS-1.
WATER TREATMENT SYSTEM 1985-90, (11.8 billion yen)	To develop a bioreactor to process and purify waste water.
INTER-OPERABLE DATABASE 1985-91, (15 billion yen)	To enable databases with different operating systems to exchange information.
ADVANCED MATERIAL PROCESSING 1986-93, (15 billion yen)	To develop advanced material processing equipment, such as high-power excimer lasers and high-performance machine tools.
ADVANCED HIGH-POWER CHEMICAL PRODUCTS 1988-96, (15 billion yen)	To produce advanced chemical products such as dyes and insulating materials using marine life resources.

Source: AIST (Total budget figures have been estimated)

TABLE 10
OTHER MAJOR MITI PROJECTS

Project	Purpose
SUNSHINE PROJECT 1974-	To develop coal liquefaction and gasification, solar power generation, geothermal and hydrogen energy.
MOONLIGHT PROJECT 1978-	To develop energy conservation technology such as magnetohydrodynamic (MHD) power generators, high-efficiency gas turbines, chemical heat pumps.
BASIC TECHNOLOGIES FOR FUTURE INDUSTRIES 1981-	To stimulate R & D for next-generation technology and to promote cooperation between companies, universities and the government in research on new materials, biotechnology and new devices.
FIFTH GENERATION COMPUTER 1982-	To develop advanced computers that will use artificial intelligence to make them easier to run.
SIGMA (SOFTWARE INDUSTRIALIZED GENERATOR AND MAINTENANCE AIDS) 1985-89	To develop an automated system for producing software.

Source: AIST.

MITI budgeted a total of 3.429 billion yen for superconductivity research in fiscal 1988, 1.124 billion of which goes to the Research and Development Project on Basic Technologies for Future Industries and 438 million of which goes to the national technology project on high-speed computers.[41] MITI has also set up a new International Superconductivity Technology Center (ISTEC) designed to promote international cooperation in research.[42] The Science and Technology Agency requested 2.36 billion yen for superconductivity research in fiscal 1988.[43] In January 1988, the STA's National Research Institute for Metals came up with a major breakthrough, developing a less expensive and more readily available new superconductive material. The material is made up of bismuth, strontium, calcium, copper and oxygen, and is superconductive at 105 degrees Kelvin.[44] U.S. experts expect some of the first practical applications of superconductive materials will be in highly specialized electronics technologies for military use such as infrared sensors, high-frequency antennas, and high-speed wiring.[45]

The ministries compete at least as much as they cooperate in R & D programs, and the fiercest of the turf battles, that between MITI and the MPT, had the unintended consequence of creating one of Japan's newest research programs, the Key Technology Center. The famed "Telecom Wars" erupted between MITI and the MPT beginning in 1982 largely in a dispute over the ministries' respective jurisdictions as MPT's protected state monopoly, the Nippon Telegraph and Telephone Corp. (NTT), prepared for privatization.[46] The Key Technology Center, founded in 1985, is funded and controlled 50-50 by the uneasy neighbors, MITI and the MPT. MITI's share of the budget totaled 26.0 billion yen in fiscal 1988.[47] The Center does not actually conduct any research on its own, but it provides up to 70 percent of the costs of creating new research companies comprised of at least two private companies. Projects to date

41. Ministry of International Trade and Industry (January 1988), p. 7.

42. *Business Tokyo* (July 1988), pp. 14-16.

43. Daniel Sneider, "Superconductivity: the Next War or a New Era of Cooperation?," *Tokyo Business Today* (November 1987), pp. 40-43.

44. *Science and Technology in Japan* (June 1988), pp. 52-53.

45. Andrew Pollack, "New Era for Superconductors," *The New York Times* (25 October 1988).

46. Johnson (1986) and Samuels (1987), pp. 45-48.

47. Ministry of International Trade and Industry (March 1988), p. 56.

have focused on information and communication systems, biotechnology, advanced materials, optoelectronics, and ultra large-scale integrated circuits (ULSI).[48]

The MPT also has its own research programs in areas such as telecommunications and space technology which more often than not compete directly with similar programs of the STA or MITI. The MPT's main research organization was founded as the Radio Research Laboratory in 1952 and reorganized as the Research Institute of Telecommunications in 1988. The institute now has an annual budget of 180 million yen and focuses on five areas of research: 1) integrated communication systems, 2) space communications, 3) space and atmospheric science, 4) remote sensing, and 5) radio standards.[49] NTT itself has traditionally carried on most of the research in the communications field, but it has yet to be seen how the new companies created under privatization will coordinate their R & D activities.

The Ministry of Education (MoE) controls all university-based research, a traditional area of weakness relative to the United States and Europe. The MoE sponsors most of this research directly through a network of institutes at the 95 state-run universities. In addition, the ministry has established inter-university institutes such as the Institute for Space and Astronautical Sciences and the Okazaki National Research Institute. As a whole, the quality of these institutes does not match that of their U.S. counterparts, but there are some notable exceptions such as Osaka University's laser fusion laboratory and Tokyo University's astronomical observatory.[50]

Private firms themselves, of course, initiate and perform the bulk of R & D in Japan. Their relative success, particularly in areas of industrial application, can be attributed to such factors as a highly educated workforce, a high rate of investment, good management and an efficient use of resources. The government nevertheless plays a crucial role in funding cooperative research projects and in guiding the national R & D effort as a whole. Japan's overall success is probably best seen as a healthy combination of private sector initiative and public-sector

48. See Satoh (1986), pp. 102-107, for a listing of Key Technology Center projects.
49. Kikui interview (30 July 1987).
50. Bloom (1985), pp. 8-13.

guidance, of cooperation among firms and competition between them. As stated above, the most successful research has been in areas with direct applications in the commercial market. Many of these same areas have important military applications as well. The case of optoelectronics research is particularly instructive as an example of successful government-industry cooperation in an area of enormous potential for military applications.

Japan has gained world leadership in optoelectronics, and it is a credit to this success that U.S. Defense officials singled out this area as the target of their first technology assessment mission to Japan in 1984. A 1985 report by the Japanese Optoelectronics Industry Technology Development Association (*hikari sangyo gijutsu shinko kyokai*) judged Japan to be ahead of the United States in video discs, optical fibers, polarized wave front optical fibers, and optoelectronics (receptors and emittors), comparable in optical communications and laser beam printers, and behind in solar optical electricity generation and medical lasers.[51] (See Table 11.)

The most important research project in this area was the AIST large-scale optical measurement and control system project, originally scheduled for 1979-85 and budgeted at 15.7 billion yen but since extended to 1987. Fourteen companies and the Electrotechnical Laboratory (ETL) joined forces in this project to develop an optical measurement and control system for a specific need. The system was designed for oil refineries in the Kansai area, and was actually introduced by the Mizushima Oil Refinery Plant of the Japan Mining Company (Nihon Kogyo) in January 1986. For research purposes, the optical system was divided into five subsystems, each of which centered on a specific optoelectronic device.[52] Nine of the fourteen companies and the ETL participated in the related Optoelectronics Joint Research Laboratory established in 1981. MITI provided 6 billion yen in research funds, approximately one-third of the total. The laboratory had a staff of 50, and over its six-year lifetime produced 130 patents and 510 research publications. The laboratory focused on generic materials technology, not on the devices themselves. The member companies were thus able

51. Glazer (1986), p. 19.
52. Merz (1986), pp. 7-12.

TABLE 11
COMPARATIVE TECHNOLOGICAL LEVELS AND R & D POTENTIAL IN OPTOELECTRONICS: JAPAN, EUROPE, U.S.

Field	Japan Level	Japan Poten.	Europe Level	Europe Poten.
Solar optical electricity generation	2	3	2	2
Medical lasers	2	1	3	3
Video discs	4	3	2	3
Optical fibers	4	3	2	3
Polarized wave front optical fibers	4	3	2	3
Optoelectronics (receptors, emittors)	4	3	2	2
Optical communications	3	3	2	2
Laser beam printers	3	4	3	3

5 = high relative to U.S. 4 = fairly high 3 = same as U.S.
2 = fairly low 1 = low relative to U.S.

Source: Glazer (1986), p. 19.

to work on basic research of common interest without giving away privileged information about the more sensitive aspects of processing and fabrication. The researchers formed six groups to work on, respectively, bulk crystal growth, maskless ion implantation, epitaxial growth, applied surface physics, fabrication technology, and materials analysis and characterization. The member companies in many cases chose to concentrate their energies on one or two of these areas. The Optoelectronics Joint Research Laboratory generated a number of collaborative research projects with the member companies, and also with university laboratories.[53] James L. Merz of the University of California, Santa Barbara judges that Japan has gone from a position of inferiority to virtual domination of the optoelectronic device market during a time span only slightly longer than the six-year life span of the laboratory.[54] This cannot be attributed solely to the joint laboratory, but the laboratory did contribute important advances in crystal growth, advanced processing, the fabrication and processing of superlattice structures, and the characterization of defects in bulk, semi-insulating gallium arsenide.

These MITI-AIST research projects have been the most visible national research efforts in optoelectronics, but NTT's Musashino Laboratories have also been extremely active in this area. In addition, the STA and the MPT's Institute of Telecommunications have their own research programs in optoelectronics. The government's commitment to optoelectronics research has played a crucial role in encouraging greater research efforts by the private sector.[55] The Japanese government and industry have also cooperated in similarly impressive research efforts in such military-related areas as new materials and computers.

Japanese R & D will most likely continue to focus on areas of important potential military use. Policy statements from the Science and Technology Agency suggest where national R & D priorities lie. In terms of overall policy, the Council for Science and Technology's November 1984 report marked an important transition toward an increased focus on more basic research.

53. *Ibid.*, pp. 5-27.
54. *Ibid.*, p. 19.
55. For a detailed assessment of Japanese optoelectronics technology, see Department of Defense (May 1987).

As the goal is no longer to catch up but to lead, the report stresses, the government must change the orientation of its R & D programs. On March 28, 1986, the Cabinet announced a "Policy Outline for Science and Technology" (*kagaku gijutsu seisaku taiko*), largely echoing the Council's recommendations.

In terms of the substance of research, the Cabinet set areas of top priority as follows:

Information technology and electronics
New materials
Life sciences
Software
Space development
Marine sciences
Earth sciences

This may at first appear to be a rather all-inclusive list, yet an STA bureaucrat suggests that it actually represents a fairly pointed policy program, for not all "priorities" are equal.[56] The bulk of research and development will go into areas of present strength: information technology and electronics, and new materials. The private sector will put most of its effort here, and will expect to reap the most immediate benefits. Japan remains behind in the next three categories and views research and development as a long-term process not designed to narrow the gap in the short run so much as to gain world leadership in the 21st Century. The government and private industry will dedicate a more modest effort in the final two areas. Ministry leaders feel that research in the marine and earth sciences will bring fewer immediate benefits, but that Japan should nonetheless remain a player in global research.[57]

In short, the Japanese government and the private sector will concentrate the bulk of their R & D resources on a few key sectors. The STA will favor the national programs on space technology and energy development, but MITI, the MPT and the private firms themselves will focus on electronics and information technology. Japan can be expected to continue to lead the world in the areas of robotics, memory chips, and optoelectronics. It will vie for leadership with the United States

56. Ishii interview (27 July 1987).

57. This assessment of Japan's national R & D priorities is the author's own, but it is based in large part on a series of interviews with government bureaucrats, businessmen and scholars in Tokyo during the summer of 1987. The interviews are listed at the end of the paper.

in a wide variety of sectors including computers, electronic components, new materials, and telecommunications. The leaders in the Japanese R & D bureaucracy see these as the most important areas of competition in what is a growing world market for commercial high-technology products. They are not unaware, however, that these same areas of technology represent the keys to leadership in the military sector as well.

The Military Uses of Commercial Technology

Japan's commercial technology base is more military-relevant today than ever before, and it will be even more so in the future. Japanese defense contractors will increasingly benefit from "spin-ons" from this technology base. For one thing, Japan's most important area of technological strength, electronics, is becoming increasingly important to military systems. The electronics content in the U.S. defense budget has grown from 6 percent during World War II (1945) to 9 percent during the Korean War (1952), and on to 14 percent during the Vietnam War (1968) and to 17 percent in 1980. The Department of Defense spends 35 percent of its R & D and procurement budget on electronics.[58] More than one-half of the value-added of a fighter plane today goes to electronics. Richard A. Linder, president of Westinghouse's Defense Electronics Group, suggests that electronics will be even more important for the emerging military technologies of the future, particularly stealth and multi-spectral systems. He argues that four technologies which will make crucial contributions to military systems are: 1) very high-speed integrated circuits (VHSIC), 2) digital gallium arsenide (GaAs) circuits, 3) microwave monolithic integrated circuits, and 4) mercury cadmium telluride (HgCdTe) for infrared detectors.[59] Japanese corporations excel in all four of these technologies. "Thanks to the 'electronics-ization' of defense," says Mitsubishi Electric Managing Director Takeshi Abe, "the stage is finally set for Japan to build weapons even better than those made in the U.S.A."[60]

58. Department of Defense (February 1987), p. 31.

59. Bruce D. Nordwall, "Electronic Technology to Dominate Next Generation of Weapon Systems," *Aviation Week and Space Technology* (6 June 1988), pp. 81-85.

60. *Nikkei Business* (11 May 1987), p. 15.

TABLE 12
SOME EXAMPLES OF JAPANESE DUAL-USE TECHNOLOGY

Civilian technology	Producer	Military use
MATERIALS		
Radar-proof ferrite paint (for bridges)	TDK	Stealth aircraft
Carbon fiber pre-impregnated composite materials	Toray	XT-4 trainer plane
COMPONENTS		
"Silicon-on-saffire" microchip	Toshiba	Survives nuclear blasts
Charge coupled device (for video cameras)	Sanyo	Missile guidance
SUBSYSTEMS		
Doppler radar to warn cars of impending collision	Fujitsu	Aircraft landing and guidance
Satellite ground terminal receiver	NEC	Military receiver
SYSTEMS		
BK 117 A3 helicopter	KHI	Could be equipped with anti-tank missiles

Japan leads in other important dual-use areas as well (see Table 12). Japan, for example, excels in advanced industrial ceramics, which can be used to coat aircraft engines or to hermetically insulate missile guidance systems and warheads. Japan also produces carbon composite materials which have the light weight and strength required for both civilian and military aircraft. Japanese radar manufacturers are already challenging the U.S. lead in military radar.[61] Furthermore, some Japanese commercial technologies such as optoelectronics and high-power lasers will be directly applicable to the warfare of the future as envisioned by the architects of the Strategic Defense Initiative.[62] The Japanese journal *Voice* judged that Japan leads the United States in thirteen categories of technology of important military use, while the United States leads in seven and the two are equivalent in two (see Table 13). The Department of Defense estimates that the Soviet Union does not lead the United States in any of 20 basic technology areas of strategic importance (see Table 14). A similar comparison with Japan would probably show that Japan leads in at least five of these areas, and threatens to pull ahead in several others (see Table 15). The United States' most formidable rival in the realm of dual-use technology is no longer the Soviet Union, but Japan.

