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Reprint No. 214

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Ann R. Markusen

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THE MILITARIZED ECONOMY

Ann Markusen

In overall terms, the U.S. economy has performed indifferently throughout the early 1980s. It has suffered at least one serious recession, has failed to sustain the high growth rates of the earlier postwar period, and has experienced mounting trade deficits. Investment and productivity have lagged, and unemployment has hovered around 8 percent for most of the decade.

Perhaps even more worrisome than this lackluster aggregate picture has been the dismal performance of certain key industries. Manufacturing employment has begun to fall in absolute terms, and nonmilitary manufacturing in particular has suffered severe losses. For the last several years, every manufacturing category has experienced a trade deficit—with the notable exception of military goods, whose net exports tripled between 1980 and 1984. At the same time, those regions that specialize in basic manufacturing have been affected by chronic recession: several states in the Midwest, for example, have recorded absolute employment declines since 1978, at a time when the nation as a whole added 15 percent more jobs. This unemployment has been heavily concentrated in blue-collar occupations, and thus has contributed to a worsening of the national income distribution.

What accounts for this poor performance, especially within certain industries and regions? One major cause is the dramatic shift in federal expenditures toward military hardware and away from other types of public spending. Since 1979, the Pentagon has been accelerating its investment in that portion of the U.S. manufacturing sector that it has built up with great care and resources over the postwar period. The result has been an

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unstated industrial policy that favors aerospace, communications, and related high-tech industries over steel, autos, machinery, and other kinds of basic manufacturing.

Thus, intentionally or otherwise, the Pentagon has assumed more and more of an industrial policy role in the U.S. economy. Its research and development (R&D) and procurement programs have become major stimuli for technological innovation and industrial development, and have accelerated the growth of new high-tech industries. Increasingly, these goals have been explicitly expressed in the language used to justify new defense projects, such as the Strategic Defense Initiative (SDI), and to build political support for them.

But can a military-led "industrial policy" foster the types of commercial innovation and industrial development that will enable the United States to maintain a healthy, diversified economy? The record suggests that it cannot. Indeed, far from strengthening the U.S. economy, this closet industrial policy is dangerously destabilizing. In the short run, the military buildup has been disruptive, imposing severe adjustment costs on individuals, communities, and industries. And, in the long run, it threatens to deform America's basic economic structure by forcing the economy to become increasingly devoted to military production.

Military Spending as Industrial Policy

According to popular belief, the United States, unlike most industrialized countries, does not have an industrial policy. It is the lack of such a policy that many critics point to in order to explain America's relatively low productivity gains, deteriorating trade balance, and widespread plant closings in recent years. Yet one can also argue that in the United States military spending acts as a de facto industrial policy, and that the poor performance of the economy results from the distortions brought about by this reliance on military-led investment and innovation.

It is hard to deny that Washington's pattern of military spending bears many of the earmarks of an industrial policy, which can be characterized by most or all of the following features. It targets specific sectors in the economy that are believed to possess long-term potential for promoting growth in employment and output. It provides substantial research and development funding to firms in those sectors. It offers large-scale incentives for technological innovation and funds for major investments on favorable terms. It provides for the government to act as a large and dependable customer through special procurement arrangements. It utilizes trade

policies, such as trade promotion and protection, to favor certain industries. And it provides adjustment assistance for displaced workers and communities through retraining of personnel and conversion of idled facilities.

In the United States, military spending functions in all of these ways without being explicitly labeled industrial policy. Through research overheads on major prime contracts, and through special programs like the Defense Advanced Research Projects Agency (DARPA), the government channels substantial resources to a rather small set of large, heavily defense-dependent firms in high-tech industries like aircraft and missiles, communications equipment, and electronics. It provides a protected market for their products by acting as the single largest buyer in crucial early commercialization stages and by practicing a "Buy American" policy. It funds pioneering efforts to adapt numerically-controlled machine tools, CAD/CAM (computer-aided design/computer-aided manufacturing) systems, and other automating technologies to the production of military hardware. It builds and leases or sells plants to defense contractors at bargain rates. Through the Pentagon's Office of Economic Adjustment, it helps communities to redevelop facilities and retrain workers following base or plant shutdowns. It offers lifetime job and income security to military personnel, as well as retraining services for retired officers.

This de facto industrial policy has played an increasingly important role throughout the postwar period, particularly in the area of research and development. Until World War II, the federal government provided only about 15 percent of R&D funding in the United States. By the 1960s, however, its share exceeded 60 percent and has not decreased since.[1] Furthermore, the military share of this research budget has grown at the expense of the civilian share. As recently as 1980, military R&D consumed just over 50 percent of the federal research outlays of $30 billion. By 1985, it is estimated to have jumped to over 70 percent of federal outlays of $50 billion.[2] Thus, the concentration of research resources in the United States has shifted from the coffers of private companies to the federal budget and, within it, from nonmilitary to military projects.

Though federal military spending has long influenced the course of U.S. industrial development, no administration has so explicitly used it for this purpose as the current one. Indeed, the Reagan administration has acknowledged that its $2.5-trillion military buildup is not only aimed at improving defense preparedness, but is expected to tackle the problem of U.S. economic competitiveness as well. In its rationale for the Strategic Computing Initiative (SCI), for example, the administration has unambiguously set forth the dual goals of "national security and economic

strength." This $600-million strategic computing and artificial intelligence research project contains a commitment to industrial development—specifically, to stimulating new computer concepts, encouraging industrial funding, generating new computer-based applications, and pioneering new techniques in software development and methodology. In this way, the administration has closely tied commercial concerns to military ones—a policy designed not only to justify the enormous escalation in military-related research commitments, but also to hasten the adaptation of Pentagon-subsidized innovations for commercial uses.