The U.S. Department of Defense (DoD) has not overlooked the enormous potential for the military use of Japanese commercial technology. In fact, the Pentagon already depends heavily on Japanese components, particularly memory devices, for its weapon systems. In 1980, the DoD and the Japan Defense Agency (JDA) established the Systems and Technology Forum to explore avenues for cooperation in military research and development, production, and procurement. Japan was severely restricted in its ability to "cooperate," however, due to a self-imposed ban on military exports. In 1983, Prime Minister Yasuhiro Nakasone announced that Japan would make an exception to this ban for exports of military technology, but not for military systems, to the United States. In November 1983, Japan and the United States signed notes establishing a Joint Military Technology Commission (JMTC) comprised of State and

61. Mitsubishi Electric Company's active phased-array radar will be discussed further in Chapter II.

62. See Glazer (1986).

TABLE 13
JAPANESE HIGH TECHNOLOGY COMPARED WITH U.S. AND SOVIET HIGH TECH IN AREAS OF MILITARY IMPORTANCE

	Japan	U.S.	U.S.S.R.
COMPUTERS			
Large-scale DRAMs	▲	^	▼
Gallium Arsenide circuits	▲	^	▼
Josephson junctions	▲	▲	▼
High-speed computers	^ *	▲	▼
Artificial intelligence	^ *	▲	▼
Charge Coupled Devices (CCD)	▲	^	▼
Infrared sensors	▲ *	▲	▼
Acoustic sensors	▲	^	▼
Ultra-sound search devices	▲	^	▼
Millimeter wave radar	▲	^ *	▼
High-power lasers	▼	▲	^
Low-power (semiconductor) lasers	▲	^	▼
AEROSPACE			
Control Configured Vehicle (CCV)	▲	^ *	▼
Carbon fibers (composites)	▲	^	▼
Titanium composites	▼	^	▲
Liquid crystal displays	▲	^	▼
Jet engines	▼	▲	▲
Liquid hydrogen rockets	▲	^	^
Miniature bearings	▲	^	▼
Extra large machine tools	▼	^	▲
Specialty machine tools	^	▲	^
Numerical control machines	▲	^	▼
Superconductive materials	▲ *	▲	^

NOTE:
▲ relatively ahead
^ somewhat above average
▼ relatively behind
* potential for rapid advance in the future

Source: *Voice* (September 1987), p. 95.

TABLE 14
A 1986 COMPARISON OF U.S. AND SOVIET TECHNOLOGY IN 20 AREAS

Area	U.S. Lead	Parity	Soviet Lead
Aerodynamics & fluid dynamics		●	
Computers & software	▲		
Conventional warheads		●	
Directed energy (lasers)		●	
Electro-optical sensors	●		
Guidance and navigation	●		
Life sciences	●		
Materials	▼		
Microelectronics & IC manufacturing	●		
Nuclear warheads		●	
Optics		●	
Power sources		●	
Production & manufacturing	●		
Propulsion	▼		
Radars & sensors	▼		
Robotics & machine intelligence	●		
Signal processing	●		
Signature reduction	●		
Submarine detection	▼		
Telecommunications	●		

NOTE: ▲ U.S. position improving
● U.S. maintaining position
▼ Soviet position improving

Source: Department of Defense (March 1986).

TABLE 15
A COMPARISON OF U.S. AND JAPANESE TECHNOLOGY IN 20 AREAS

Area	U.S. Lead	Parity	Japan Lead
Aerodynamics & fluid dynamics	●		
Computers & software	▼		
Conventional warheads	●		
Directed energy (lasers)	●		
Electro-optical sensors			●
Guidance and navigation	▼		
Life sciences	▼		
Materials		▼	
Microelectronics & IC manufacturing			●
Nuclear warheads	●		
Optics			●
Power sources	●		
Production & manufacturing			●
Propulsion	●		
Radars & sensors		▼	
Robotics & machine intelligence			●
Signal processing		●	
Signature reduction	●		
Submarine detection	●		
Telecommunications		▼	

NOTE: ▲ U.S. position improving
● U.S. maintaining position
▼ Japanese position improving

Source: Estimates of U.S. and Japanese experts, compiled by the author.

Department of Defense representatives in the American Embassy in Tokyo and Japanese representatives from the Defense Agency, the Ministry of International Trade and Industry and the Ministry of Foreign Affairs. In December 1985 the two sides followed up with detailed arrangements for the transfer of military technologies.[63]

To date, there have been three examples of such technology transfer, all of which were contrived more for their role as precedents than for any actual benefit to the United States. Gregg Rubinstein, one of the original architects of the agreement, suggests that the DoD pushed for the exchange arrangements not with any expectation of significant transfers in the short term, but in the hope of setting up an apparatus which could bring real payoffs in the 1990s and beyond.[64] The first case involved the guidance and control system for the Toshiba portable Keiko surface-to-air missile (SAM), a system heralded as a success in Japan but nonetheless of questionable value to the U.S. military. The JMTC approved the government-to-government transfer at a price of approximately $700,000 in December 1986, but the sale was never made due to the political fallout of the Toshiba Machine incident.[65] In the second case, an industry-to-industry transfer, Ishikawajima-Harima Heavy Industries (IHI) sold shipbuilding technology for tactical auxiliary oil tankers to the Pennsylvania Shipyards of the Military Sealift Command. In the final case, an industry-to-government transfer, IHI sold its expertise to the U.S. Navy's Philadelphia Shipyard for overhauling the U.S. aircraft carrier Kitty Hawk under a service-life extension program. Both of the final two transfers met real needs of the U.S. Navy, but they probably could have been arranged as commercial technology transfers if they had not been such convenient trial cases for the new military technology transfer arrangements.[66]

In any case, the DoD always has been more interested in Japanese commercial or so-called "dual-use" technology than in strictly military technology. A Defense Science Board Task Force which toured Japan in November 1983 cited 16 primary areas of interest:

63. Department of Defense (February 1986).
64. Rubinstein interview (3 June 1987).
65. The Toshiba Machine incident is discussed further below.
66. Allen interview (26 June 1987) and Chinworth (August 1987).

Gallium-arsenide devices
(microwave, high-speed logic)
Microwave integrated circuits
Fiber-optic communications
Millimeter-waves
Sub-micron lithography
Image recognition
Speech recognition/ translation
Artificial intelligence
(knowledge-based computer architecture)
Electro-optical devices
Flat displays
Ceramics (for engines, electronics)
Composite materials
High temperature materials
Rocket propulsion
Computer-aided design
Production technology
(including robotics/ mechatronics)[67]

The DoD sent its own technology team to Japan in July 1984 and April 1985 to look specifically at electro-optics and millimeter/microwave technology and sent a follow-up team in August 1986. The second team visited Sony, Oki Electronics, Mitsubishi Electric, Matsushita, NEC, Fujitsu, Japan Aviation Electronics and the Defense Agency's Technical Research and Development Institute (TRDI) and identified a vast array of technology areas of interest.[68] In January 1987 Dr. Clinton Kelly led a DARPA mission to look into Japanese manufacturing technology in electronics, heavy machinery and avionics. The DoD is now planning a technology assessment team on advanced materials technology in Japan. Jamieson C. Allen, director of military R & D exchange at the U.S. embassy in Tokyo, argues that these efforts have failed to result in transfers of Japanese technology primarily because U.S. industry has been inexplicably uninterested in Japan's technology.[69]

The concept of Japanese military technology transfer to the United States took on a whole new meaning when the Reagan administration called for its Western allies to participate in research for the Strategic Defense Initiative (SDI), "Star Wars."

67. Department of Defense (1984), p. 42.
68. Department of Defense (1985) and (May 1987).
69. Allen interview (26 June 1987).

Although Japanese peace groups were horrified, Japanese corporations were generally enthusiastic, welcoming the opportunity to participate in a major international research project and to cultivate an important customer, the U.S. Department of Defense. Japanese industry organized missions to the United States in September 1985 and January 1986 to explore the possibilities for SDI research. The DoD's SDI Office (SDIO) gave these missions specific lists of Japanese technologies of interest.[70] (See Table 16.) Company representatives from the second mission concluded in their report that "participation in SDI could play an important role in raising the level of our technology in related areas."[71] Firms such as Mitsubishi Electric and NEC were particularly favorably inclined because they felt non-participation could mean "missing the boat" (*nori okure*) on important technology spin-offs.[72]

Over time, the initial enthusiasm waned as it became clear that the fruits of SDI research would fall under the control of the U.S. government. Japanese companies might be prevented from capitalizing on the commercial spin-offs of their research for security reasons. The Federation of Economic Organizations (Keidanren) issued a statement on October 20, 1986 welcoming the idea of participation in SDI research yet demanding that 1) Japanese companies be able to utilize the fruits of their research, 2) Japanese proprietary information and technology be sufficiently protected, and 3) U.S. regulations concerning use of sensitive technology be clarified. The Japanese Cabinet agreed to Japanese participation in SDI research "in principle" in September 1986, and this was confirmed by an official announcement in July 1987. Mitsubishi Heavy Industries and a group of Japanese electronics firms and U.S. defense manufacturers received the first Japanese contract for SDI research in December 1988. The consortium will be paid $3 million for a one-year architecture study on anti-ballistic missile (ABM) defense in the Western Pacific.[73]

70. *Hogaku semina* (1987), p. 114., prints a full list of major Japanese corporations and their potential contributions to SDI.

71. Kishida (1987), appendix pp. 3-11.

72. For Japanese perspectives on SDI, see Kishida (June 1986 and 1987), Kibino (1987), and Research Institute for Peace and Security (1987).

73. *Japan Economic Journal* (17 December 1988).

TABLE 16
U.S. STRATEGIC DEFENSE INITIATIVE OFFICE's (SDIO) AREAS OF INTEREST IN JAPANESE TECHNOLOGY

A. Surveillance, acquisition, targeting, and kill assessment (SATKA)
- 1. Radar transmitting modules
- 2. Mercury Cadmium Telluride (HgCdTe) focal plane arrays
- 3. Gallium Arsenide (GaAs) circuit devices
- 4. Real-time signal processing
- 5. Optical data storage
- 6. Optoelectronic and electronic device production

B. Kinetic energy weapons (KEW)
- 7. Miniature accelerometers
- 8. Micro- and millimeter wave integrated circuits
- 9. Radar dome materials
- 10. Radar absorbent materials

C. Directed energy weapons (DEW)
- 11. Compensative optic system technology
- 12. Magnetic core materials for accelerators
- 13. Large-scale optic system composite materials
- 14. Ion sources for neutral particle beams

D. Systems analysis, communications, command and control (SA&C3)
- 15. Architecture study for threat assessment in the Western Pacific

Source: Notes from Japanese SDI delegation (October 1985).

The domestic debate in Japan over the pros and cons of involvement in SDI was only upstaged by the enormous uproar over what became known as the Toshiba Machine Incident. In summer 1987 it came out that Toshiba Machine, a subsidiary of Toshiba, had sold sophisticated milling machines which reportedly enabled the Soviet Union to reduce the noise level of their nuclear submarines. U.S. Congressmen staged a ceremonial declaration of war on Toshiba on the Capitol lawn, smashing Japanese-made radios in front of TV cameras from around the world, and the Japanese media went berserk. Many Japanese commentators viewed the whole incident as a pretext for "Japan-bashing," pointing out that the Soviets had achieved quieter submarines before they imported the Toshiba machines. More sober analysts pointed to the Toshiba incident as a demonstration of the potential power of Japan's commercial technology. If this export did not, in fact, alter the U.S.-Soviet military balance, another one just might.

The Japan Defense Agency (JDA) and Japanese defense contractors, like their U.S. counterparts, are vigorously investigating the potential military uses of Japanese commercial technology. The JDA's Technical Research and Development Institute (TRDI) has set up a small bureau to gather information on such dual-use technology, and to coordinate the process of directing this technology to its military purposes. The major Japanese electronics firms, meanwhile, have set up new departments of one sort or another to explore the possibilities of expansion into the defense business. The JDA sees Japanese electronics technology as a major asset, and already has plans to incorporate some of the hottest new dual-use technology into its weapon systems. JDA officials and the contractors are particularly eager to try out some of the most promising technology on the next-generation support fighter, the FSX.[74] "With so much advanced dual-use technology," notes Takeshi Inagaki, "it is no wonder that manufacturers want to use this technology as a base to develop their own new weapons."[75]

To have this dual-use technology is one thing, to apply it in its military use is another. In some cases, the commercial

74. The technology (Chapter II) and the politics (Chapter III) of the FSX will be discussed further below.

75. Inagaki (1987), p. 100.

technology can be used as it is. In other cases, it must be made to conform to military requirements so that it can endure the harsher conditions of military use. In a few cases, the technology must be completely re-designed for its new role. But in order to maximize the benefits from their dual-use technology, the Japanese must be able not only to adapt this technology to new uses, but to mix and match a whole range of such "dual-use" components to produce an integrated weapon system. Those who are most skeptical about Japan's ability to catch up with the Soviet Union or the United States in military technology stress the difficulty in bridging the gap between producing isolated parts and producing complete systems. The Japanese may have the necessary technology, the argument goes, but they can not put together a system.

CHAPTER II: WEAPON SYSTEMS

The Japanese Defense Industry

To those who claim that the Japanese cannot integrate weapon systems, one could simply respond by pointing out that they already do. The Japanese produce military aircraft, warships, tanks and missiles, some under license but others on their own. But this response begs two more difficult questions. First, to what extent do the Japanese rely on U.S. technology and U.S. parts? And second, just how good a system can they produce?

To better understand Japan's technological capabilities and limitations, we need to disaggregate the technology and know-how required to build a weapon system. As has been illustrated in Chapter I, Japan has a technology base comparable if a bit different in character from that of the United States. Japan excels in all areas of basic technology needed to produce a weapon system such as an airplane. Japan might in fact surpass the United States in selected areas such as electronic devices and coating materials. Moving one level up on the ladder of integration, Japan has some decided weaknesses when it comes to large subsystems, particularly jet engines. In fact, even under the plan for domestically developing an FSX support fighter, JDA officials were resigned to the fact that they would have to import the engines from either Rolls-Royce of the United Kingdom, or Pratt & Whitney or General Electric of the United States. Japanese manufacturers are more accomplished at producing other subsystems such as the computer and communications systems for an aircraft cockpit. Japan's greatest weakness comes in the realm of overall technological know-how in areas such as aerodynamics, and of course, in system integration (see Table 17). Japanese contractors lag in these areas primarily because of their inexperience in developing their own weapon systems. They have advanced considerably through the repeated experience of co-producing under license, but they will be able to master the subtleties of system

TABLE 17
THE TECHNOLOGY NECESSARY TO MAKE AN AIRPLANE

AREA	EXAMPLES
MATERIALS AND COMPONENTS	
Advanced materials	aluminum composites, ceramics
Electronic parts	integrated circuits, gyros
General parts	seats, ventilation system
Structure	welding, hardening
SUBSYSTEMS	
Flight control	automatic pilot, sensors
Operation	radar, cockpit controls
Propulsion *	engine, exhaust system
KNOW-HOW	
Aerodynamics *	wing design, computer analysis
Production technology	laser processing, FMS
Testing & evaluation *	weather tunnel, simulation
System integration *	overall design, simulation

* Areas where Japan lags considerably.

Source: Compiled by the author, based in part on information from the Japan Aerospace Industry Association.

integration only through the experience of developing their own new systems or at least co-developing them with foreign producers. It is not surprising, therefore, that these contractors were so determined to indigenously develop the next-generation support fighter, the FSX, but they will have to settle for co-development of a modified General Dynamics' F-16.

The U.S.-Japan technology gap in weapon systems should not be underestimated. In most weapons systems, the United States is a full generation (five or more years) ahead of Japan. Furthermore, the Japanese defense industry has learned practically everything it knows from its senior partner in the United States. At the same time, however, we must not underestimate Japan's ability to close this gap, given the political will.[1] Japanese defense contractors have managed to license essential know-how from the United States and to expand their own capabilities to the point where they are now positioned to develop their own weapon systems within a reasonably short period of time. The Japan Defense Agency continues to import those systems which can not be produced at home, while doing its best with its limited budget to close the technological gap and to decrease reliance on the United States. The JDA has been remarkably successful in staying not-too-far behind with only a very modest investment in military R & D. "Up until now," remarks Sanshiro Hosaka of the JDA's Technical Research and Development Institute (TRDI), "we have always been running behind the United States. That's why we have been able to research and develop so efficiently, learning from the Americans' mistakes. And now, all of the sudden, we have some of the best technology in the world."[2]

In the long term, a re-emergence of the Japanese defense industry could have some rather ominous implications. One 1982 report estimated that Japan would eventually capture 60 percent of the market for naval ships, 40 percent of military electronics, 46 percent of military automobiles and up to 30 percent of the aerospace market.[3] These estimates may be unrealistic, but nonetheless there are indications that Japanese companies could be successful in exporting military equipment.

1. Japan's ability to "catch up" militarily depends not merely on technology, of course, but also on its economic power and effective government leadership (see Chapter IV).

2. Part 2 of *Kokubo* series (November 1986), p. 109.

3. McIntosh (1986), p. 58.

Japan's "reliability" advantage already extends into the military sector. Yasuo Komoda of Fujitsu complains that the quality of the U.S.-made chips he buys for military requirements is abysmal: "Sometimes only ten percent work."[4] The Westinghouse APQ 120 radar for the F-4 fighter reportedly lasts an average of eight hours before failure, while the Mitsubishi Electric equivalent for the F-4EJ lasts an average of 40 hours.[5] And the readiness rate for the Japanese-made F-15J is higher than that for the U.S.-made F-15.[6] Although the Japanese weapon systems may have been used under less demanding conditions than the American systems, they have still fared astonishingly well.

Furthermore, Japan's technological strengths could play right into the needs of the warfare of the future. In the 21st Century, much of U.S. and Soviet hardware may be obsolete. Meanwhile, laser weapons and robot-soldiers could become a reality.[7] The U.S. and Soviet military establishments probably would not be caught entirely by surprise with such developments, but they certainly would not enjoy the technological lead over Japan which they now have in the most important areas of weapons production. To the extent that new technology makes present technology obsolete, it will be that much easier for Japan to catch up. The U.S. and Soviet lead, in fact, could simply disappear. Robert J. Art illustrates this point in his discussion of the British development of the dreadnought in 1906. The dreadnought, with its greater power and range, made all other battleships obsolete. By developing the dreadnought, however, the British inadvertently wiped out their own significant lead in pre-dreadnought battleships.[8]

For the time being, however, Japan's defense industry is doubly constrained. Japanese defense contractors compete within a small domestic market, and they are prohibited from selling beyond that market. Despite these limitations, the defense industry has weathered the storms of the postwar years and has even managed slow but steady growth. The U.S. Occupation General Headquarters eliminated the Japanese defense

4. Komoda interview (14 July 1988).
5. Interview with senior American executive.
6. Piper interview (31 May 1988).
7. Miyazaki (1982) takes a look at Japanese potential for "robot war."
8. Art and Waltz, eds. (1983), p. 186.

industry at the conclusion of the Second World War, and the old arms factories were either destroyed or converted into shipbuilding or steel plants. The GHQ began to reverse its policy with the outset of the Korean War in June 1950 because the U.S. forces needed a source of supplies closer than the United States. Japanese technicians gained invaluable experience by serving as the primary maintenance workers for U.S. aircraft, ships, and other weapon systems, and manufacturers got a chance to get back into the business beginning in March 1952.[9] Demand dropped after 1957, causing a number of defense contractors to go out of business, but things have stabilized since. The same six companies, three of which are electronics firms, have dominated the defense industry in recent years: Mitsubishi Heavy Industries (MHI), Kawasaki Heavy Industries (KHI), Mitsubishi Electric, Ishikawajima Harima Industries (IHI), Toshiba and NEC. The defense business has become more attractive as a haven of steady growth since the yen-dollar realignment deflated profits in the export sector. The defense budget for "acquisition of equipment" in fiscal 1988 (through March 1989) totaled 1.039 trillion yen, up from 966 billion in 1987 and 900 billion in 1984.[10]

It is impossible to judge how much of Japan's defense equipment is produced domestically because JDA figures grossly overrate this percentage by only accounting for completed systems. The JDA counts a system produced in Japan under U.S. license, for example, as 100-percent domestically produced. JDA figures for 1985 showed that 99.0 percent of naval vessels, 89.9 percent of military aircraft, 88.1 percent of weapons and 88.1 percent of ammunition was domestically produced.[11] Nevertheless, Japan still produces many of its more sophisticated weapon systems under license and it relies on the United States for many of the most important parts. The Japanese contractors themselves estimate that U.S. manufacturers produce 15 to 40 percent of the total value of Japanese defense procurements.[12] JDA officials explicitly aim to minimize reliance on foreign producers because they want to have the ability to maintain and to repair their systems at home. These

9. Ono (1986), p. 15.
10. Procurement Bureau, JDA.
11. *Boei Tsushin* (17 April 1987).
12. *Electronics News* (26 May 1986), p. 26.

officials still remember when they had to overhaul 14 reconnaissance versions of the F-4E which were delivered to Japan in 1977-78. In addition, they argue that they are able to get better systems at a lower price from the United States when they have the option of domestic production. In essence, however, they simply do not like the idea of having to depend on the United States for military hardware. "It gives me chills to think how much we rely on U.S. parts," laments Yasuo Komoda, a former major general in the Ground Self-Defense Forces.

On the whole, Japan is most advanced in those military systems which exploit its strengths in areas of basic technology, and in those military systems which resemble commercial systems most closely. Japan is farthest behind in the most sophisticated systems, particularly in those lacking any commercial counterpart. A senior JDA official who asked not to be identified assessed Japan's capabilities as follows:

COMPARABLE TO THE UNITED STATES:
- radar
- electronic systems
- ASM and SSM

SLIGHTLY BEHIND:
- tanks
- support fighter aircraft (FSX)
- trainer aircraft (XT4)

FAR BEHIND:
- fighter aircraft (F-15)
- jet engines
- torpedoes

The example of Japan's "new tank" is particularly illustrative of the state of Japanese defense technology. Although the new tank (Type 90) does not rival the improved U.S. M-1 (M-1A1) and German Leopard tanks now under development, it does surpass the M-1 and the Leopard-2 as they were first fielded in 1981 and 1978, respectively. The manufacturer, Mitsubishi Heavy Industries, has developed a 50-ton tank with a 1500 horsepower diesel engine. The high power-to-weight ratio gives the tank better acceleration and agility than its predecessor and enables it to travel at 70 km per hour. The Type 90 incorporates some of Japan's best dual-use technology. It has greater survivability due to composite armor and compartmentalization. It also has an all-electric fire control system (FCS) developed by Mitsubishi Electric. The FCS uses NEC's Yttrium-Aluminum-Garnet (YAG) laser and Fujitsu's thermal image technology. Mitsubishi Electric is developing a tracker for the new tank which can follow a moving target. NEC is working on a laser designator which can identify the location and direction of a hostile laser beam. Nihon Seikosho will import the first 100 of the 120 mm smoothbore guns for the tank from West Germany, but will produce the remainder itself under license. MHI has already produced two tanks for the first technical test and four for the second, and anticipates producing at least 300 once full-scale production begins in 1990. Due to the small number which will be produced annually, the unit price of the Type 90 is likely to exceed 1 billion yen.[13]

Military R & D

Present R & D programs indicate that Japan will continue to stay not-too-far behind in most important military technologies, and it will actually close the gap in some areas. The miracle of Japanese military R & D to date is not so much how much the JDA has achieved but how little it has spent. The R & D budget generally has accounted for only one percent of the defense budget, which itself is only about one percent of gross national product (GNP). Military R & D spending has been increasing by 10-15 percent annually, however, reaching 73.3 billion yen, or 2.1 percent of the defense budget, for fiscal 1988 (see Table 18).

The JDA's Technical Research and Development Institute (TRDI) coordinates all military R & D and weapons testing, and conducts the government portion of research. The TRDI is a division within the JDA with a civilian director-general and four uniformed directors in charge of ground systems, naval systems, air systems and guided weapon systems, respectively. The JDA decided to reorganize the TRDI on July 1, 1987, in order to use its limited budget more efficiently. The primary goal was to

13. Inoue interview (24 July 1987); "Kokusan sensha 61-shiki kara shin sensha e no ayumi: gijutsu kakushin de 'seizonsei' no tsuikyu e" [A History of Domestic Tanks From the 61-Type to the New Tank: the Pursuit of "Survivability" Through Technological Progress], Part 5 of *Kokubo* series (January 1987), pp. 66-77; and Ebata (1988).

TABLE 18
COMPOSITION OF THE DEFENSE BUDGET 1983-88 (percentage)

	1983	1984	1985	1986	1987	1988
PERSONNEL AND PROVISIONS	44.5	44.6	45.1	45.1	43.9	42.7
SUPPLIES	55.5	55.4	54.9	54.9	56.1	57.3
Equipment acquisition	24.9	26.3	26.2	26.9	27.5	28.1
R & D	1.1	1.2	1.6	1.7	1.9	2.1
Facility improvement	1.9	1.3	1.4	1.7	2.0	2.8
Maintenance	16.3	15.5	15.1	14.4	14.2	14.1
Base countermeasures	10.0	9.7	9.5	9.0	9.4	9.2
Others	1.3	1.3	1.2	1.2	1.1	1.0

Source: Asagumo Shimbunsha (1988), p. 233.

eliminate programs which could be handled by the private sector, such as nutrition research, and to concentrate on areas of Japan's greatest potential strength, such as optics, electronics, and command, control, communications and intelligence (C3I). (See Table 19.) The TRDI restructured the Second Research Center in particular to promote the integration of Japanese commercial technology into military systems. Technicians in this research center are now using advanced materials to develop 3-5 and 10-micron band infrared charge coupled device (IRCCD) sensors.

The TRDI tries to do as little in-house research as possible. It restricts itself to those areas which are either too general or too risky for the private sector to undertake. In the case of in-house research, the TRDI transfers the technology to the contractors if the JDA decides to procure the system. In most cases, however, the TRDI commissions private firms to conduct research or to cooperate with the TRDI on its own projects. Defense contractors are generally reluctant to engage in defense research at their own expense unless they are confident of being effectively paid back through procurement, but there are exceptions. NEC, for example, is working on a wide range of dual-use technologies, including sensor systems, command and control electronics, millimeter and microwave systems, and infrared lasers. NEC managers feel that these efforts will eventually pay off through commercial spin-offs or technical advances which will allow the company to expand its share of the growing market for defense electronics.[14] In the case of the FSX, a consortium led by MHI was willing to initiate research well before any decision on procurement was made. Ishikawajima Harima Industries formed a similar group to work on jet engines.

In most cases, the contractor begins its own research after it has already reached some sort of understanding with the JDA. MHI, for example, is working on a ship to house the Aegis system that was expected to be approved for import from the United States in 1988.[15] Anticipating the signing of a contract,

14. Nagasawa/Saito interview (3 August 1987).

15. In June 1988, a group of U.S. congressmen led by Rep. Charles Bennett of Florida tried to stop the export of the $500 million system on the basis that Japan cannot be trusted to keep the technology secret. In addition, Sen. J. Bennett Johnston of Lousiana

TABLE 19
ORGANIZATION OF THE TRDI LABORATORIES

FIRST RESEARCH CENTER

1st division:	artillery, small arms, ammunition, explosives
2nd division:	armor, anti-ballistic structures
3rd division:	camouflage, parachute and quartermaster supplies
4th division:	hydrodynamics, structure and noise-reduction technology for battleships

SECOND RESEARCH CENTER

1st division:	information system integration, communications, computer applications
2nd division:	radar systems, electronic warfare, microwave antennas and components
3rd division:	electro-optical systems, forward-looking infrared lasers, optical warning systems, electro-optical components

THIRD RESEARCH CENTER

1st division:	aerodynamics, stability and control, structure and integration of subsystems for future fighter aircraft, helicopters, missiles, and remote piloted vehicle (RPV)
2nd division:	air-breathing and rocket propulsion systems
3rd division:	missile guidance, fire control systems, sensors, navigation systems

FOURTH RESEARCH CENTER

1st division:	mine warfare, protective structures
2nd division:	vehicle subsytems such as transmission, suspension system, and engines
Test division:	testing and evaluation of vehicles, including new tank

FIFTH RESEARCH CENTER

1st division:	advanced submarine sonar, underwater acoustics
2nd division:	torpedoes, mines
Field test and evaluation division:	testing of torpedoes, mines, sonar
Kawasaki branch:	shipboard degaussing, magnetic sensors

Source: TRDI.

MHI began designing two ship types, Japanese counterparts to the U.S. CG 47 and DDG 51. MHI is developing a larger controllable pitch propeller, a more powerful generator and a new air conditioning system to meet the requirements of the new ships.[16] Fujitsu is doing intensive R & D on contracts already received for an anti-submarine warfare operation center (ASWOC) for the Maritime SDF and an Electronics Warfare Evaluation System (EWES) for the Air SDF. NEC is working with the Air SDF in fine-tuning the BADGE air-defense system which went into operation in fiscal 1988.[17]

In April 1987, the TRDI director-general set top priority on three areas: aircraft, guided weapons, and electronic machinery. The TRDI's most important aircraft project before the FSX has been the XT-4 intermediate trainer aircraft. Flight tests have been completed, and Kawasaki Heavy Industries (KHI) delivered its first production types in 1988.[18] The JDA reportedly spent less than one-quarter as much to develop the XT-4 as the United States spent to develop its trainer, the T-46.[19] The TRDI is working with NEC and other electronics producers on a Division Air Defense data processing system for the Ground SDF. NEC is also developing an integrated sonar system for surface vessels under contract with the TRDI (see Table 20). The TRDI's most promising R & D programs today, however, focus on derivatives of the air-to-surface missile, the ASM-1, and on subsystems for the next-generation support fighter, the FSX.

Mitsubishi Heavy Industries started developing the ASM-1 (Type 80) missile in 1973, and began production in 1980. F-1 and other fighter aircraft now carry the 50-kilometer range, Mach 1 speed missile for attacks on surface ships. The missile uses inertial guidance in mid-course and active radar homing in its terminal phase.[20] MHI has been widely heralded for

amended the 1989 defense approporiations bill, HR 4781, with a provision prohibiting the sale of the Aegis system to Japan unless the ship itself was also made in the U.S. On August 5, Sen. Bill Bradley of New Jersey managed to strike this provision from the bill. See *JEI Report*, Nos. 24B, 30B, and 31B (24 June, 5 and 12 August 1988).16. I. Yamamoto interview (4 August 1987).

17. Adachi interview (28 July 1987).

18. See "Shin chuto renshuki XT-4: cho-onsoku sentoki nami no undo seino" [The New Medium-Range Trainer XT-4: the Agility of a Supersonic Fighter], Part 5 of *Kokubo* series (March 1987), pp. 84-94.

19. Interview with senior JDA official.

20. O'Connell (1987), p. 54.

TABLE 20
SOME WEAPON SYSTEMS CURRENTLY BEING DEVELOPED BY THE TRDI

Year R & D Started	System
AIRCRAFT	
1983	(Ship-board) anti-submarine helicopter
1988	Fighter support aircraft (FSX)
GUIDED WEAPONS	
1986	Ship/air-to-ship missile (XSSM-1B, XASM-1C)
1986	Dogfight missile (XAAM-3)
1987	Portable surface-to-air missile
VEHICLES	
1982	New tank
1984	Infantry fighting vehicle
ELECTRONIC MACHINERY	
1983	Aircraft control and warning radar
1984	Surface vessel sonar system
1986	Division air defense data processing system

Source: Japan Defense Agency (1988), p. 320.

completing development within budget and on schedule, and for producing a missile that has achieved exceptional hit-rates in field tests. In 1979, MHI began development of a surface-to-surface missile, the SSM-1, based on the ASM-1. MHI designed the missile for the Ground SDF with a range of 150 kilometers so that it can be launched from points approximately 100 kilometers inland and still strike enemy ships well offshore. The missile is launched by rocket off a special MHI truck. The turbojet-powered cruise missile then uses inertial guidance in its overland phase and part of its oversea phase, but switches to active radar homing as it skims over the water toward its target.[21] The Ground SDF tested the missile at Point Mugu, California in 1987, and MHI executives report that hit-rates exceeded the 60-70 percent which Americans generally consider to be "very good."[22]

With the success of the SSM-1, the TRDI and MHI are now planning two more ASM-1 derivatives: an XSSM-1B ship-to-ship missile for the Maritime SDF and an XASM-1C air-to-ship missile for the Air SDF. They are also working on an XAAM-3 air-to-air dogfight missile for the Air SDF based on the U.S. AIM-9 (Sidewinder) series. The XASM-1C, which will be carried on the FSX, will have a turbojet engine like the SSM-1 and will have a range of about 150 kilometers. The XASM-1C, however, will have an infrared image homing system using a higher precision infrared camera and a better image processing system than in similar foreign weapons.[23] Japan may continue to co-produce the larger missile systems like the Patriot or the Hawk, but it has no more need of U.S. assistance in developing the smaller family of missiles.[24] "We have caught up with the Americans in missile technology," claims one TRDI bureaucrat, "but we have only been able to do so because of the high-performance semiconductors, high-density integrated circuits, quality control, and

21. "Japan Uses SSM-1 Expertise to Develop Cruise Missile," *Aviation Week and Space Technology* (21 March 1988), p. 59.