This closet industrial policy is fully consistent with the Reagan administration's ideological commitment to a free-market economy and governmental deregulation. The White House has publicly rejected the notion of industrial policy, whether targeted at sunset or sunrise industries. But by enlarging and redirecting the military budget, the administration has been able to pursue a Keynesian policy of macroeconomic stimulation through deficit spending, as well as a closet industrial policy targeted at certain high-tech industries, without officially embracing either.

Whether implicit or explicit, these goals of economic stimulation and high-tech development are reflected in both the size and composition of the Reagan military budget. As the military buildup that began under Jimmy Carter has accelerated under Ronald Reagan, military spending has risen from 5.5 of gross national product (GNP) in 1976 to 6.5 percent in 1985. Between 1980 and 1985 alone, the Pentagon's budget increased 51 percent and, by the end of that period, accounted for a full 27 percent of the federal budget—a 4-percent rise over five years. By 1987, the Pentagon's budget is expected to reach $320 billion, compared with $143 billion in 1980.[3]

Not only has the overall military budget increased, but, within it, priorities have shifted toward military capital investment (procurement, R&D, and military construction) and away from more traditional items like base operating expenses, pay, and benefits. Since 1980, spending on weapons procurement has doubled, outlays for weapons research have grown by 80 percent, and those for the expansion of bases and facilities have increased by 95 percent—raising the portion of the military budget devoted to such "investments" from 36 percent in 1980 to 47 percent in 1985. And while the share of the budget spent on nuclear weapons has risen from 7 to 10 percent, the lion's share of the budget increase has gone for hardware and facilities (weapons, weapons research, and bases), and for conventional forces. In 1985, $213 billion was spent on the latter, chiefly on fighter planes, bombers, tanks, attack submarines, surface ships, helicopters, and

air-defense missiles. The military's role as an industrial market has thus become increasingly important in the 1980s.

At the same time, the Reagan administration has actively encouraged the sale of U.S. weaponry to foreign markets—a policy that has contributed to an increase in U.S. exports of military-related goods from $10.2 billion in 1980 to $24.4 billion in 1984.[4] In a clear departure from his predecessor, Ronald Reagan has not only facilitated the sale of first-generation military technology to other countries, but has also permitted U.S. corporations to use their research overheads to develop specially-designed weapons for military situations in the Third World.[5] Such policies have exerted a considerable impact on the economy: as of the early 1980s, some 840,00 U.S. jobs were dependent on foreign arms sales.[6]

Military Spending and Deindustrialization

The macroeconomic consequences of military spending—that is, its effects on aggregate output, employment, and price levels—have been hotly debated. While some critics have argued that military spending is less efficient at stimulating the economy than social spending, others have contended just the opposite.[7] In the past, studies have supported both positions; more recently, research suggests that equivalent spending on social services and military production would produce about the same amount of economic activity.[8]

But whatever its macroeconomic implications, military spending is clearly playing an important role in the industrial restructuring of the American economy. By favoring certain industries over others, military spending is distorting the overall economic structure, and exacting serious costs in the process. Because military hardware is increasingly sophisticated, and because big-ticket items are so expensive that many fewer of them are now purchased annually, today's military outlays favor an entirely different set of industries than were favored in the past. High-tech industries have replaced steel, heavy machinery, and construction as the chief beneficiaries of military spending.[9] As illustrated in Table 1 (see next page), the prime contract industries today include missiles, ordnance, aircraft, and tanks—all of which are chiefly high-tech in nature, whether measured by the predominance of engineers and scientists in their work force, or by the percent of sales spent on research and development.[10]

The single largest high-tech sector in the United States, communications equipment, which employs more than 425,000 people, is also heavily DOD-dependent. In 1979, 45 percent of its output went directly or

TABLE 1

DEPARTMENT OF DEFENSE SHARES OF SELECTED INDUSTRY OUTPUT, 1979–87

Title	*Defense share of output* 1979	1982	1987	*Defense output growth* 1982–87
	(%)	(%)	(%)	(%)
Tanks and Tank components	78.1	93.8	95.0	47.2
Ammunition	95.1	90.9	93.2	55.6
Ordnance	85.1	79.7	81.2	35.3
Complete missiles	71.0	67.5	79.4	64.4
Shipbuilding and repair	47.9	61.7	62.1	24.1
Radio and TV communication	44.8	58.0	62.5	54.2
Aircraft and missile engines	42.3	53.5	56.1	32.9
Aircraft and missile equipment	43.4	41.2	44.2	34.9
Aircraft	35.0	40.4	46.1	58.7
Optical instruments	21.6	28.0	30.7	38.0
Engineering instruments	23.5	27.7	33.6	59.9
Electronic components	12.0	17.0	19.8	49.3
Semiconductors	9.5	12.5	12.5	51.4
Aluminum foundries (castings)	7.9	9.1	11.2	58.5
Aluminum production	5.8	7.5	9.0	51.4
Metal stampings	5.8	7.3	9.1	60.3
Electron tubes	8.3	7.3	11.5	105.3
Computers	3.6	7.1	12.7	141.0
Screw machine products	5.6	6.9	8.6	57.5
Iron and steel forgings	7.9	6.9	7.6	31.4
Machine tools—cutting	6.1	6.2	7.5	54.4
Special dies and tools	4.9	6.0	7.5	45.4
Fabricated metal products	5.0	5.6	6.8	53.4
Chemicals	5.5	5.6	7.1	53.3
Blast furnace steel mills	4.5	5.6	6.7	45.6
Electrometallurgical products	4.9	5.4	6.3	26.7
Machine tools forming	5.0	4.8	6.3	70.0
Iron and steel foundries	3.9	4.5	5.2	45.1

SOURCE: Henry, "Defense Spending," *U.S. Industrial Outlook*, 1983.

indirectly into Pentagon products; by 1987, this military share will rise to 63 percent (see Table 1). High-tech industries like semiconductors and computers, not usually considered military-oriented, will also benefit disproportionately from the current buildup. Indeed, military-oriented output growth in computers tops that of all the other industries in Table 1—up 141 percent from 1982 to 1987. In short, the Reagan military buildup will reverse a 20-year trend in which commercial demand consistently outpaced military output growth in the electronics and computing industries.