22. Tajima/Wani interview (8 July 1988).

23. *Aviation Week and Space Technology* (21 March 1988), p. 59, and Tajima/Wani interview (8 July 1988).

24. MHI produces the Patriot under license from Raytheon. Raytheon's Bob Ilg, who works closely with MHI, suggests that the United States may need Japan's help in developing a medium-range surface-to-air missile to replace the Hawk (interview, 15 July 1988).

microprocessors that have come from Japan's industrial technology base."[25]

When Japan agreed to co-develop a modified version of the General Dynamics' F-16C as its next-generation support fighter (FSX), the decision was heralded as a victory for the United States and as a major loss for the Japanese defense industry. Since that time, the TRDI and MHI, the primary contractor on the Japanese side, have made it clear that they plan to use the FSX opportunity to try out all of their latest dual-use and military technology. They are likely to end up with an aircraft which only vaguely resembles the F-16C. They may not be able to develop an airplane which can challenge the U.S. aircraft that are now being developed, but Japanese producers will gain invaluable experience in the process. "We would like to catch up with the generation after the FSX," declares Sakichiro Ono of the Japan Ordnance Association.[26]

The TRDI plans to develop new wings for the FSX in order to make it more stealthy and more maneuverable. The TRDI will have to develop its own stealth technology, which depends on advanced materials as well as on wing design, because the United States will not transfer this technology. Likewise, the TRDI will have to develop improved control configured vehicle (CCV) technology on its own.[27] CCV aircraft are inherently unstable as they have smaller "canard" wings, but they are much more agile than conventional aircraft. They can "slide" horizontally where a traditional aircraft would have to make a banking turn. The FSX will use a new digital fly-by-wire system to continuously monitor flight parameters and instantly readjust in order to maintain balance. The TRDI has already tested CCV technology on a remodeled T-2 trainer. The TRDI also plans to use a domestic fire control system (FCS) and computer for the FSX. Mitsubishi Electric, NEC and Fujitsu will co-develop a computer based on their commercial models, using "off-the-

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25. *Kokubo* (October 1986), p. 31. For a more in-depth look at Japanese missile development, see Part 1, "Kokusan misairu: suppo kara toppu reberu ni" [Domestic Missiles: From the Bottom to the Top Level], and Part 2, "Kokusan misairu: ASM-1 to MAT" [Domestic Missiles: the ASM-1 and the MAT], *Kokubo* series (October and November 1986).

26. Ono interview (6 July 1987).

27. The U.S. F-16 has an analog fly-by-wire system, and the F-16 ATF uses digital fly-by-wire CCV technology, but to date the United States has not agreed to license this technology.

shelf" commercial memory devices.[28] The computer will have to be miniaturized and specially packaged for use on aircraft, and it will need its own cooling system.[29]

The most widely heralded subsystem being developed for the FSX is Mitsubishi Electric's (Melco) active phased-array radar. Melco and the TRDI are reportedly 3-4 years ahead of Westinghouse, Hughes and Texas Instruments in that they have already produced two prototypes and they have tested them on a C-1 aircraft at the TRDI's Gifu test center. The radar, which has more than a thousand "active" radiating elements, boasts ultra-high resolution and unprecedented terrain-mapping capabilities. The challenge now is to make it affordable and to make it small enough to serve as an airborne FCS radar. The TRDI will probably need one or two more years to make it more resistant to electronic interference and to integrate it into the complete fire control system.[30]

In the summer of 1988, the Japanese government took the initiative, proposing that the United States and Japan work together on research and development in five areas: 1) anti-armor technology, 2) degaussing (erasure of magnetic signature) techniques for submarines, 3) missile seekers, 4) ducted rocket engines, and 5) laser jamming technology. The two sides have decided to drop the fifth area, but the United States is likely to agree to cooperate in two or three of the other areas.[31] It is still too soon to determine whether the Japanese government sees this more as an opportunity to learn from the United States, or rather as a chance to promote closer cooperation with its strongest ally.

The Nuclear Option

One weapon system which the Japanese have chosen not to produce is the nuclear weapon. This choice is primarily, of course, a political one, and not one dictated by a lack of technological capability. The political issues involved will be discussed in the following chapter, but it is necessary here to note the technological considerations, for they fit into an overall

28. *Nikkan Kogyo Shimbun* (23 May 1988), p. 16.
29. Interview with senior JDA official.
30. *Ibid.*
31. U.S. Department of Defense sources.

assessment of Japan's actual and potential capabilities. Yatsuhiro Nakagawa, a professor of political science at Tsukuba University and Japan's self-proclaimed "lone advocate" of nuclear armament for Japan, insists that Japan would have significant technological barriers to cross if it were to go nuclear.[32] Japan has a small amount of low-quality uranium in Okayama, but this would not be enough for a significant nuclear arsenal. The Chinese have pointed to the fact that this uranium has never been used for energy purposes as evidence that Japan intends to go nuclear, but the Japanese contend that it simply would not be economical to try to dig it up. Beyond this, Japan would either have to convince the United States, Canada or Australia to export uranium for military uses, or Japan would have to divert its uranium from energy to military use. In order to divert its uranium from energy use, Japan would have to choose between trying to fool the International Atomic Energy Agency (IAEA) inspectors—a formidable task—or abrogating the Non-Proliferation Treaty (NPT).[33] Japan has a "pilot scale" enrichment plant at Ningyo Pass which produces uranium enriched to three percent (of the U-235 isotope), but which could be relatively easily converted to produce weapons grade, 93 percent enriched uranium. Nakagawa estimates that Japan could be producing weapons-grade uranium within two years if it chose to do so.[34]

Alternatively, Japan could use plutonium for nuclear weapons. Japan has large stockpiles of plutonium from spent fuel that was reprocessed in Europe. Under an April 1988 agreement with the United States, for the next 30 years Japan no longer needs to request U.S. permission on a case-by-case basis to send its used nuclear fuel to Europe for reprocessing. Japan also has a "pilot scale" reprocessing (plutonium extraction) plant of its own, and is planning to build a larger one within the next decade. This plutonium is intended for use as fuel in fast breeder reactors when they become commercially feasible. This fuel is "reactor-grade" rather than "weapons-grade." It can still be used for nuclear weapons, but it is not the plutonium of choice because it has a high percentage of the

32. Nakagawa interview (29 July 1987) and Nakagawa (1986 and 1987).
33. Japan signed the NPT in 1976.
34. Nakagawa interview (29 July 1987).

isotope Pu-240. Japan could adapt its nuclear reactors in order to produce weapons-grade plutonium, but this would be considerably more difficult and more costly than converting uranium enrichment plants so they can produce weapons-grade uranium. Japan has a variety of delivery systems—tactical aircraft, missiles and long-range artillery—which could be equipped to deliver nuclear warheads.[35]

The Missing Link: Space

While Japanese officials are reluctant to set forth any long-term goals for the defense industry, they are much clearer about their intentions in an area of direct import for weapons systems: space technology. Further development of its space industry will give Japan greater international prestige and independence from the United States, it will encourage the development of Japanese technology as a whole, and it will give the country valuable experience in systems integration. Furthermore, Japan's ability to close the technology gap in space systems bodes well for its potential to catch up in military systems as well. The Space Activities Commission's (SAC) Long-Term Policy Council, formed in November 1985, produced a report on May 26, 1987 declaring that Japan is aiming for a "central role" in the global space market by the beginning of the 21st Century. The report states that Japan will complete the Engineering Test Satellite-VI (ETS-VI) and the H-II booster without foreign assistance, and will launch a Japan Experiment Module (JEM) by the mid-1990s. From the late 1990s into the beginning of the new century, Japan will develop an operating space station and will move on to manned space activity, moon and planet exploration.[36] The report even sets out estimated development budgets and proposed dates for completion of a number of projects.[37]

Space development has generally been, along with nuclear energy development, one of only two reserved domains for the

35. See Endicott (1975), Sorenson (1975), and Spector (1987) on nuclear technology and Japan's nuclear option. The author is particularly indebted to Leonard Spector for comments on an earlier draft of this section.

36. Japan has decided to join the international space station project proposed by U.S. President Ronald Reagan at the Toronto Summit in 1988. Japan will produce one capsule for the space station at a cost of 300 billion yen. (Aoe interview, 13 July 1988).

37. *Science and Technology in Japan* (August 1987), pp. 18-19.

TABLE 21
JAPANESE SPACE BUDGET FOR FISCAL 1988 (million yen)

Science & Technology Agency	98,470
Ministry of International Trade & Industry	14,089
Ministry of Education	13,364
Ministry of Transportation	3,089
Ministry of Posts & Telecommunications	532
TOTAL	129,543

Source: STA (1988), p. 34.

Science and Technology Agency. In the proposed budget for fiscal 1988, the STA, primarily through its public corporation, the National Space Development Agency (NASDA), spent 98 of a total 130 billion yen in space-related government expenditures.[38] (See Table 21.) The Ministry of Education houses the smaller Institute of Space and Astronautical Science (ISAS) which has been involved primarily in scientific missions, including the launching of two spacecraft to intercept Halley's Comet.[39] MITI has been stepping up its own involvement in this area, and it upgraded its space industry section to a full-fledged division in July 1987.

NASDA's original launch vehicle, the N-1, was first used in 1975 and was 53-67 percent domestically produced.[40] Japan licensed much of the technology from the McDonnell Douglas corporation, producer of Delta rockets. The N-2, first used in 1981, was 56-64 percent domestically produced. Japan decided to develop its own inertial guidance system for the H-1, as the United States had "black-boxed" this technology for the N-1 and N-2.[41] The H-1, which was first used in 1986, was more than 80 percent domestically produced.[42] It can lift 1200 pounds into geosynchronous orbit. The H-1 marked an important transition in Japan's space development, as Japan developed its own cryogenic propulsion technology for the second stage because the United States did not want to relinquish its own technology. NASDA has refused all U.S. assistance in developing the H-2, which will be able to launch 4400 pounds, more than a U.S. Air Force Titan 34 D. The H-II is scheduled for its first launch in January 1992.[43]

Japan entered the satellite business late, but it has made catching up a national priority. One American expert suggests that Japan may catch up with the United States within five years.[44] The government has carefully orchestrated the development of the industry so as to cultivate some competition, although Mitsubishi Electric is clearly the leader in terms of its

38. *Ibid.*, p. 20.
39. For more on ISAS, see Fisher (1986).
40. The domestic content increased as the launch vehicle was upgraded between uses. The N-1 launched a total of seven satellites.
41. Aoe interview (13 July 1988).
42. Domestic content estimates are from Science and Technology Agency data.
43. *Aviation Week and Space Technology* (14 July 1986), p. 18.
44. Beitchman interview (23 July 1987).

ability to integrate satellite systems. The government has generally granted contracts to Toshiba for broadcast satellites, to NEC for weather satellites, and to Mitsubishi for communications satellites. The government surprised all, however, by choosing NEC as prime contractor for the third-generation broadcast satellite after the Toshiba BS-1 and BS-2 did not live up to expectations.

NEC is planning to launch its fourth-generation geosynchronous meteorological satellite (GMS-4) in 1989. Mitsubishi Electric launched a third-generation communications satellite in February 1988. Mitsubishi is working with NEC on a 3000 pound earth resources satellite (ERS-1) which will carry Japan's first synthetic aperture imaging radar and visible and infrared imaging homing sensors. Mitsubishi is also the likely prime contractor for the engineering test satellite (ETS-VI) spacecraft which will be the first H-2 booster payload, now scheduled for launch in January 1992. In the case of all satellites, the Japanese producers are trying to gradually withdraw from dependence on U.S. technology. The BS-1, launched in 1978, was 90 percent U.S.-produced (assembled in the United States by RCA). The BS-2A and BS-2B, launched in 1984 and 1986, respectively, were 70-percent U.S.-made (assembled in Japan). And the BS-3A, set for launch in 1990, will be almost entirely domestically produced.[45]

Japan's space research and development is designed not so much to approach the U.S. level in the short term as to catch up and to surpass it, at least in a few specific areas, in the long term. The government has shown itself willing to devote considerable resources to this effort and it will continue to do so. Private companies, particularly Mitsubishi Electric, NEC, MHI and Nissan, have made investments in research beyond those justified by the immediate returns alone. The level of Japanese commitment suggests that Japan is likely to be a formidable competitor in the commercialization of space. Japan will gain valuable experience in the integration of systems such as rocket boosters which have important military applications. Japan may never catch up with the United States in overall space systems technology, but it is likely to be able to produce superior hardware. In addition, Japan's space program will give

45. Beitchman interview (23 July 1987).

Japanese companies more opportunities to use and to develop advanced components. Mitsubishi Electric, for example, has designed a gallium arsenide solar cell for use on satellites which exceeds the capabilities of anything designed in the United States. Solar cells have an advantage over silicon cells in that they generate 30-50 percent more power, and they are more resistant to rays and more durable in high temperatures. "The United States may produce solar cells," notes a manager at Mitsubishi, "but they cannot mass produce them, and they cannot produce cells of the same quality."[46]

Japan still lags behind the United States in its ability to integrate systems both for commercial use in space and for military use. Yet achievements to date and the level and efficacy of the R & D effort indicate that Japan is likely to catch up with the United States in the production of space systems such as boosters and satellites and to stay just one step behind in weapons systems. Even in the area of weapon systems, where Japan has not yet shown any inclination of making the kind of investment it would take to catch up, the Japanese government has shown a determination to decrease its technological reliance on the United States and to stay within striking range of the world's leading producers in important military technologies. Japanese corporations are well poised, therefore, to become leading producers of weapon systems—if Japan's political leaders choose to support them.

46. Kasugabe interview (6 August 1987).

CHAPTER III: THE POLITICAL CONTEXT

The Defense Debate

Japan's leaders will make their choices about the country's military future within a distinct political context. Many commentators, particularly Japanese ones, have argued that Japanese military expansion is strictly constrained by domestic political forces. This paper suggests, however, that while this was true in the 1950s and 1960s, it will be much less so in the 1990s.

The Japanese defense debate has evolved so gradually, so imperceptibly, that it is hard to say precisely when the Yoshida "consensus" on national strategy dissolved. Yet at some point in the 1970s, the old consensus gave way to a new one which points in a very different direction. The difficulty in evaluating this change comes in part from the fact that neither "consensus" was ever really a consensus in the literal sense. Japan has always had its pacifists and its militarists; only the weight of the conservative mainstream has shifted. The Yoshida consensus refers to a policy originally adopted under the administration of Prime Minister Shigeru Yoshida (1948-54), under which Japan would control internal security while depending primarily on the United States for protection from external threats. This policy incorporated rather severe constraints on the role of the defense forces, the most prominent of which was Article Nine of the constitution which declares that "war potential will never be maintained." In the wake of World War II, the consensus held, Japan should concentrate on reconstructing the economy, not building up the military. Japan should limit its role in world affairs. This consensus rested on the assumptions that Japan could not afford to rearm and that any rearmament would meet virulent opposition both at home and abroad. The United States could be counted on for protection, and in any case, the Communist threat to Japan was minimal.[1]

1. This analysis is based in part on my earlier study of the Japanese defense debate. See Vogel (1984).

A number of developments throughout the 1970s served to erode this consensus. The simultaneous rise of Japan as an economic power and the relative decline of the United States as a military power provided the most basic impetus behind this transition. The Japanese became increasingly aware of this shift in world power as the United States retreated from the gold standard in 1971 and withdrew from Vietnam in 1975, and as Japan recovered remarkably well from the oil shocks of 1973 and 1978. Japanese leaders began at the same time to question American protection and to reconsider their country's role in the world. Four specific developments reinforced this trend toward greater "realism" in defense policy. First, U.S. reversion of Okinawa to Japanese rule, finalized in 1971, represented a withdrawal of the U.S. nuclear deterrent from Japanese territory and a partial "Japanization" of defense. Second, U.S. President Richard Nixon's visit to China in 1972 paved the way for Sino-American and Sino-Japanese detente, and for Chinese recognition of Japan's Self-Defense Forces (SDF). This struck a harsh blow against the Japan Socialist Party (JSP) and the doves within the LDP who had long claimed that Japanese forces posed a threat to relations with China. Third, a major Soviet buildup in the Far East in the late 1970s moved many Japanese leaders to re-examine their benign view of the Soviet threat. The weakness of Japan's early warning system was dramatically exposed in 1976 when a MiG-25 aircraft crashed in Hakodate. In 1978, 75,000 Soviet ground troops were relocated in the Northern Islands (just north of Hokkaido), and in 1979, the United States announced that the Soviets had deployed SS-20s in the Asian theater. Fourth, officials in the Carter administration (1977-81) and a chorus of U.S. congressmen began to call for greater Japanese efforts on defense. This "foreign pressure" had a tremendous impact on Japanese attitudes, for Japanese leaders are acutely aware of their dependence on the United States in the economic as well as in the security realm. This pressure served to sway those Japanese allied with U.S. interests, particularly those in the business community, in favor of higher defense spending.

In the meantime, convinced of the need to strengthen Japan's defenses, a number of Japanese leaders including Prime Minister Eisaku Sato (1964-72) and Directors-General of the Defense Agency Yasuhiro Nakasone (1970-71) and Shin Kanemaru

(1977-78) made special efforts to raise public "defense consciousness." The Takeo Miki administration (1974-76) was particularly skillful in minimizing public resistance to Japan's long-term defense plan, the National Defense Program Outline (*boei keikaku no taiko*) of October 1976. The administration coupled the Outline with a limit on the role of the SDF to that of repelling a "limited and small-scale attack." More importantly, the Cabinet passed a resolution on November 5 limiting defense spending to "about one percent of GNP." The opposition parties were not to let the LDP rid itself of this resolution for more than ten years.

The new mainstream policy did not kill off those within the LDP and within the ministries who favor strict limits on defense, but it did strike a forceful blow against them. The majority of Diet members now accept the "realist" position which favors gradual defense expansion, essential cooperation with U.S. requests for sharing a greater portion of the defense burden, and an effort to make Japan's defense more closely designed to meet specific military threats. By 1980, a *Nihon Keizai Shimbun* poll showed that 78.6 percent of LDP Lower House Diet members advocated expansion of the Self Defense Forces while only a handful were opposed. 41.4 percent said that the Soviet Union posed a "major threat" while 50.5 said it presented a "potential threat." 46.4 percent opposed the arms export ban and 36.7 favored revision of the Peace Constitution.[2]

The so-called Defense Tribe (*boei-zoku*) has been at the vanguard of this new policy. This group of LDP Diet members from the LDP's three defense committees, many of whom are former directors-general of the Defense Agency, have consistently lobbied for higher increases in defense spending since the "budget revival" (*fukkatsu sessho*) negotiations of December 1979.[3] Their primary role has been to contest Ministry of Finance limits on spending. They only managed to get a 6.5 percent increase for fiscal 1980 but they succeeded in topping the MoF's absolute ceiling of 7.5 percent with a 7.754 percent increase in fiscal 1982 (see Table 22). The Defense

2. *Asahi Shimbun* (27 and 29 April 1980). On the varying perspectives within the Japanese defense debate, see Mochizuki (1984) and Vogel (1984).

3. The three committees are the Investigative Committee on National Security (*anzen hosho iinkai*), the National Defense Committee (*kokubo bukai*), and the Special Committee on Military Bases (*kichi taisaku tokubetsu iinkai*).

TABLE 22
JAPAN'S DEFENSE BUDGET 1955-89 (billion yen)

Year	Def. Budget	% increase over previous year	As % of GNP	As % of total budget
1955	134.9	3.3	1.78	13.61
....				
1965	301.4	9.6	1.07	8.24
....				
1975	1327.3	21.4	0.84	6.23
1976	1512.4	13.9	0.90	6.22
1977	1690.6	11.8	0.88	5.93
1978	1901.0	12.4	0.90	5.54
1979	2094.5	10.2	0.90	5.43
1980	2230.2	6.5	0.90	5.24
1981	2400.0	7.6	0.91	5.13
1982	2586.1	7.8	0.93	5.21
1983	2754.2	6.5	0.98	5.47
1984	2934.6	6.6	0.99	5.80
1985	3137.1	6.9	0.997	5.98
1986	3343.5	6.6	0.993	6.18
1987	3517.4	5.2	1.004	6.50
1988	3652.3	5.2	1.013	6.53
1989 *	3900.0	5.9	—	—

* Estimate based on a political settlement in January 1989. See *JEIReport,* No. 58 (31 January 1989).

Source: Japan Defense Agency (1988), p. 332.

Tribe has both played a leading role in shaping the ruling party's defense policy and in making the previously "taboo" question of defense into an issue of national debate.

At the same time, a number of politicians, scholars and military officers have tried to come up with a strategy to match Japan's proposed new role. In the past, Japanese defense was designed simply to meet a vaguely defined "limited small-scale attack." Defense White Papers before 1980 did not even refer to the Soviet Union or any specific country as a military threat. With the new direction in policy, a new group of "military realists" have begun to try to assess precisely what capabilities Japan would need to meet the Soviet threat in specific situations, and to decide which missions could be carried out by Japan alone and which missions could only be carried out with U.S. assistance. One of the most prominent headquarters for such thinkers is the Center for Strategic Studies of Japan (CSSJ), headed by senior LDP Dietmen Shin Kanemaru and Noboru Minowa and staffed by military experts, mostly former officers. In the Center's 1981 treatise, *Ko sureba nihon wa mamoreru* [This is How to Defend Japan], the Center staff members develop a strategy whereby Japan essentially provides for its own defense while only relying on the United States for nuclear deterrence. In a 1981 proposal to the LDP leadership, they suggested that Japan raise its spending by 0.1-0.3 percent of GNP per year until it reached at least 2.5 percent.

In a May 1981 meeting with U.S. President Ronald Reagan, Prime Minister Zenko Suzuki agreed that Japan would defend its own sea lanes out for a distance of 1000 nautical miles. Japanese acceptance of this mission implies a need for much greater reconnaissance and anti-submarine warfare (ASW) capabilities. The JDA has decided to purchase four ships equipped with the sophisticated Aegis system, and it is studying the possibility of developing its own over-the-horizon (OTH) radar. The Japanese already have large escort ships which can carry up to three helicopters, but they are now considering procuring helicopter carriers such as those used by Britain and Italy for sea-lane defense. In addition, Japanese deployment of the SSM-1 missiles will give Japan a much greater capability to block the three straights—the Soya, the Tsugaru, and the Tsushima straights—which Soviet ships based in Vladivostok must traverse in order to reach the Pacific.[4] U.S. and Japanese officials have exchanged information on defense planning more freely since the establishment of the "Guidelines for U.S.-Japan Defense Cooperation" in 1978. U.S.-Japan defense cooperation has advanced particularly since 1980. U.S. and Japanese forces have performed combined military exercises involving all branches of the services since 1986.[5]

The transition to defense "realism" has given the defense establishment a new role and greater status. As Japanese military capabilities approach those recommended in the 1976 Outline, defense planners now can realistically envision carrying out their prescribed missions. "With fulfillment of the 1985 Mid-Term Plan," says one JDA official, "Japan will finally have meaningful defense. This gives us both a burden and a responsibility."[6] In the early postwar years, anti-military sentiments were so strong that members of the defense establishment were ashamed to hand out their name cards. The Defense Agency was considered the lowliest of government agencies, and the director-general of the JDA was the meekest of ministers. In fact, directors-general of the JDA, who are also Diet members, were known to have an uncanny propensity for losing their first re-election bid after serving in the post. The military still does not have the respect of all, but the SDF now have the overwhelming support of the population.[7] Furthermore, JDA bureaucrats are no longer second-class citizens within their own agency. In the past, the bureaucrats who were hired after the war to staff the new agency were not senior enough to qualify for the top posts, so officials were brought in from other ministries to fill these positions. In May 1988, however, Seiki Nishihiro became the first JDA-"born" bureaucrat to reach the top civil service post, that of administrative vice-minister, and others are moving up as well.[8] The JDA itself, still an "agency" rather than a full-fledged "ministry," is slowly gaining in prestige. Particularly noteworthy was the appointment of

4. O'Connell (1987) discusses the role of the SSM-1 at length.

5. On U.S.-Japan defense cooperation, see Rubinstein (1988) and Levin (1988).

6. Shinkai interview (24 June 1987).

7. See poll data given later in this chapter.

8. Katsuya Hirose has done a comprehensive study of JDA bureaucrats in "Boei kanryo no purofiiru" [A Profile of Defense Bureaucrats], *Hogaku Semina* special issue (November 1987), pp. 283-293.

Yuko Kurihara, a powerful LDP politician and an experienced defense hand, as director-general in 1986. In the past, the LDP has appointed relatively junior Dietmen with little or no experience in defense affairs to the rather unpopular post.

The Military-Industrial Complex

Each of these groups—the LDP's Defense Tribe, the military realists, and the members of the defense establishment—forms an important constituency in favor of defense expansion. In the years to come, however, the most important such constituency may be the emerging Japanese military-industrial complex. Defense production accounts for a meager 0.5 percent of total production for Japanese industry, and even for the largest contractors defense production only accounts for a small portion of sales.[9] Yet at the same time, Japan's top defense contractors are also some of its largest and most powerful corporations (see Table 23). These corporations expend more resources and more political capital on their defense business than might be warranted by defense sales alone. "Defense may only account for three percent of our business," says Kunio Saito, general manager of NEC's 1st Defense Sales Division, "but it certainly takes up more than three percent of our energy."[10] Defense requires more political effort because it is a political business. Defense contractors have only one client, the Japan Defense Agency, so the incentives to lobby are great. Companies are willing to allocate more resources to the defense business in part because they see it as a secure business, insulated from the pitfalls of the business cycle, and because they see it as a business that will continue to grow steadily. "By the year 2000 we are confident that our sales will grow to a level warranting the kind of investment we are making today," declares Yotaro Iida, president of Mitsubishi Heavy Industries. "Defense sales will at least double, reaching 600-700 billion yen."[11] The defense business is particularly attractive now that many export

9. The Japan Defense Agency (1988) states that defense production accounted for 0.54 percent of total production in 1986, up from 0.36 percent in 1980 (p. 335). Defense accounts for 10-20 percent of sales for heavy industry manufacturers such as Mitsubishi (MHI) and Kawasaki (KHI), but only for 0-5 percent for electronics makers such as NEC and Fujitsu.

10. Saito interview (3 August 1987).

11. *Nikkei Business* (11 May 1987), p. 13.

TABLE 23
JAPAN'S TOP TEN DEFENSE CONTRACTORS FOR 1987
SALES (billion yen) AND GROWTH OVER 1986

Company	Sales	(growth)	1986 rank
1. Mitsubishi Heavy Industries	262.5	(-9.9%)	1
2. Kawasaki Heavy Industries	171.4	(+18.4%)	2
3. Mitsubishi Electric	86.5	(+6.4%)	3
4. Ishikawajima Harima Industries	75.1	(-4.0%)	4
5. Toshiba	72.7	(+7.9%)	5
6. NEC Corporation	60.7	(+25.2%)	6
7. Nihon Seikosho	24.3	(+9.5%)	7
8. Fujitsu	22.3	(+57.8%)	12
9. Komatsu	21.1	(+34.2%)	11
10. Hitachi Shipbuilding	20.9	(+14.8%)	9

Source: *Nikkei Sangyo Shimbun* (6 April 1988), p. 11.

industries have been hit by the "strong-yen recession" (*endaka fukyo*). Sakichiro Ono of the Japan Ordnance Association reports that association membership jumped by 12 members in six months and his popularity has suddenly increased. "Ono-san," his friends call to say, "I hear business is still good at your place."[12]

Even more importantly, Japanese firms see involvement in the defense business as an imperative so as not to fall behind in the high-tech race. They envision commercial spin-offs from defense production, and they fear that they may miss out if they are not at least peripherally involved in the defense business. They see the defense industry as one which may drive innovations in other areas, such as electronic components.[13] "We are being challenged by the NICs in traditional consumer markets," explains Fujitsu's Komoda. "We have to go value-added, and all that is left is space and defense."[14] Their interest has grown particularly since January 1983 when Prime Minister Nakasone announced that Japanese companies would be able to export military technology to the United States. These corporations see the U.S. Department of Defense as a customer of enormous potential value. Their expectations rose even further when the United States invited its allies to join it in research for the Strategic Defense Initiative. These developments hint at the possibility of the ultimate payoff: a lifting of the arms export ban altogether.

Electronics firms have shown a new interest in defense production as they have taken note of a steadily growing defense procurement budget with an increasingly large electronics content. Electronics accounted for an average 25.6 percent of all defense procurement for 1984-87, up from an average 11.2 percent for 1979-82.[15] NEC was rewarded with 25 percent growth in defense sales in 1987, while Fujitsu registered 58 percent

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12. Ono interview (6 July 1987).

13. Samuels and Whipple (1989) use the metaphor of a tree to explain why some Japanese planners feel that the aerospace industry is so important to technological development. The aerospace industry is a stem which is connected to both the "roots" (underlying technologies) and the "fruits" (related industries) of the tree. The point is not so much that one part of the tree is more important than another, but that the parts all depend on each other for their own healthy development.

14. Komoda interview (14 July 1988).

15. *Nikkan Kogyo Shimbun* (23 May 1988).

growth.[16] Mitsubishi Electric, NEC and Toshiba have long been involved in the defense business, but firms like Hitachi, Fujitsu and Oki have only shown interest within the last few years. Hitachi set up a special Defense Sales Promotion Department in 1980 to attract more defense contracts. Fujitsu launched Fujitsu Systems Integration in 1982 to carry out defense-related research, and added a defense section at headquarters in 1986. Even Sony, noted for its lack of interest in defense, showed up at a conference on allied participation in SDI in Huntsville, Alabama in November 1987.[17] Matsushita, meanwhile, staunchly refuses any involvement in defense.

The defense industry's most powerful representative is the Federation of Economic Organization's (Keidanren) Defense Production Committee. The committee has 81 members, all of whom are presidents or chairmen of major corporations. The chairman of the committee has always been the chairman of Japan's No. 1 defense producer, Mitsubishi Heavy Industries. The Committee has enormous influence by virtue of its being part of Keidanren, Japan's most powerful business organization and a primary source of funding for the ruling LDP. The Committee makes its views known publicly through its policy position papers, and privately with small groups of LDP Diet members.[18] The Committee restricts itself to industry-wide issues, however, leaving the more specific issues to the industry associations. Keidanren has focused in recent years on three demands: 1) to raise JDA R & D spending, 2) to raise the domestic content of JDA procurement, and 3) to approve Japanese participation in SDI.