By comparison, the share of output in the heavy machinery and metals industries that is devoted either directly or indirectly to DOD outlays is small. In none of these categories, listed in Table 1, will DOD-related output exceed 12 percent by 1987, despite hefty increases in output growth associated with the current buildup. In steel, for instance, military demand accounted for only 4.5 percent of sales in 1979, and even with the Reagan buildup will reach only 6.7 percent by 1987. Similarly, only about 7.5 percent of total machine tool output in 1987 will be devoted to military purposes, up from around 5 percent in 1979. Instead, these industries' viability is much more closely tied to the consumer economy, to public investments in infrastructure, housing, mass transit, and urban development, and to the general level of industrial investment, which has been conspicuously low in the early 1980s.

What accounts for this shift in military production away from basic manufacturing and toward high tech? A primary factor is the small amount of steel and machinery used in contemporary military production. In contrast, a variety of high-tech components, such as complicated guidance and cybernetics systems, are becoming increasingly necessary for the operation of missiles, submarines, aircraft, tanks, and other modern weaponry. The bulk of expenditures for such weaponry must go to the technicians and engineering personnel who design, handcraft, assemble, and test these components.

Consider, for example, the production of communications satellites at Hughes Aircraft's satellite facility in El Segundo. There, some 8,000 employees produce approximately five satellites a year, some for strictly military purposes. Of these employees, 7,700 are engaged in testing, research, and development. Only 300 work on the "shop floor," where the only machines other than hand tools are a couple of multistory special chambers, into which completed satellites are placed for testing under simulated conditions of space. These "machines" were tailor-made for the Hughes facility.

The tremendous shift in demand from the more traditional machinery

and metalworking sectors of the economy toward the high-tech sectors is reflected in corporate profit-loss records and in the investment strategies that many corporations are now adopting. While LTV's steel company, based in Cleveland, has suffered huge losses in recent years, its aerospace and defense company, based in Dallas, has been highly profitable. TRW Inc. is abandoning major portions of its bearings and tool business in order to move more heavily into military production. General Motors, which laid off 10,000 autoworkers in March 1986, recently bought Hughes Aircraft. RCA and GE, both hoping to shed money-losing consumer electronics segments and counter their shrinking sales in machinery, transportation, and lighting equipment, recently merged. The new firm will concentrate its manufacturing energies on market niches that are chiefly military-related; since the Reagan buildup, defense business at both companies has doubled, to about 19 percent of total sales.[11]

This recomposition of the U.S. economy—from civilian to military production, from traditional to high-tech industries—has begun to show up in the aggregate statistics. Output of both consumer goods and business equipment was virtually flat throughout 1985, while production of military and space goods grew steadily at 11 percent. In January 1986, demand for military equipment increased by 45 percent, while all other factory orders fell by 1 percent. This divergence has been exacerbated by the changing composition of international trade. Net exports of capital goods fell from $42 billion in 1980 to $12 billion in 1984; over the same period, net exports of military-type goods tripled, from $5.6 billion to $16.7 billion.[12]

Another sign of this dramatic industrial shift can be found in the extraordinary unevenness of regional economic performance. In the Midwest, the heart of the nation's capital goods, metalworking, and consumer durables complex, displacement has been severe. In Illinois, for example, primary metals employment plunged 44 percent from 1978 to 1985, and nonelectrical machinery jobs fell 37 percent. These industries carried the rest of the regional economy down with them. Total nonagricultural employment in Illinois in late 1985 was 2 percent *below* what it had been in 1978; at the same time, national employment had grown more than 14 percent.[13]

Of course, not all of this industrial restructuring is the result of military spending. The remarkably poor management practices of corporations in nonmilitary sectors throughout the postwar period are also to blame, as is the persistently overvalued dollar, which makes imports more attractive and cuts deeply into overseas markets for both industrial and agricultural

exports.[14] Yet the links are complex. The dollar's appreciation has been blamed on high interest rates, which in turn are partly a function of the military-induced federal budget deficit.

In the economy as a whole, military spending has masked how poorly the nonmilitary sectors are doing. The 1983 "recovery," for example, was largely the result of deficit military spending and the limited economic stimulation it produced. The fact that the economy has failed to grow at estimated rates suggests the inefficacy of military spending as an industrial policy. Likewise, the dramatic growth of arms sales both abroad and at home has obscured how weak the rest of the manufacturing sector is. This false perception of prosperity has stalled a much-needed national debate on the desirability of, causes of, and remedies for America's current deindustrialization.

Military-Led Innovation

All of this might be tolerable in the short run if it were true that defense spending could yield a steady stream of beneficial products and new technologies for basic industry. But evidence suggests that this is unlikely.

The problem is not simply, as some critics have argued, that the military is an inefficient research funder or that the specialized and secretive nature of military research limits spinoffs.[15] Clearly, military research has yielded a large number of commercially viable products—including many of the breakthroughs in electronics, recombinant DNA, jet engines, fiberglass and other composite materials, and a major portion of communications technologies.