The most important industry association for defense manufacturers is the Japan Defense Industry Association (*nihon boei sobi kogyokai*). Established in 1951 as the Japan Ordnance Association (*nihon heiki kogyokai*), the association was renamed and reorganized in September 1988. It is now an incorporated association officially affiliated with both the JDA and MITI.[19] It is too early to tell whether this change of status will make the association more or less powerful as a representative of the defense industry. Since its inception, the JOA saw its role

16. *Nikkei Sangyo Shimbun* (6 April 1988), p. 11.
17. Komoda interview (14 July 1988).
18. Anzai interview (9 July 1987).
19. *Asahi Shimbun* (17 September 1988).

TABLE 24
FORMER MILITARY OFFICERS OF THE RANK OF LIEUTENANT GENERAL OR VICE ADMIRAL AND ABOVE IN JAPAN'S TOP SIX DEFENSE CONTRACTORS (April 1986)

Company	Ground SDF	Maritime SDF	Air SDF	TOTAL
MHI	3	5	5	13
KHI	3	4	3	10
Mitsubishi Electric	2	1	2	5
IHI	1	3	2	6
Toshiba	2	1	1	4
NEC	2	1	2	5

Source: National Security Conference (*Anzen hosho konwakai*).

essentially as one of taking care of those defense contractors which need support due to the risks they take in a business that depends on a limited market. The JOA recommended that the Japan Defense Agency notify contractors ahead of time of what its anticipated needs will be. It pushed for higher R & D spending and made an explicit goal of 100 percent domestic content for Defense Agency procurement.[20] The association is also supported by the Japanese Aircraft and Space Industry Association (*nihon koku uchu kogyokai*) and the Japanese Shipbuilding Industry Association (*nihon zosen kogyokai*). The three industry associations have a coordinating committee for collective efforts (*dantai renraku iinkai*).

The individual companies, particularly major contractors such as MHI, do some of their own lobbying. They rely particularly on retired SDF officers to maintain their ties with the JDA and the forces. Top bureaucrats have long had a tradition of "descending from heaven" (*amakudari*) into prominent roles in private industry after retirement at age 55 or 60. Military officers have made the same pattern a practice, and they now represent the most influential defense lobby of all. A defense contractor, it is said, should have at least one military "old boy" for every 20 billion yen in annual defense sales. MHI boasts 13 former officers of the rank of lieutenant general or vice admiral and higher on its payroll. Kawasaki Heavy Industries has ten and Ishikawajima Harima has seven. Electronics companies such as NEC, Mitsubishi Electric and Fujitsu each have four or five (see Table 24). Their role is to advise the company on defense production matters and to lobby the government. They are particularly effective lobbyists because they are often making requests to their own former staff at the JDA or in the services.

Despite all of its power, the defense industry appeared to have lost its most important battle in recent years in October 1987 when the JDA decided in favor of co-development of a modified General Dynamics' F-16C instead of indigenous development. The industry associations and the individual producers had set out early both to convince the JDA that they had the technology to develop the FSX on their own and to lobby the government to choose domestic development. They reportedly

20. Ono interview (6 July 1987).

lobbied the JDA to modify 100 aging F-4EJs under a Service Life Extension Program in order to "buy time" so that they could make their proposal for a domestic FSX more plausible.[21] Although government agencies did not publicly announce their position on the matter, a series of interviews in the summer of 1987 revealed that the industry had obtained strong support from most sections of the JDA, some support from MITI, and firm support from a number of LDP Diet members. Senior LDP Dietman Masayuki Fujio, for example, argued for 100-percent domestic development because Japan needs to have a certain independence in defense matters. "We cannot cut off the defense industry," he asserted, "just when it is beginning to grow."[22] The decision probably would have gone for Japanese-led co-development, despite pleas by U.S. Defense Secretary Caspar Weinberger and growing pressure to do something to counteract the growing trade surplus with the United States, if it had not been for one final straw: the Toshiba Machine incident. This put Japan in such an embarrassing situation, particularly in terms of its credibility as a producer of sensitive dual-use technology, that it could no longer resist the enormous pressure from the United States to import American technology. Nonetheless, the TRDI and the producers have done their best since the decision to ensure that Japanese manufacturers can try out their own dual-use technology on the FSX and to maximize the Japanese value-added. After intense negotiations with the U.S. Department of Defense, in June 1988 they reluctantly agreed to guarantee U.S. contractors a minimum 30-40 percent share of production value.[23]

The Disappearing Constraints

Japanese leaders have announced one barrier to defense expansion after another with great pomp and ado, and their successors have very quietly set about tearing them back down.

21. Samuels and Whipple (1989).

22. *Asahi Shimbun* (21 May 1988).

23. According to the November 1988 memorandum of understanding, technology developed under the FSX project is to "flow back" to the United States for free if it is based primarily on U.S. technology, and to be made available for sale to the United States if it is based on Japanese indigenous technology. General Dynamics has shown particular interest in Japanese composite materials for the aircraft's wings. See *The New York Times* (13 January 1989).

First and foremost of these barriers is Article Nine of the constitution. Japanese academics, journalists, politicians and officers have long argued about whether the Article can be "interpreted" to sanction the Self-Defense Forces, and if so, how powerful the SDF can be. The absurdity of these efforts to stretch the constitution can be seen, however, if one returns to the original text:

> Aspiring sincerely to an international peace based on justice and order, the Japanese people forever renounce war as a sovereign right of the nation and the threat or use of force as means of settling international disputes.
>
> In order to accomplish the aim of the preceding paragraph, land, sea, and air forces, as well as other war potential will never be maintained. The right of belligerency of the state will not be recognized.

Those who claim that the SDF could be permitted under the Constitution argue that the Constitution allows for "purely defensive" forces. Yet the SDF of today has crossed this boundary as well. Although Japan does not have long-range missiles or bombers, or aircraft carriers, its warships and medium-range aircraft certainly have offensive potential. In fact, a Sapporo district court in 1973 judged that the Self-Defense Forces were unconstitutional. The Sapporo High Court overruled this decision in 1976, arguing that the constitutionality of the SDF is outside the scope of judicial review.[24] In a study of Article Nine, James R. Van de Velde concludes that "Japanese defense policy remains a function of Diet resolutions and leadership choices and is not constrained by the supposed limits the Article poses on national policy."[25]

The most important constraint for the defense industry is the ban on arms exports. This ban was first officially articulated in 1967 by Prime Minister Eisaku Sato, who declared that Japan would never export arms to countries involved in or threatening to become involved in conflicts, to Communist nations or to countries on the United Nations' embargo list.[26] Although Sato

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24. Van de Velde (1987), p. 34.
25. *Ibid.*, p. 26.
26. Chinworth (20 February 1987), p. 2.

did not mention whether the ban included exports to NATO allies, the ban was understood to apply to all countries. The policy was reinforced in 1976 when Prime Minister Miki extended the export ban to any means of producing arms. In fact, however, Japanese firms have been able to export some military items because the Japanese define "military" in a much narrower sense than Americans do, pretty much restricting "military" items to things which explode. *World Military Expenditures and Arms Transfers 1987* estimates that Japan exported $90 million of arms in 1985, $290 million in 1984, and $320 million in 1983.[27] In addition, a certain number of military exports have slipped by the inspectors, as they did in the Toshiba Machine case. A naval base in Vladivostok, for example, boasts a state-of-the-art floating dock made in Japan ostensibly for commercial use. In addition, Japanese corporations are important suppliers of components to the U.S. Department of Defense and to other NATO allies as well.

The Nakasone announcement in 1983 that Japan would export military technology struck a first blow against this arms export ban, and the Japanese declaration of participation in SDI in 1987 provided a second. Japan may allow exports of military technology to other NATO allies in the not-too-distant future. In the short term, the government is much less likely to allow military systems exports, for Japan today has very little to export in the way of military systems anyway. In the long run, however, Japan's defense contractors will have to export if they hope to compete with their American and European counterparts. In the meantime, Japanese corporations have plenty of opportunities to expand in the defense field by exporting components and by transferring technology. They could even move on to exports of dual-use systems such as radars and command and control systems without revising the arms export ban as it now stands.

Japanese defense capabilities are further restricted by the "three non-nuclear principles." Prime Minister Sato declared in 1972 that Japan would never 1) produce, 2) maintain, or 3) introduce nuclear weapons onto its territory. This position was solidified in 1976 when Japan finally ratified the Non-

27. The U.S. Arms Control and Disarmament Agency (1988) includes all exports of military equipment and dual-use equipment with missions identified "primarily as military" in their arms export figures. They do not include foodstuffs, medical supplies, petroleum products or other such supplies (p. 144).

Proliferation Treaty. Such knowledgeable authorities as former U.S. Ambassador Edwin Reischauer have admitted that it always has been common practice for U.S. ships and submarines carrying nuclear weapons to stop at Japanese ports, so there really are only two non-nuclear principles in force. Still, the Japanese people retain their nuclear "allergy," and discussion of nuclear rearmament remains taboo. The Japanese remember Hiroshima and Nagasaki, and the anti-nuclear movement has mass support despite a lack of unity.[28]

Tsukuba's outspoken political scientist, Prof. Nakagawa, argues that Japan needs a nuclear deterrent because it can no longer count on U.S. protection. Japanese nuclear forces are needed both to deter the Soviets from a direct attack on Japan and to even out the global balance which now favors the Soviet Union. He argues that Japan should follow the course of France. Just as in the French case, U.S. disapproval will soon peter out and give way to a hearty welcome for a stronger ally. He advocates a nuclear Japan that is still a loyal member of the Western alliance. He recommends a force structure that would include U.S. Pershing-II missiles, Trident D-5 SLBMs and mobile Minuteman ICBMs.[29] (See Table 25.) Nakagawa, in fact, is not alone in advocating a nuclear option for Japan. Prime Minister Takeo Fukuda himself has mentioned the possibility and right-wing LDP Dietmen like Shintaro Ishihara and Shigeto Nakano have openly advocated it.[30]

One of the most often-cited constraints to Japanese rearmament, the GNP one percent spending limit, has already met its demise. Henry Kissinger has gone so far as to argue that "the removal of [this] tacit budgetary barrier coupled with the increased defense spending produced by the growing Japanese GNP makes it inevitable that Japan will emerge as a major military power in the not-too-distant future."[31] Throughout Prime Minister Nakasone's tenure, defense spending threatened to surpass the barrier. By the time that it finally did in 1987, the opposition and the newspapers were so worn out from crying "sheep" that they let out no more than a gentle murmur. The LDP considered establishing a new ceiling, but decided

28. See Vogel (29 February 1984).
29. Nakagawa interview (29 July 1987) and Nakagawa (1986 and 1987).
30. Research Institute for Peace and Security (1981), pp. 156-158.
31. *Washington Post* (29 January 1987).

TABLE 25
A HYPOTHETICAL NUCLEAR ARSENAL FOR JAPAN

Weapons	Range
DEFENSE WEAPONS	
Nike missiles	45 km
Lance missiles	120 km
203/155 mm howitzers	20-30 km
Nuclear land mines	——
Submarine rockets	50 km
DETERRENCE WEAPONS	
Persching-IIs (mobile)	1800 km
GLCMs (mobile)	2500 km
Nuclear Tomahawks	2500 km
SLBMs (Trident D-5)	11000 km
Mobile ICBMs (Midgetmen)	——

Source: Nakagawa (1986), p. 37.

instead to establish fixed spending levels each five years for the next five-year Mid-Term Defense Plan.

While the GNP one percent barrier has been broken, budgetary constraints have not. Despite the success of the Defense Tribe, the Ministry of Finance is still a force to be reckoned with. In fact, the Ministry of Finance is able to set the parameters of the budget debate by "making the first bid" when it sets the ceiling to which the Defense Tribe must then respond. The budgets in the 1980s have been unusually tight, but the Defense Tribe and others have been remarkably successful at making defense a top priority item in the budget. Defense spending rose 6.55 percent, for example, in fiscal 1984, the tightest budget year in 29 years. The defense share of the national budget has risen every year since 1981 (see Table 22).

The ultimate constraint on rearmament is the Japanese public, long known for its sensitivity to militarism since World War II. Anti-military sentiments were particularly strong in the 1950s, peaking in massive demonstrations in 1960 before the signing of the U.S.-Japan Mutual Security Treaty and reviving once again as the treaty was renewed in 1970. Yet double defeat has taken the wind out of the resistance, and the Japanese public now accepts the treaty and the Self-Defense Forces. Koichi Kato, a rising LDP leader, personifies this change of heart. An active demonstrator against the treaty in his days at Tokyo University, he has since made it all the way to the post of JDA Director-General (1984-86).

Japanese leaders have not merely responded to public opinion on defense matters; they have actively tried to shape public views on defense. They have not conspired in some sort of long-range plot to cultivate the Japanese public for a revival of militarism, but they have effectively prepared the Japanese public for incremental changes in defense policy. Over time, the Japanese public has become less opposed to the military and more "realistic" on defense matters. The percentage of Japanese who would like defense spending to be maintained at its present level or increased has risen from 52 percent in 1972 to 69 percent in 1988.[32] Japanese approval of the SDF has risen from 73 percent in 1972 to 83 percent in 1984. Furthermore, the percentage of the population that supports a security system based

32. *Asahi Shimbun* (27 June 1988).

on the SDF and the U.S.-Japan Security Treaty has risen from 41 percent in 1972 to 69 percent in 1984.[33] One might suggest that Japan's policy shift during the 1970s merely reflected this change in popular attitudes. I would argue the opposite: the change in popular attitudes reflected the shift in policy.[34] The Japanese government did not, after all, suddenly announce a new policy, but introduced relatively small changes incrementally. The government coupled movements toward a more assertive defense posture with publicly announced limits on defense, and consistently made an effort to justify changes to the public. Thus Prime Minister Sato declared the export ban and the non-nuclear principles while also renewing the security treaty. Prime Minister Miki established the one percent limit and reinforced the export ban while announcing the largest build-up plan in Japan's postwar history. Prime Minister Nakasone publicly appealed for support of a more "realistic" defense policy, based on full cooperation with the United States. It is no accident that Defense White Papers and statements by top political leaders have consistently stressed the "understanding of the people." LDP leaders have tried to create this "understanding," and all in all, they have been quite successful.

Some authors have argued that Japanese anti-militarism could give way to the equally powerful force of Japanese nationalism.[35] Although nationalism has been primarily directed toward commercial endeavors in the postwar period—catching up and surpassing the Western powers economically—it could eventually be redirected toward military expansion. Not all Japanese favored acquiescence to U.S. power after World War II, and many still feel the wounds of a humiliating defeat. Former Prime Minister Nakasone himself in 1956 expressed a deep-seated resentment of U.S. control over Japanese security:

> Japan has been left spiritually and physically handicapped due to American misgovernment. The claim to a national defense that would not be manipulated by the United States—the claim for any

33. Japan Defense Agency (1987), pp. 228 and 229.
34. This argument is made in greater depth in Vogel (1984).
35. See, for example, Axelbank (1972) and Hoyt (1985).

> defense of the motherland in the real sense—has been denied.[36]

A young student today is equally blunt:

> [The Americans] want us to be weak. That is why they rigged our educational system—to stop Japan from being a major power.[37]

Resentment of the United States is re-emerging as "trade friction" between the two countries flares up.[38] A 1987 feature article on U.S.-Japan trade friction in the *Tokyo Shimbun* carried a disturbing headline: "This Would Have Meant War in the Old Days." This kind of resentment could push the Japanese people to support a military build-up as an alternative to reliance on the United States.

The opposition parties, particularly the Japan Socialist Party (JSP) and the Japan Communist Party (JCP), have taken the lead in criticizing LDP policies on defense. These two parties have effective control over the peace movement, and they have traditionally garnered much public support for their anti-military stand. Yet as public anti-military views softened, these two parties gradually lost ground in Diet elections. The JCP has stuck to its principles, but it has paid dearly for its close ties with the Soviet Union in an era in which Soviet forces invaded Afghanistan (1979) and shot down a Korean Air Lines passenger jet not far from Hokkaido (1983). The JCP does not oppose the notion of Japanese armed forces *per se*, but it insists that the SDF are unconstitutional. The party might even support revising the constitution in order to permit such forces.[39] With only 27 seats in the House of Representatives (*shugi-in gi-in*) and without any solid ties to the other opposition parties, the JCP is not likely to influence national defense policy.[40]

The JSP, still the No. 1 opposition party with 85 seats in the House of Representatives, has waffled on defense issues since

36. As quoted in Otake (3 July 1981), p. 30.
37. Buruma (1987).
38. See Buruma (1987).
39. Yoshioka interview (15 July 1988).
40. The House of Representatives, or the Lower House, is the more powerful of the two chambers in the Japanese National Diet.

1983.[41] Masashi Ishibashi, architect of the unarmed neutrality doctrine and chairman of the JSP at the time, inflicted the death blow to his own doctrine during the well-publicized Diet Budget Committee debates of the fall of 1983.[42] These debates traditionally offer the opposition a golden opportunity to question and to attack the administration on national television. In this case, however, Prime Minister Nakasone counter-attacked, accusing the JSP of sticking to an "unrealistic" defense policy. Ishibashi then performed an ill-advised half-retreat, suggesting that the SDF are "legal" yet still "unconstitutional." Under Chairwoman Takako Doi, the JSP still nominally supports unarmed neutrality, but an increasing number of JSP Diet members are moving toward a more "realistic" position. "We have to accept the shift in public opinion and recognize the SDF," says JSP Dietman Kenji Kawamata. "Otherwise we may still be the party of the constitution, but we will never be the party of the people."[43]

The Komeito, sometimes known as the Clean Government Party, first recognized the SDF and the U.S.-Japan Mutual Security Treaty in 1981 and further solidified this position at the party congress in 1985. The Komeito position argues that the role of the SDF should be strictly limited to defending Japan's own territory, Japanese airspace and Japanese waters.[44] The center-of-the-road Democratic Socialist Party recognized the SDF in 1975, and now has a reputation for being as "hawkish" as the LDP. The DSP has particularly distinguished itself with its aggressive support for a national espionage law. In addition, the DSP refused to join the other opposition parties in denouncing the demise of the GNP one percent ceiling on defense spending. The DSP largely supports the LDP position on defense, although it tries to differentiate itself with an even more "realistic" perspective. "The DSP has the most rational defense policy," claims DSP Dietman Yoshihiko Seki, "because we base this policy on a careful assessment of real defense requirements in light of the existing

41. As of January 1989, the LDP had 298 seats in the House of Representatives, the JSP had 85, the Komeito had 56, the DSP had 29, the JCP had 27, and independents had 6. Eleven seats were empty.

42. See Ishibashi (1980).

43. Kawamata interview (8 July 1988).

44. Ichikawa interview (11 July 1988).

Soviet threat."[45] DSP support gives the LDP added leeway to proceed with its own defense policy with little more than casual concern for the views of the opposition. Even if the LDP were ever to lose its majority, LDP leaders can be confident that the tiny New Liberal Club or the more sizeable DSP would much sooner join the LDP in a coalition than they would take sides with the JSP and the JCP.[46]

The transition of the 1970s and the early 1980s has taken its toll on the supposed constraints on defense expansion, but it has hardly wiped them out altogether. The Japanese defense debate has reached a compromise position which will continue to favor spending increases in the range of five to seven percent per year in the short-term future, *whether or not* the United States pressures Japan further to share a greater part of the defense burden. The JDA will continue to raise the proportion of its budget targeted for procurement and for R & D, and will reorganize its force structure to meet specific threats and to protect Japan's sea lanes for up to 1000 nautical miles. The JDA will continue to increase the domestic content of its procurements where possible, and the defense industry will pursue opportunities to export military-use components or military technology to the United States and other NATO allies. But Japan will not become a major military power if the international situation remains as it is today. Only with some external impetus will Japan significantly accelerate its military build-up.

International Factors

What could push Japan to further rearm? I will briefly discuss three possible developments which could have this effect, beginning with the most powerful.

1. U.S. PROTECTION OF JAPAN LOSES CREDIBILITY, OR DISAPPEARS ALTOGETHER. The Japanese people, somewhat like the Europeans, have never been quite sure whether the United States would really come to the rescue if Japan were attacked. Would the United States put New York at risk just to save Tokyo? To say the least, the Japanese are skeptical. An

45. Seki interview (12 July 1988).

46. The seven members of the New Liberal Club did in fact join a coalition with the LDP after the LDP barely missed an absolute majority in the December 1983 elections.

Asahi Shimbun poll showed that 56 percent of the Japanese people feel that the United States would not come to the rescue in the case of an attack on the Japanese homeland.[47] The Japanese desire to increase its military role will grow to the extent that Japanese leaders perceive a decline in the U.S. capability or intention to protect Japan. As pointed out above, the original move away from the Yoshida strategy was motivated by a perception of U.S. weakness. Japanese leaders are particularly suspicious of U.S. intentions to protect Japan because the United States has refused to map out the specific steps it would take in the case of a military attack on Japan. In the future, these leaders will be sensitive to 1) U.S. economic weakness, 2) U.S. military weakness, 3) U.S. pressure on Japan to do more for itself, and 4) a partial or complete withdrawal of U.S. forces from Japan. More than a few Japanese shuddered when President Jimmy Carter suggested that the United States might withdraw its forces from South Korea. If the United States cannot or will not protect Japan, Japan will defend itself. Some U.S. policy-makers may welcome such a development, but if Japan does choose to take over full responsibility for defense, the United States will lose control over Japanese force levels and military doctrine, and the United States will sacrifice much of its leverage over Japanese foreign policy.

The Japanese leadership has been, and will continue to be, extremely sensitive to signs of declining U.S. support. JDA officials claim that the U.S. Defense Department has been much less forthcoming to the Japanese with defense information and technology since 1980.[48] The defense industry has been particularly attuned to the efforts of U.S. companies to "black box" military technology sold to Japan so that Japanese firms will not be able to copy it. Although U.S. leaders may see this as nothing more than good business and the protection of America's own security interests, the Japanese perceive this as a sign of U.S. distrust and an important reason why Japan should build up its own military production capability.

2. JAPAN'S RELATIONS WITH THE UNITED STATES AND EUROPE GO SOUR. The Japanese have become accustomed to constant "trade friction" with trading partners, but they have

47. *Asahi Shimbun* (1 November 1978).

48. Kinjo interview (23 June 1987) and Shinkai interview (24 June 1987).

hardly grown to like it. Japanese government officials and business leaders are increasingly bitter about what they see as unjustified "Japan-bashing" by the United States. They feel that a lack of diligence and poor management has lead to the reduced competitiveness of U.S. products, and that U.S. critics of Japan are simply using Japan as a scapegoat for their own woes. Japanese see U.S. attacks on Japanese mistakes as little more than American plots to retaliate against Japan. When Japanese businessmen from Hitachi and Toshiba were caught stealing secrets from IBM, Japanese commentators saw this as an unfair American trap. "In Japan," remarked one Japanese manager indignantly, "we do not put respectable businessmen in handcuffs and throw them before TV cameras."[49] Likewise when Toshiba Machine was caught selling military-use technology to the Soviets, the Japanese press portrayed the whole thing as some sort of American scheme. The Japanese media will show up to empty congressional subcommittee meetings in order to uncover the slightest hint of Japan-bashing, and will then enlarge the story to merit first-page coverage. It is no wonder that tempers in Tokyo, as in Washington, are rising.

It is beyond the scope of this paper to analyze just how far trade war can go in an age of interdependence, but the record to date shows that tensions between the United States and Japan are likely to get worse, not better. The Japanese side will become even more embittered as U.S. criticism turns into bills which actually punish Japanese firms. Japanese exporters are already suffering from the effects of a stronger yen. On the U.S. side, of course, anti-Japanese sentiments will reach a new high if the trade deficit does not begin to shrink substantially in the near future.

3. THE MILITARY THREAT TO JAPAN, PERCEIVED OR REAL, INCREASES. The military threat to Japan is not likely to increase in the near future, for ratification of the Intermediate Nuclear Forces (INF) Treaty signifies a substantial *decrease* in the Soviet threat to Japan. Furthermore, the Gorbachev administration has shown itself far more willing to pursue improved relations with Japan than any of its predecessors. If anything, the Japanese side has been more reluctant. If the Soviet Union could bring itself to return the four Northern Islands

49. Yokota interview (20 July 1987).

that it seized after World War II, it might succeed in ushering in a new era of Sino-Japanese detente. The Japanese have no fondness for the Soviets, but they have few specific disputes beyond the Northern Territories and the perennial question of fishing rights. Japan's reaction to the Soviet build-up in the late 1970s did show, however, that the Japanese are now sensitive to specific military threats and are likely to react to them in the future. Furthermore, some have argued that U.S.-Soviet detente may actually encourage Japanese defense efforts. For one thing, the Japanese may question the U.S. commitment to protect Japan even more. And as former JDA director-general Koichi Kato has noted, a decrease in the nuclear threat implies an increase in the Soviet conventional threat, which is what Japan is most concerned with in the first place.[50] When asked whether they could trust the Soviets now that the Soviets have agreed to eliminate their intermediate-range nuclear forces, only 34 percent of the Japanese surveyed said "yes" while 46 percent said "no."[51]

Japanese leaders could also choose to build up their forces as a reaction to some new military threat. They are particularly concerned with the political instability which plagues their neighbors, South Korea and the Philippines. Japan will react particularly strongly to heightened tension between the Koreas or to a weakening of the U.S. commitment to South Korea. To date, Japan has been remarkably unconcerned about conflicts in the Middle East, given its heavy dependence on oil from the region. If a conflict were actually to result in a partial or complete cut-off of supplies of Middle Eastern oil, however, Japan might radically revise its policy of non-involvement in military conflicts beyond its own borders.

Any of the three developments discussed above, or any combination of them, could push Japan to adopt a more independent defense posture. It should be noted, however, that international factors could serve as constraints as well as catalysts for Japanese military expansion. Japan's Asian neighbors are

50. Kato interview (12 July 1988).

51. *Asahi Shimbun* (25 December 1987). The "yes" and "no" percentages were 55 and 40 for Americans, 54 and 29 for French, 65 and 23 for British, and 73 and 16 for West Germans.

TABLE 26
SDF FORCE STRUCTURE UNDER THE NATIONAL DEFENSE PROGRAM OUTLINE

GROUND SDF	
Authorized personnel	180,000 men
Basic units	12 divisions
Peacetime units	2 combined brigades
Mobile operation units	1 armored division
	1 artillery brigade
	1 airborne brigade
	1 training brigade
	1 helicopter brigade
MARITIME SDF	
Basic units	
Anti-submarine surface ship units (for mobile operation)	4 escort flotillas
Anti-submarine surface ship units (regional district units)	10 divisions
Submarine units	6 divisions
Minesweeping units	16 squadrons
Land-based anti-submarine	
	aircraft units 16 squadrons
Main equipment	
Anti-submarine surface ships	60 ships (approx.)
Submarines	16 submarines
Combat aircraft	220 aircraft (approx.)
AIR SDF	
Basic units	28 groups
Air control and warning units	10 squadrons
Interceptor units	3 squadrons
Support fighter units	1 squadron
Air reconnaissance units	3 squadrons
Air transport units	1 squadron
Early warning units	6 groups
Main equipment	
Combat aircraft	430 aircraft (approx.)

Source: Japan Defense Agency (1987), p. 95.

likely to protest any further defense build-up.[52] Asian leaders have had little effect on Japanese defense policy to date, but they could become more forceful in the future. In addition, the United States at some point may stop encouraging Japanese defense expansion and start discouraging it.

Japan will not emerge as a major military power in the next decade, but Japanese leaders will make policy decisions in the coming years which will critically influence the direction of Japanese defense policy in the early 21st Century. By 1990, when they decide on a new Mid-Term Plan for 1991-95, they will have to consider revising the nearly fulfilled National Defense Program Outline. A number of LDP Dietmen, such as Sohei Miyashita and Hisao Horinouchi, are already pushing for revision.[53] In the LDP tradition of ambiguity, they are most likely to choose to revise the prescribed force structure without altering the Outline's text (see Table 26). JDA officials are almost certain to procure over-the-horizon (OTH) radar within the next five years, but they will face more difficult choices over whether to procure tanker aircraft and aircraft carriers as well. Furthermore, Japanese leaders will have to re-examine some of the traditional constraints on military power. Will they allow military technology exports to NATO countries, or military systems exports to the United States? Will they send Japanese forces abroad, even if only to participate in United Nations peacekeeping forces? As Japanese leaders answer these smaller questions, they will also begin to answer some larger ones.

52. See Jusuf Wanandi, "Armed, Yes, But Must It Be to the Teeth?," *Far Eastern Economic Review* (14 July 1988), pp. 32-33.

53. Miyashita interview (12 July 1988) and *Jiyu* (June 1988), pp. 10-25.

CHAPTER IV: JAPAN'S OPTIONS

Japan as Military Superpower

Chapter I showed that Japan has a technology base unsurpassed even by the United States, and that it leads the world in a number of crucial dual-use technologies. Chapter II illustrated that Japanese producers are accomplished enough at putting together weapon systems that they could conceivably catch up with their American counterparts—if they were willing to make the enormous investment required. Our judgement that Japan could emerge as a military superpower within the policy-relevant future (10-25 years) rests not only on these assessments of Japanese technological capabilities, however, but also on three additional assumptions. First, Japan has the necessary economic resources to become a military superpower. Second, Japan has the necessary human resources. And third, the Japanese government has the ability to direct and to control these resources.

Japan has enough money to buy itself a world-class defense establishment if it wants to do so. Japan's gross national product (GNP) for fiscal 1987 (through March 31, 1988) reached 317.6 trillion yen.[1] Japanese GNP growth has outpaced the other major industrialized countries throughout most of the postwar period. Japan weathered the oil shocks of the 1970s remarkably well, and it has adjusted surprisingly well to the considerable appreciation of the yen since 1986. Growing domestic demand compensated for declining export demand in fiscal 1987, as GNP grew by 5.2 percent. GNP growth for fiscal 1988 was expected to grow by about 5.2 percent again, easily surpassing the Economic Planning Agency's forecast of 3.8 percent.[2] The Japanese economy can be expected to grow steadily at a rate of 3 to 5 percent per year in the near-term future. With a large and healthy economy, the Japanese can certainly afford to build up their military forces. David Denoon has estimated

1. *JEI Report*, No. 47B (16 December 1988).
2. *Asahi Shimbun* (19 January 1989).

that Japan could double defense spending without any substantial negative impact on GNP growth.[3] "Within anticipated ranges," he concludes, "limitations on defense spending are political and not due to economic constraints."[4]

Japan has the human resources necessary to develop a competitive defense industry and to manage a powerful military establishment. Japanese literacy rates are among the highest in the world, and the quality of Japanese education, particularly at the secondary level, is the highest in the world. A third of Japanese children go to college.[5] In 1985, Japan had more than 5 million students specializing in science and engineering in high school, more than 2 million in college, and 60,000 in postgraduate courses.[6] According to the *UNESCO Statistical Digest 1987*, Japan has 7.2 million economically active engineers compared to only 3.5 million for the United States.[7] An estimated 7000 Japanese students are now studying science in the United States.[8]

Furthermore, the Japanese government has been extremely successful at directing its economic and human resources into productive uses. Western scholars have come up with a wide range of explanations for the Japanese economic "miracle," citing such advantages as cheap wages, low defense spending, a high savings rate, skilled corporate management and a Confucian work ethic. Each of these factors added to Japan's success, yet none of them would have meant as much without the leadership of a strong, centralized government.[9] Laura D'Andrea Tyson and John Zysman explain Japanese success in

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3. Denoon interview (5 February 1987).

4. Denoon, ed. (1986), p. 208. Also see the chapter in this book on "Japan and South Korea" written by Walter Galenson and David W. Galenson, pp. 152-194.