Indeed, many of the inventions that have most altered the postwar world economy have evolved from military-related research. Successful transition from prototype development to commercial product has often taken place during a period of government-guaranteed markets. The first large electronic computer was built under contract to the army during World War II. In the decade following the war, the military and federal government absorbed virtually all of the computer industry's output. That era proved to be the entry point for all of the major U.S. computing firms; IBM, for example, enjoyed a competitive edge from the industry's infancy because of the U.S. Air Force's patronage.[16]

But while it has invested much in military research and development, Washington has clearly neglected many nonmilitary industries. As discussed earlier, government expenditures on nonmilitary basic industrial R&D have been low compared with expenditures on high-tech, military-

related R&D. Consequently, the U.S. steel, auto, machinery, and even consumer electronics industries have suffered. The steel industry, for instance, has been denied $15 *million* by the Reagan administration for its project of "leapfrog technology"; U.S. high-tech industries, on the other hand, will enjoy the benefits of $30 *billion* in research outlays under SDI. In 1984, spending on defense electronics was estimated to exceed $40 billion, well above the $30 billion spent on all consumer electronics products. Similarly, in 1984, the air force spent more on research and development of nuclear missiles than General Motors did on its entire research budget.[17]

More than in most other industrialized nations, research resources in the United States are harnessed to military ends. At the same time, the United States spends comparatively little on nonmilitary R&D: while, for example, the United States spent 1.9 percent of its GNP on nonmilitary R&D in 1982, Japan spent 2.5 percent and West Germany spent 2.6 percent.[18] This emphasis on military-led innovation, at the expense of nonmilitary innovation, has left the United States poorly equipped to compete in many areas with those nations that have chosen other research and production priorities. Hence, New York and most other major cities now purchase their subway cars from Japan and France.[19] U.S. markets for medium-sized tractors and trucks have become dominated by Japanese imports, while markets for consumer electronics, including VCRs, have also become import-dominated. More efficient production processes for everything from steel to wine-making have been pioneered by companies outside the United States and are now brought in as technology imports.

In contrast, military-led research and development in the United States has tended to focus on other sorts of problems. U.S. military research is largely preoccupied with a single end: to reduce the hazards of combat by improving the flexibility, maneuverability, invisibility, undetectability, and infallibility of lethal weapons and their delivery systems. Because they are the products of these defense-driven priorities and not of a natural evolutionary process,[20] a great many of the innovations that Pentagon-subsidized research has produced have been highly tailored to military specifications. For instance, military research has been incredibly successful at developing mobile weaponry, as well as the guidance systems—the computing, electronics, communications, and instrumentation equipment—to make it perform reliably.

These innovations have also led to the development of a variety of flexible production technologies—such as integrated circuits, numerically-controlled machine tools, and CAD/CAM systems—that have played an

important role in automating production. These technological breakthroughs not only led to the invention of the "autopilot," which helped relieve pilots of some of their duties, but also led to the development of tools for removing the machinist from his or her lathe. In other words, the same technologies that have modernized the U.S. military have also automated civilian production—and consequently have ended up displacing American workers.

Even more problematic is the fact that U.S. companies appear to be less and less able to develop viable commercial spinoffs based on these technologies. Instead, it is Japanese firms that are increasingly developing the commercial applications for these technologies, such as small- and medium-sized machine tools, which now account for 90 percent of the U.S. trade deficit in that product line, and new ceramics applications (for example, auto engine blocks) that have put Japan in the lead in automobile production. As a result, U.S. jobs lost through automation are not being replaced by new jobs in the U.S. machine tool industry.

Most experts concur that Japan's great success at translating basic innovations into commercial hardware is largely due to the following features of the Japanese economy: an evaluation of innovation in light of overall societal goals; an emphasis on certain targeted industries (autos, steel, machine tools, electronics are examples); a cooperative and coordinated planning process between industry and government, between finance and industrial capital, and among firms; lifetime job security; and superior labor relations. In addition, the Japanese economy is geared toward "technology pull"—the concentration of the nation's scientific and engineering expertise on production technologies and product quality.

In contrast, the U.S. economy is characterized by the military's domination of many high-tech industries, the absence of a long-term industrial policy that explicitly targets key industrial sectors, and the poor state of its industrial engineering. These factors contribute to U.S. industries' relatively poor record in translating military innovations into commercial products. Indeed, the skewing of American R&D resources toward military ends has left the entire nomilitary industrial sector poorly equipped for harnessing the products of military-oriented innovation. In contrast, Japanese firms, without the benefit of a huge defense budget and despite a second-rate university research establishment, are much better positioned to take U.S. defense-generated technologies and apply them to basic industrial production.

Despite its ambiguous "spinoff" record, military-funded research is increasingly heralded as the key to future U.S. economic vitality. Among

current military research projects, the major hope for commercial spinoffs lies with the Strategic Computing Initiative. Indeed, the purpose of SCI is clearly not to militarily overtake the Soviets, but rather to economically outpace the Japanese. No one is contending that the Soviets are in any way equipped to compete with the United States on this particular high-tech frontier; in fact, it is widely acknowledged that they are far behind in basic computing capability. This means that what is really behind SCI is not fear of the Soviets, but fear that the Japanese fifth-generation computer project will undermine the U.S. lead in computer innovation.

Supporters of SCI assume that defense research efforts can produce the commercial spinoffs that are so badly need to revitalize the U.S. economy. But though SCI is more "applied" than any previous DARPA program, its research applications are still predominantly military-oriented and geared toward equipment like battle management systems, the autonomous land vehicle, and the pilot's assistant—automotive technologies designed to "extricate the soldier from hazardous situations" and to help decision-makers cope with the pace of the conflict. As a result of its military orientation and the Pentagon's secrecy, SCI's civilian applications are indeed limited.

While the United States is directing research toward military ends, the Japanese will be focusing similarly massive research budgets on civilian problems. Overall, the Japanese will spend $700 million on supercomputing, compared with the $600 million the United States is pouring into the SCI. The U.S. artificial intelligence program is preoccupied with battle management applications, at the expense of civilian applications like computer-assisted education and "intelligent library" systems. In Japan, however, artificial intelligence is aimed at enhancing business and consumer productivity, and improving social services.[21]

By banking on SCI to produce commercial spinoffs, the United States threatens to set off another round of competition with the Japanese in a narrow category of research. Historically, each round of defense-bred innovation has allowed the Japanese to enter a once strong domestic export sector. In other words, not only are jobs eliminated through the automated products of military research, but the jobs created in making the robot are increasingly located abroad as well.