5. 1985 figures from Science and Technology Agency (March 1987), p. 35.

6. *Ibid.*, pp. 116-19.

7. UNESCO (1987), pp. 148-49 and 206-07. See Westney and Sakakibara (1985) for a qualitative comparison of the training of engineers in the United States and Japan. Also see "The Great Engineering Gap," Chapter 6 of Gregory (1985), pp. 119-27.

8. *Far Eastern Economic Review* (31 March 1988), p. 62. U.S. legislators have cited this figure as evidence that U.S.-Japan technological exchange is a one-way street. U.S. negotiators pushed for "equal access" to Japanese research when the U.S.-Japan Science and Technology Agreement came up for renewal in 1988. According to the new agreement signed by President Ronald Reagan and Prime Minister Noboru Takeshita in June 1988, Japan has promised to welcome more U.S. researchers into its government and private sector laboratories.

9. For three "classic" interpretations, see Patrick and Rosovsky, eds. (1976), Calder and Hofheinz (1982), and Johnson (1982).

three "tiers." First, the postwar coalition used the institutions of a centralized state to create an effective developmental policy. Second, Japanese leaders combined domestic promotion and external protection to drive private sector investment and to cultivate intense competition for market share. As a result, Japanese firms developed a pattern of constant production innovation. Third, the government's developmental strategy created a distinct pattern in Japanese trade in manufactures which made access to the Japanese market uniquely difficult.[10]

Although Westerners have finally begun to recognize Japan's success, they continue to underestimate Japanese ability to advance in new sectors. The Japanese could make toys, most Westerners thought, but not TVs. They could make TVs but not cars, cars but not semiconductors, semiconductors but not computers, computers but not missiles... Table 27 gives the approximate dates when Japanese producers overtook their U.S. competitors in various sectors. Although the estimates in this table are by their very nature imprecise, they should suffice to make an essential point: Japanese producers have gone from a position of clear inferiority to superiority in a whole range of sectors within a remarkably short period of time.

Could they do the same in the military sector? The skeptics argue that the technology necessary to produce a fighter plane or a ballistic missile differs fundamentally from that necessary to produce a Sony Walkman or a Toyota Corolla, and of course they are right. Yet as we saw in Chapter II, Japan already has some experience in military production. Furthermore, Japanese government leaders and private sector managers have the skills and the resources to overcome deficiencies in this sector just as they have done in others. The skeptics also note that it takes enormous private-sector investment combined with substantial government support to compete in a business like aircraft production, and here they have a more powerful point. Japanese manufacturers are not likely to make the kind of investment necessary to compete in the commercial aircraft industry because industry leaders like Boeing and Airbus are already intensely competing for what is a limited market, and more importantly, because they can not count on government support at

10. Tyson and Zysman (1987), pp. 1-6.

TABLE 27
SOME GENERAL ESTIMATES OF THE LEVEL OF JAPANESE TECHOLOGY VS. U.S. TECHNOLOGY OVER TIME

Product	Japan Behind	Even	Japan Ahead
Ships	——*	——	1955
Steel	1958	1960	1965
Video tape recorders	1956	1965	1975
Televisions	1965	1970	1975
Automobiles (compacts)	1972	1978	1982
Industrial robots	1974	1978	1982
Memory devices	1978	1982	1985
Anti-shipping missiles	1985	1990?	1995?
Satellites	1990?	2000?	2010?
Combat aircraft	2000?	2015?	2030?

* The United States was never really competitive in commercial shipbuilding after World War II.

NOTE: Years listed denote estimates of when Japanese manufacturers 1) last clearly lagged, 2) were closest to even, and 3) first clearly surpassed U.S. manufacturers in their ability to produce the best product at the lowest cost.

this point.[11] They will continue, however, to produce business planes and helicopters, and to actively pursue joint ventures with foreign producers.[12] Nevertheless, Japanese leaders may decide to offer more support to the industry in the future, particularly if international events convince them to seek a more autonomous defense posture.[13] If Japan were to militarize, Japan's strong, centralized state would serve it well. The Japanese government would be well-poised to coordinate national research efforts and to stimulate private-sector investment. Furthermore, the Japanese government would have the ability to rapidly and efficiently divert resources from the civilian to the military sector.

How long would it take for Japan to emerge as a military superpower? It is impossible to say precisely, of course, because this would depend on too many factors: the international situation, Japanese determination and goals, the health of Japan's economy and that of the global economy, the evolution of military technology, etc. But for the sake of argument, and to make Japan's options more concrete, let us look at two possible scenarios.

THE TEN-YEAR PLAN, 1995-2005
Defense spending: GNP 2% in 1995, 3% in 2005
Cost to GNP growth: minimal (0-1%)
Military capabilities upon completion:
On par with the UK or France—a minimal nuclear deterrent, significantly upgraded conventional capabilities

THE TWENTY-YEAR PLAN, 1995-2015
Defense spending: GNP 2% in 1995, 6% in 2015
Cost to GNP growth: significant (2%)

11. In 1986, MITI revised the Aircraft Industry Law (*kokuki kogyo-ho*) so that it would only support joint ventures with foreign producers in the commercial aircraft industry, and set up a 3 trillion yen fund to promote these ventures. (Isayama interview, 27 July 1987).

12. The Japan Aircraft Development Corporation, a joint venture of Mitsubishi (MHI), Kawasaki (KHI), and Fuji Heavy Industries (FHI), is working with Boeing on a 150-seater, tentatively called the 7J7. Boeing suspended most of its work on the project in 1987.

13. See Samuels and Whipple (1989) for a more in-depth discussion of the Japanese commercial and military aircraft industry.

Military capabilities upon completion:

On par with the U.S. or Soviet Union—credible nuclear deterrent and significant counterforce capabilities, world leadership in important areas of military technology

The first scenario would involve what Kenneth Waltz calls a "process-level" change in international politics. It would influence relations between the major nations and would alter the balance between the two superpowers, but would not change the fundamental bipolar "structure" of international politics. The second scenario, however, would signify a transformation in this structure from a bipolar to a tripolar world.[14]

We have argued that these two scenarios are technically feasible, but are they politically realistic? In Chapter III, we concluded that Japanese policy in the long term hinges on international factors, for domestic political constraints would not hinder Japan if the external situation required rearmament. However, no transformation of the international environment is likely to be so sudden as to change the direction of Japanese defense policy in the next five years. Therefore, the starting date of 1995 may be premature. The more likely situation would be one in which the momentum of the present Japanese "consensus" on defense continues unaltered for the rest of this century, with a gradual but continuing shift in domestic political attitudes and significant incremental increases in defense spending and in military capabilities. By the turn of the century, Japan will be more open to a full-scale military build-up politically, and even more prepared to carry one out technologically.

Both of these scenarios assume that Japan would model its military force structure roughly along the lines of other powers, the United Kingdom and France under the first scenario, the United States and the Soviet Union under the second. But what if Japan were to become a military power of a new and different kind? Japan, for example, might choose to replace nuclear weapons with a high-technology alternative.[15] Japan's quickest

14. See Waltz (1979).

15. Japanese analysts have not refrained from speculating about the military potential of Japan's high technology. Kaoru Murakami (1985) suggests that rather than trying to imitate the superpowers, Japan should exploit its technological strengths and defend itself with high-tech weaponry. Masahiro Miyazaki (1982) envisions a world in which

route to military dominance would be through a technological "leap-frog." If Japan, rather than the United States or the Soviet Union, were to come up with the next technological breakthrough in weaponry, this advantage could conceivably compensate for Japan's disadvantage in other conventional and nuclear hardware. This is rather unlikely, however, given the extraordinary effort on the part of the two superpowers to stay on top of the latest technology of any potential military use. Furthermore, the superpowers would make sure that any Japanese technological lead would not last long. A more likely situation would be one in which the United States or the Soviet Union came up with a new dominant military technology which was relatively easy for the Japanese to emulate. Japan would not have "leap-frogged" the leaders, but it would have joined them at a very reasonable cost.[16]

In an era of three-way parity in the sophistication of military technology, Japan would have some rather significant advantages. First of all, the Japanese might be able to use their advantage in production technology to produce weapons more quickly and more cheaply than their rivals. They might be able to use flexible production systems to bring the low-cost advantages of mass production to the specialized production of advanced military systems. Furthermore, Japan's reliability advantage could prove to haunt both its economic competitors and its military enemies. While U.S. weapon systems incorporating all of the latest electronic equipment continued to malfunction, the Japanese might achieve decisive superiority with slightly less sophisticated but more reliable systems. If Japan could produce the 100-percent reliable weapon system, would the United States and the Soviet Union be able to keep up?

The Power Behind Technology

To say that Japan *could* emerge as a military superpower is certainly not to say that Japan *will* do so. After all, Japan's leaders may choose not to build up the nation's military

Japan's advanced robots, rather than its citizens, fight the country's wars. Teruyuki Inoue (1986) discusses the possible military application of Japan's telecommunications technology.

16. As a U.S. Congress, Office of Technology Assessment report (1988) notes: "Maintaining a technological lead in fielded military equipment is a far more difficult task than catching up."

capabilities any further. Or they may just muddle along, maintaining defense spending at the "about one percent" of GNP level. We have evaluated Japanese capabilities, but we cannot predict future Japanese intentions. We can, however, infer some more modest conclusions from Japanese capabilities *alone*. For regardless of whether or not Japan chooses to build up its military forces, Japanese technological capabilities and military potential alone will give Japan greater leverage with its allies and greater influence on the international political scene as a whole. "High technology not only strengthens our defense capabilities," notes Noboru Makino, director of the Mitsubishi Research Institute, "but it also serves to redistribute bargaining power and resources in the world. Japan's 'strategy' can only be high-tech."[17]

First of all, Japan will gain political leverage through U.S. Department of Defense dependence on Japanese components and technology. Martin Libicki et al. suggest that foreign dependence will impair the United States' "surge capability"—its ability to accelerate the production, maintenance and repair of critical items during a conflict. In addition, this dependence will create "technology base vulnerability" because the United States may lose access to the most advanced technology for the development and production of weapons.[18] The Defense Science Board Task Force Report on Semiconductor Dependency (1987) suggests that DoD reliance on Japanese semiconductors seriously threatens U.S. national security interests because the United States cannot count on maintaining a technological lead over the Soviet Union if it does not control the production of crucial electronic components.[19] Those who downplay U.S. dependence argue that the United States could produce just about anything the Japanese can, albeit at a higher cost. This begs three more important questions: At what cost? How quickly? And most importantly, just how good would the U.S. substitute be? Cost is a factor, even in military affairs. The United States

17. Makino's introduction to Murai (1984), p. 2.

18. Libicki et. al. (1987), pp. 5-7.

19. The DSB report has inspired other studies of technology dependence and the defense industrial base, including Okimoto et. al. (1987) and U.S. Congress, Office of Technology Assessment (1988). In July 1988, the office of Robert B. Costello, undersecretary of defense for acquisitions, came out with a report on the defense industrial base recommending the creation of a Defense Manufacturing Board. See *JEI Report*, No. 29B (29 July 1988), p. 8.

will not suffer seriously even if it has to pay $1 million for a crucial semiconductor. It will lose out, however, if it has to pay more for a whole variety of components ranging from semiconductors to costly subsystems. In addition, there is a difference between being able to produce something eventually and being able to produce something today. In a crisis situation, the U.S. military may not be able to wait around for domestic producers to come up with an item that had been previously "Made in Japan." The U.S. military will not be able to escape its dependence if U.S. products, at any cost, are not as reliable as the Japanese ones. A domestic substitute will do more harm than good if it does not function properly. Furthermore, even if U.S. manufacturers have the ability to produce many of the components now imported from Japan, they may lose further ground if they are not actually producing them. Through a gradual process of product improvement and production innovation, the Japanese firms that manufacture these components may come up with advances that their idle American competitors will not be able to emulate.

Semiconductor dependence is particularly problematic because Japan's top semiconductor manufacturers are also Japan's top computer manufacturers. NEC, for example, might find it to be in its interest to withhold the technology for its most advanced semiconductors so that it would have an advantage in its competition with U.S. computer makers. Alternatively, Japanese producers might be more interested in the more lucrative commercial market, and therefore would be unwilling to produce their parts to military specification.[20] Furthermore, these companies might give priority in delivery to their own valued customers rather than to the U.S. government.

How will this dependence translate into political leverage? Japan could use the threat of halting exports at a crucial period to gain its own political goals. Libicki suggests that this could only work once because the United States would quickly move to compensate for its dependence on Japan through research and development.[21] The cycle of offering and selectively denying the United States advanced Japanese technology could, however, develop into an ongoing process. The United States would

20. Office of Technology Assessment (1988), p. 40.
21. Libicki interview (20 June 1987).

lose out if Japan began to refuse to export the best of its advanced technology, or if Japan used this as a threat to gain U.S. concessions in other areas. As the well-known Japanese commentator Hajime Karatsu put it:

> If Japan stopped exporting semiconductors, the United States would be turned upside down. This gives Japan an extraordinary amount of bargaining power.[22]

This is not to say, of course, that Japan will not remain heavily dependent on the United States as well, but only that the balance of power within this interdependent relationship may even out yet further.

Japanese technological capabilities give Japan the potential to tip the global balance of power without building up its own military capabilities. If U.S.-Japanese technological cooperation in areas of military use progresses as some Pentagon analysts hope it will, the United States may be able to achieve permanent superiority over the Soviet Union in most areas of military technology. U.S. defense analysts have argued that the United States, with its superior industrial base, should be able to beat the Soviet Union in an arms race, but the Soviets consistently have managed to catch up just as the United States threatened to take a decisive lead. Japanese technology transfers could make the difference. The combination of U.S. strength in basic research with Japanese prowess in applied research, and U.S. sophistication with Japanese reliability, could overwhelm the Soviet Union. At some point, of course, Japanese officials could threaten to withhold their cooperation if they were dissatisfied with the direction of U.S. foreign policy.

Conversely, even occasional technology exports from Japan to the Soviet Union could undermine the most valiant of U.S. efforts to retain a technological edge over the Soviet Union. The Toshiba Machine Co. dramatically illustrated the potential damage in this area when it exported advanced milling machinery which allegedly helped the Soviets produce quieter submarines. In the wake of the Toshiba affair, the Ministry of International Trade and Industry (MITI) has expanded its corp of technology export control inspectors from 15 to 100 and has established

22. *Sekai* (January 1988), p. 82.

some of the most severe penalties for export violations among U.S. allies. In April 1988 the Japanese government agreed to protect U.S. military technology with registered, classified patents.[23] Nevertheless, most of Japan's best dual-use technology is still readily available, and Japanese corporations remain unaccustomed to security controls. Robert L. Mullen, assistant deputy undersecretary of defense for trade security policy, suggests that the problem will intensify by 1992, when Japan completes its H-2 rocket launch vehicle. By that time, Japan will have developed a whole array of important components for use in space. Japan will be able to export these as commercial-use products, but the purchasers are more likely to be interested in them for their military uses.[24]

The mere fact that Japan can become a military superpower will also affect the global balance of power, even if Japan does not choose to exercise this potential. The Soviet Union may not have to worry about Japanese "potential" in a limited conflict, but it will certainly have to consider this potential in the event of a protracted war. Furthermore, the Soviets are likely to be more cautious about making any move that could push Japan to accelerate rearmament. The United States will also have to consider the costs and benefits of a more powerful Japan, and may be willing to make concessions to Japan in order to ensure that Japan remains a steadfast ally.

In sum, Japan will gain power through its technology and through its military potential irrespective of its defense policy choices. In the next century, Japan will have enormous influence not only in the realm of global economic and financial policy, but also in the realm of international security. The question remains, however, as to whether Japan will be a great power on the model of the United States and the Soviet Union, or a great power of a new and different kind.

23. Allen interview (11 July 1988) and JEI Report, No. 16B (22 April 1988), p. 9.
24. Mullen interview (31 May 1988).

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