There is also little chance that the Strategic Defense Initiative will provide many commercial spinoffs. Although SDI represents a huge commitment of $60 billion to new research, its focus is primarily on specific military problems. More than 40 percent of SDI funding will go toward surveillance programs (radar, infrared detection, telescopes of high-flying

airplanes), while an additional 40 percent will be divided equally between "directed-energy" weapons (laser and ray guns) and "kinetic-energy" weapons (guided missiles that collide with or spray shrapnel on enemy missiles). Among the few spinoffs from these efforts that have even been suggested are x-ray holograms and ray guns to kill Medflies.[22]

Meanwhile, SDI will continue to divert resources from commercial projects. In the coming years, it is expected to capture 20 percent of all high-tech venture capital funds. It will also shift research toward industry and away from universities. Although some have heralded this shift as important for facilitating commercialization, the record indicates that major military contractors are increasingly less interested in commercial markets than they were in the past.[23]

In sum, a further concentration of U.S. research talent in another round of military competition may allow the Japanese once again to leap ahead in technological innovation—perhaps this time in computers. Indeed, the Defense Department is now considering the purchase of some types of applied technology from Japanese firms, because the Japanese products have surpassed their American counterparts in performance. In return, the Japanese have requested access to the latest defense-funded research results, and the DOD appears willing to accede. These kinds of arrangements will simply accelerate the rate at which Japan, now America's major industrial competitor, can receive and commercialize U.S. high-tech inventions, presumably with further depressive effects on basic industrial sectors within the United States.[24]

Socioeconomic and Political Consequences

The question is not only whether defense-led innovation "works" as a development strategy, but, more importantly, "for whom does it work?" As it turns out, defense-related manufacturing has a very different impact on the composition, level, and location of employment than does commercially-oriented industry.[25]

Because the production of military hardware requires continual innovation, industries that manufacture missiles, aircraft, and other hardware tend to hire a disproportionately large number of workers with professional and technical backgrounds in scientific research. In manufacturing as a whole, engineers, engineering technicians, computer scientists, life and physical scientists, and mathematicians account for less than 6 percent of total employment. In the missile industry, however, such workers account for 41 percent; in computers, 27 percent; in communications equip-

ment, 22 percent; and in aircraft, 19 percent. Studies from the early 1970s (no recent data are available) show that 22 percent of all U.S. electrical engineers, 48 to 59 percent of U.S. aeronautical engineers, and 23 to 38 percent of U.S. physicists work on military-related projects.[26] Since then, these proportions have certainly increased.

The Reagan administration's military buildup has created an enormous, unsatiated demand for engineers and other high-tech professionals. In fact, the demand among California firms for college engineering graduates is so great that it cannot be met by California universities alone. As a result, many companies located in California have launched aggressive recruitment campaigns aimed specifically at the better engineering institutions in the Midwest. These job opportunities are not lost on college students worried about their futures—electrical engineering is widely acknowledged to be the most popular major among entering freshmen at California's top academic institutions.

This growing demand for white-collar workers represents a significant departure from the defense industry's traditional pattern of employment. For many years, skilled blue-collar workers were well represented in certain types of defense manufacturing. In 1970, for example, 54 percent of tool and die makers, 25 percent of sheet metal workers, 19 percent of machinists and airplane mechanics, and 14 percent of draftsmen worked in military production. But as defense-related production has become more high-tech, the shares of these occupations within the defense work force have been declining. This recomposition of the defense labor force is occurring for two reasons.

First, the quantity of weaponry produced is falling as the quality and price of weaponry rise. For example, many fewer fighter planes can be built today than could be built during the 1960s for the same real dollar expenditure. With a decline in the number of weapons produced, the number of blue-collar workers needed to build weaponry has also dropped off. Second, major defense contractors, supported by Pentagon incentives, have pioneered the adoption of certain types of automation within the production process. The automation of the more routine tasks means that, on the whole, blue-collar workers are rapidly losing ground to scientific and technical workers. There is also some anecdotal evidence that firms are engaging in explicit union-busting, again with Pentagon encouragement.[27]

The sexual composition of the defense manufacturing work force is also skewed, with women generally underrepresented. While this tendency is largely a function of economy-wide occupational segregation, there is evidence that the percentage of women found in certain occupations within

the defense industry is lower than the percentage of women found in those same occupations within the economy at large. For instance, a study of defense-dependent communities in California found that women engineers at Livermore Laboratory were underrepresented in comparison with the overall share of the state's engineering jobs held by women.[28]

Minority groups also tend to be underrepresented in defense production, although some exceptions do exist. Because of massive recruitment campaigns in World War II, black men are found in relatively large numbers in the production of big-ticket items such as aircraft and ships. But this cadre is for the most part an older group whose ranks are not being replenished with younger, skilled, black workers. Hispanics, a more recent group of immigrants, have not been incorporated into defense-related production at anywhere near the level of their participation in the work force at large. Asians, too, occupy a relatively small number of white-collar jobs in defense-related manufacturing.

The defense manufacturing work force may also be getting younger. In a recent interview with Lockheed, which by 1984 was hiring approximately 700 engineers per year at its Sunnyvale plant alone, a recruiter noted that today the company tends to hire young, recent college graduates; a decade ago, however, about half of the new job slots would have been filled by older, more experienced engineers.[29] One reason for this trend is that it is cheaper for firms to hire young, unmarried engineers who are willing to occupy apartments in expensive housing markets like Silicon Valley and are less costly to relocate. In addition, the stepped-up pace of innovation in defense manufacturing tends to favor recent college graduates, who have received up-to-date training, rather than seasoned engineers, who may be out of touch with recent technological advances.

These occupational shifts, when combined with the extraordinary destruction of unionized, blue-collar jobs in the nonmilitary manufacturing sectors, may be contributing to the worsening distribution of income in the United States. Steelworkers and machinists are disappearing from the "middle class." And while new engineers and accountants are added to the middle-income bracket, their numbers are not great enough to compensate. Meanwhile, the cutbacks in social spending have hurt the lowest income groups. Whether measured by family or individual income, inequality in this country has increased since the late 1970s.[30] While no statistical work has been done to determine the extent to which this trend has been fueled by the shift toward military output, the apparent correlation between the two is highly suggestive and grist for further research.

Just as it favors certain types of workers, defense-related manufacturing

also favors certain regions. Since World War II, military-related industry in the United States has increasingly snubbed the midwestern industrial heartland; instead, it has gravitated toward suburban and even exurban areas along what has come to be known as the "defense perimeter," the stretch of land extending from New England through Florida to Texas, California, and Washington state.[31] Though much of the wartime buildup, including new plant construction, took place in the industrial heartland, following the war these plants were rapidly dismantled to make way for residential development or reconverted for production of autos, machine tools, and other basic capital goods. New defense-industrial complexes were then constructed in previously unindustrialized areas in the south and west. As a result, the defense industry drew, and continues to draw, much of the nation's new industrial capacity to "virgin" locations.

Why has this shift occurred? For one thing, defense-oriented firms face different locational constraints than do conventional manufacturers. The latter have traditionally chosen least-cost locations between major resource sites and major consumer markets, depending upon the transportation cost calculus. But military-related producers are relatively footloose with respect to both resources and markets. Raw materials form only a tiny fraction of total costs for weapons systems producers, and the location of the client (Washington, D.C.) is unimportant, since the products are mobile and their destinations are often dispersed, secret, or changeable.[32]

What does matter to defense-related manufacturers is access: they need access to the type of labor that can perform innovative product development, to other firms in the same business, and to military bases or launch sites where they can test their equipment. For this reason, military-related plants tend to agglomerate, as most innovative, youthful sectors do, but rarely alongside older centers of innovation in basic manufacturing. Instead, military-related, high-tech firms have gathered in entirely new or revitalized centers like Silicon Valley and Orange County, California; Huntsville, Alabama; Titusville-Melbourne, Florida; and southern New England. With the exception of the last example, these areas did not already contain pools of skilled, professional, technical labor, but created them in the process of setting up defense camp.

Political and strategic factors have also played an important role in this shift. For example, the opening up of the Pacific front during World War II and the rise to power of new sunbelt politicians, such as Johnson, Nixon, Reagan, and their congressional counterparts, encouraged the spread of industrial capacity to the west and south. Another factor was the political and social orientation of the defense contractors themselves. These indus-

trialists, many of whom were former military men, tended to distrust and dislike existing industrial areas—cities like Buffalo, Baltimore, St. Louis, and Milwaukee, known for their troubled labor-management relations and their support for New Deal policies.[33]

The Defense Department's willingness to pay for relocation costs of personnel recruited from other parts of the country also encouraged military contractors to form their own local labor pools. In effect, this policy meant that the Pentagon was underwriting and contracting out the business of relocating large portions of the U.S. work force. And because the Pentagon was also willing to pay a normal rate of return on relocating costs, firms found relocating their workers profitable. Thus while population redistribution was clearly not the intent of defense policy, it did prove to be one side-effect.

What this evidence tentatively suggests is that the defense-related work force—the fastest growing segment of the manufacturing work force—is disproportionately young, white, male, suburban or exurban, and concentrated in the "defense perimeter." Over time, this trend could play an increasingly important role in shaping this country's geopolitics; already, the states south and west of the industrial heartland are becoming increasingly Republican. And in 1984, a larger proportion of young, white males voted for Reagan than did almost any other population group.

Meanwhile, blue-collar workers in America's industrial heartland are bearing most of the costs of this industrial shift. These workers are on average older and more likely to be female and minority than their counterparts in high-tech, defense-dependent industries. As they contribute tax dollars to build new infrastructure for defense-related communities elsewhere, these blue-collar workers are watching their own jobs disappear. Their communities are shouldering part of the burden, too, as they cope with the consequences of industrial and population outmigration, underutilized public sector capacity, higher social service costs, and a tax burden spread over a shrinking base.

The Future Structure of the Economy

The Pentagon's quiet industrial policy thus favors some industries, technologies, occupations, regions, and socioeconomic groups over others. Though it has created jobs and boosted profits in some sectors, its impact has been very uneven. Furthermore, this military-induced restructuring has exacted hefty social costs.

As time goes by, not only midwestern blue-collar workers, but *all*

Americans are likely to suffer from the neglect of basic manufacturing. The formidable public sector costs of the current industrial restructuring are being paid for out of current receipts from taxpayers and by substantial federal government borrowing. That the federal deficit persists despite large increases in military spending suggests that this kind of economic stimulus is not powerful enough to generate self-financing revenues. As a result, future generations will have to pay higher debt-financing charges. In other words, the current investment in military-related manufacturing is taking place at the expense of future consumption.

In addition, all Americans will find that today's military spending has contributed little to the productive base of their economy. Certain types of public spending—such as expenditures on roads, bridges, mass transit, and waterways—tend to improve efficiency in a wide range of businesses while, at the same time, providing services for consumers and taxpayers and stimulating production. But few externalities of this sort can be expected from the current military buildup. The mothballed ships standing bow-to-stern in the Sacramento River—the legacies of past buildups—are useless to any other industry or enterprise.

Indeed, if the present buildup continues, it will transform America's huge, diversified economy into one heavily specialized in high tech, arms, business services, and resources. The manufacturing sector will suffer many casualties as capital goods and consumer durables go the way of shoes, apparel, toys, and consumer electronics. Over time, most steel and auto production will move overseas, leaving only some assembly and finishing on American soil. Similarly, tractors, industrial machinery, and consumer electronics will be increasingly imported.

For such a division of labor to be tolerable in the long run, military-led research must be able to produce new, useful products at a steady pace. The record suggests, however, that the type of inventions that spin off from military research are geared primarily toward improving automation. In other words, the highly engineering- and labor-intensive military hardware sector is producing innovations that will make nonmilitary manufacturing more capital-intensive. Many of these spinoffs have therefore exacerbated the rate of worker displacement in basic manufacturing without appreciably improving that sector's comparative advantage, in large part because automating technologies can be easily installed in any plant anywhere in the world. Furthermore, this heavy commitment to military-led innovation has left U.S. basic manufacturers poorly equipped to apply military innovations to commercial uses.

In the long run, Washington's current strategy of depending on defense-

related research to improve U.S. competitiveness may create an "innovation race" that in many ways resembles the arms race. The result could be an economy continually destabilized by new rounds of competition and new forms of production. In that event, the imperative "to compete" would have completely replaced any discussion within U.S. society of the goals of that competition.

An alternative development path does exist, however. The United States has never really had a development plan, but in light of the economic difficulties it now faces (a slowdown in productivity growth, deterioration in manufacturing, and high, chronic unemployment), the time seems right to fashion one. Such a development plan would be two-pronged. First, it would give highest priority to human needs, such as housing, transportation, education, food, health, and culture. Second, it would favor economic stabilization rather than the extraordinary occupational, regional, and industrial displacement associated with current macroeconomic policy.

Central to this type of development path would be the preservation of a diversified economic structure in the United States, as well as the creation of similar structures in industrializing countries. A path that resists the pressure to overspecialize will not only preclude the formation of more OPEC-type cartels, with their destabilizing impacts on price structure and growth rates, but will also ensure more balanced sustainable economic growth and minimize the social costs of adjustment forced on individuals and communities.

In the United States, the revitalization of nonmilitary manufacturing is essential. Largely because of military priorities, these manufacturing industries have been starved of research funds, capital, entrepreneurship, and professional and technical expertise. But, as economic base theory tells us, the prosperity of manufacturing is the key to overall economic viability. The theory states that most sectors in the economy are secondary or tertiary—that is, their sales are dependent on the dynamism of a number of "basic" sectors whose output is largely exported. Previously, this theory was applied mainly to regional resource-based economies. But as the United States becomes integrated into the world economy, the model is increasingly applicable to the domestic economy as a whole. In this critical period, when international competition (mostly from high-wage countries) is challenging U.S. manufacturing firms, the United States needs an industrial policy designed to nurture, not neglect, basic manufacturing.[34]

Such a policy would have to ensure that in return for intermediate-term support from the government, participating firms and industries would meet performance requirements in terms of job retention and

efficiency. Of, course, not all industries and companies would merit such support; in order to determine those worthy of assistance, the United States would have to choose carefully, as the Japanese do through MITI and other organizations. In the short term, some judicious resort to managed trade would also be required.

An industrial policy of this sort could be funded out of savings from the military budget, particularly from categories not aimed at real defense needs. It could also be "financed" out of the considerable savings in social spending that would become available if the tide of plant closings across the country were stemmed. The resulting developmental process would produce a very different kind of economy in the future. More diversified, less vulnerable, more productive, it would undoubtedly go further toward meeting real human needs than does a military buildup that, although championed as a competitive strategy, is really an imperfect industrial policy in disguise.

Notes

[1] Kenneth Flamm, paper presented at the Conference on Strategic Computing, University of California, Santa Cruz, March 1985.

[2] "Military Research and the Economy: Burden or Benefit?" Center for Defense Information, *The Defense Monitor*, Vol. 14, No. 1, Washington, DC.

[3] See *Our Own Worst Enemy: The Impact of Military Production on the Upper South* (New Market: Highlander Research and Education Center, 1983) for the political background on the current buildup. Even the figures understate the true significance of military spending for the economy, since they do not include commitments such as the Department of Energy's nuclear warhead and waste activities, the defense-related portions of the National Aeronautics and Space Administration, and the activities of the National Guard, Coast Guard, the Federal Emergency Agency, and others. See Randy Shutt, *The Military in Your Backyard: A Workbook for Determining the Impact of Military Spending in Your Community* (Mountain View, CA: Mid-Peninsula Conversion Project, 1984).

[4] Norman Fieleke, "The Foreign Trade Deficit and American Industry," *New England Economic Review*, The Federal Reserve Bank of Boston, July/August 1985, pp. 43–52.

[5] For an excellent treatment of this issue, see Michael Klare, *American Arms Supermarket* (Austin, TX: University of Texas Press, 1984). Arms purchases have consumed a growing share of many Third World countries' gross national product. However, in 1984, purchases of arms in the Third World in absolute terms began to fall, as the debt crisis and economic stagnation set in. Arms exports from the United States were about $31 billion in 1983 and fell somewhat in 1984.

[6] Michael Boretsky, "Trends in U.S. Technology: A Political Economist's View," *American Scientist*, January/February 1975; The Boston Study Group, *The Price of Defense* (San

Francisco: W. H. Freeman, 1982), p. 258; Jacques Gansler, *The Defense Industry* (Cambridge, MA: MIT Press, 1980), pp. 208–9.

[7] See Wassily Leontieff, Alison Morgan, Karen Polenske, David Simpson, and Edward Tower, "The Economic Impact—Industrial and Regional—of an Arms Cut," *Review of Economics and Statistics*, Vol. 47, No. 3; Roger Bezdek, "The 1980 Impact—Regional and Occupational—of Compensated Shifts in Defense Spending," *Journal of Regional Science*, Vol. 15, No. 2; and Chase Econometrics Associates, *Economic Impact of the B-1 Program on the U.S. Economy and Comparative Case Studies*, Bala Cynwyd, PA, 1975.

[8] This has been the conclusion of competing simulations by the Congressional Budget Office, Data Resources Inc. (DRI), and Barry Bluestone's group at Boston College. However, Bluestone's research shows that targeting certain industrial sectors would prove much more effective than current military-led deficit spending.

[9] In a large data-based study of high-tech industries in the United States in the 1970s, we found that about 47 percent of all high-tech manufacturing employment is found in sectors that are defense-dependent, as defined by the Bureau of Industrial Economics. See Ann Markusen and Robin Block, "Defensive Cities: Military Spending, High Technology and Human Settlements," in Manuel Castells, ed., *High Technology, Space, and Society*, Volume 28, Urban Affairs Annual Reviews (Beverly Hills, CA: Sage, 1985).

[10] For an extensive discussion of high-tech industries, their composition and growth patterns, see Ann Markusen, Peter Hall, and Amy Glasmeier, *High Tech America: The What, How, Where, and Why of the Sunrise Industries* (Boston: Allen & Unwin, 1986).

[11] Bruce Nussbaum, "The Case Againt GE's Megamerger with RCA," *Business Week*, December 30, 1985.

[12] "Factories Are Plugging Along," *Business Week*, December 30, 1985; "Orders to Factories Rise," *New York Times*, March 5, 1986; Fieleke (fn. 4), Table 2.

[13] Figures are from the Labstat series, U.S. Department of Labor, Bureau of Labor Statistics, December 1985.

[14] See the discussion of the macroeconomic and managerial issues affecting recent steel industry performance in Ann Markusen, *Steel and Southeast Chicago: Reasons and Opportunities for Industrial Renewal*, Northwestern University, Center for Urban Affairs and Policy Research, November 1985, Chapter 8.

[15] See, for example, Mary Kaldor, *The Baroque Arsenal* (New York: Hill and Wang, 1981). Teresa Amott and Tom Riddell, in "The Freeze, Militarism and the American Economy," *Socialist Review*, March-April 1984, argue that many critics have understated the spinoff effect.

[16] Flamm (fn. 1) and "Military Research and the Economy" (fn. 2).

[17] Markusen (fn. 14), Chapter 7; Kenneth Geiser and Bennett Harrison, "The High-Tech Industry Comes Down to Earth," *The Boston Globe*, June 23, 1985; and "Military Research and the Economy" (fn. 2), p. 2.

[18] "Military Research and the Economy" (fn. 2), pp. 2, 4.

[19] See the excellent discussion of the subway car situation in David Morse, "Why Can't We Build Subway Cars," *The Nation*, December 14, 1985, pp. 648–50.

[20] See David Noble, *The Forces of Production* (New York: Alfred A. Knopf, 1984); Harley Shaiken, *Work Transformed* (New York: Holt, Rinehart and Winston, 1984); and Seymour Melman, *Profits Without Production* (New York: Alfred A. Knopf, 1983).

[21] Jay Stowsky, "Beating Our Plowshares into Double-Edged Swords: Assessing the Impact of Pentagon Policies on the Commercialization of Advanced Technologies," unpublished paper, Berkeley Roundtable on the International Economy, February 1986.

[22] Malcolm Browne, " 'Star Wars' Technology Promises Host of Peaceful Inventions," *International Herald Tribune*, April 11, 1985.

[23] Rosy Nimroody and William Hartung, "Putting Industry Even Further Behind," *New York Times*, December 12, 1985.
[24] Michael Borrus, "Friend or Foe?: The Unconsidered Consequences of Military Spending on the U.S. Competitive Position in High Technology," Conference on Strategic Computing, University of California, Santa Cruz, March 1985.
[25] See also Gordon Adams and David Gold, "The Economics of Military Spending: Is the Military Dollar Really Different?" Center on Budget and Policy Priorities, Defense Budget Project, Washington, DC, December 1985, for an extended argument along these lines.
[26] Markusen, Hall, and Glasmeier (fn. 10); Richard Dempsey and Douglas Schmude, "Occupational Impact of Defense Expenditures," *Monthly Labor Review*, December 1971, pp. 12–15; and Max Rutzick, "Skills and Location of Defense-Related Workers," *Monthly Labor Review*, February 1970, pp. 11–16.
[27] Ann Markusen, "Military Spending and Urban Development in California," *The Berkeley Planning Journal*, Vol. 2, No. 1, 1985.
[28] *Ibid.*
[29] Sabina Deitrich, "Military Spending and Migration into California," unpublished paper, Department of City and Regional Planning, University of California, Berkeley, 1984.
[30] Bennett Harrison, Chris Tilly, and Barry Bluestone, "The Great U-Turn: Increasing Inequality in Wage and Salary Income in the U.S.," paper presented to the Fortieth Anniversary Symposium of the U.S. Congressional Joint Economic Committee, Washington, DC, January 1986; Lester Thurow, "A General Tendency Toward Inequality," paper presented at the American Economic Association meeting, December 1985.
[31] Markusen and Block (fn. 9); Jay Stein, "U.S. Defense Spending: Implications for Economic Development Planning," working paper, Graduate City Planning Program, Georgia Institute of Technology, 1985; and Brendan Oh'Uallachain, "Some Regional Implications of Recent Growth in the American Military Industrial Complex," working paper, Department of Geography, Northwestern University, 1986.
[32] See Ann Markusen, "Defense Spending and the Geography of High-Tech Industries," in John Rees, ed., *Technology, Regions and Policy* (New York: Praeger, forthcoming), for an extended discussion of military manufacturing location.
[33] See James Fallows, *National Defense* (New York: Vintage, 1982), for a description of how military manpower is structured in contrast to private labor markets.
[34] See Stowsky (fn. 21) for a similar conclusion that defense-related innovation is not a substitute for a civilian industrial policy.