THE ECONOMIC AND REGIONAL CONSEQUENCES OF MILITARY INNOVATION*

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We have, in the postwar period, endured a costly and relatively undernoted reorganization of our industrial, occupational and regional structure in the U.S. This reorganization is the product of a "quiet industrial policy" conducted via the Pentagon. The policy has channelled extraordinary levels of resources into the types of technology, typified by defense computing, designed to enhance the nation's military rather than economic position in the world. The reorganization which it has engendered leaves the U.S. ill-prepared to maintain its role as an industrial leader in the world economy and has crated significant social problems in its wake.

In this paper, I argue that defense innovation has artificially accelerated the shift of resources to high tech industries, with adverse consequences for basic, commercially-oriented sectors, especially capital goods. In addition, defense innovation is a major cause of worsening occupational and income disparities, setbacks in racial and sexual economic progress, and accelerated urban and industrial belt decline. Even more troubling, defense innovation is fundamentally altering the way the economy as a whole performs. It has introduced a dynamic impulse toward more or less permanent innovation, a reflection of cold war competition, which has stepped up the pace at which existing capacity, labor force skills and even entire communities become obsolete. While altering the manner in which business cycles threaten to plunge the economy into periods of stagnation, it carries with it serious new developmental and social problems.

A. The Developmental Consequences of Defense Spending

Since the 1870s, we have experienced periodic crises in capitalist economies. Whether one prefers the Keynesian underconsumptionist or the Marxist overproductionist theories of this phenomenon, it is clear that entire economies can experience prolonged periods of underutilization of capacity and widespread associated unemployment, in the face of demonstrable human need.

There have been two ways out of this morass, neither mutually exclusive. One has involved intervention by the state to reformulate the relationship between capital and labor in a manner which guarantees profitability against labor demands while assuring a market for commodities produced (O'Connor, 1984). This was the Keynesian revolution. In the past decade, the limits of Keynesian approaches appear to have been reached with the emergence of inflation as a permanent tendency and the acceleration of international market integration which renders national policy efforts less potent.

The other has been a more anarchic, private sector initiative - the generation of a new set of innovations which render existing capacity and products lines obsolete, forcing massive restructuring and calling forth large investment commitments. In each major downturn over the past century and a half, a series of fundamental production-altering inventions were commodified, forming the basis of a new growth dynamic: railroads in the first half of the 19th century, steel and mechanical machinery in the latter half, autos and electrical machinery entering into the new century, petrochemicals and electronics since the 1930s (Hall, 1982; Mensch, 1979). It has been argued that major innovations emerge only in periods of severe crisis because in more prosperous times, entrepreneurs are preoccupied with the more routine tasks of supervising production and marketing their product.

In the most recent recession, national economic policymaking appear to have turned fro Keynesian remedies (although one could consider military spending in Reagan proportions just that) toward permanent innovation as the route back to industrial supremacy. This path has been found rather accidentally, a byproduct of defense policy in the postwar period. Rather than waiting for hard times to propel basic innovation forward, policymakers are increasingly talking about the advisability of pursuing innovation in a sustained way, to germinate "sunrise" industries that will permit us to stay ahead of our industrial and third world competitors.

Why is permanent innovation a product of defense policy? The answer lies in cold war rivalry. As Gene Rocklin points out elsewhere in this volume, real wars are generally won with quantity not marksmanship. But the cold war has been prosecuted by institutionalizing continual innovation in weaponry and delivery systems. The goal of military research and development spending is to render the product of the opposition ineffective. This sets in motion a process of rapid depreciation and obsolescence of recently created technologies. Generations of fighter planes are frequently retired, bins of nerve gas destroyed, missile silos abandoned.

This innovative dynamic is not subject to the conventional crises of capital accumulation. Defense-based industry responds to a unique client and sports a competitive structure unlike that of industries producing for commercial markets. Demand is fairly much guaranteed by the persistence of the cold war and by the fact that there is only one major buyer—the United States Government—who cares more about performance qualities of the products and timeliness of delivery than cost per se. Variations in the level and composition of demand do occur, but without any very clear link to business cycles.[1]

[1] Though shifts in levels and growth rates of defense spending will, simply because of their sheer size, ameliorate or exacerbate peaks and troughs.

Defense spending *is* subject to dramatic swings in geopolitical climate, as the Viet Nam build-up and aftermath demonstrate, but these are less apt to affect the underlying innovative impulse than they would in purely commercial sectors.[2] Whatever the fashion in Pentagon budgets, research and development activities aimed at new, more sophisticated instruments of defense and destruction continue to be underwritten.

Until the present era, military research was conceived of as a strategic necessity, not as research program for basic industrial innovation. Yet in the most recent defense buildup, which will amount to a 2.5 trillion dollar infrastructure program in the 1980s (Tello, elsewhere in this volume), the stated rationale has begun to include economic performance as a second, even coequal, goal. The Strategic Computing Program, for instance, has as its goal "increasing national security and economic strength" (Nielson, elsewhere in this volume). The DARPA program, funded at $600 million for 5 years, contains an explicit commitment to industrial development, including the intent to stimulate new computer concepts, encourage industrial funding, generate new computer-based applications, and pioneer new techniques in software development and methodology. The Services have for years been subsidizing the adoption by military manufacturers of automation technologies such as CAD/CAM systems and numerically controlled machine tools, but this recent thrust brings the commercial concerns farther back into the very structure of research programs themselves.

Indeed, the Strategic Defense Initiative places the major responsibility for industrial innovation formally in the hands of the military, which has informally

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[2] Though even here, competition for resources within the defense sector can cut into funds for innovative research. An example is the ascendancy of combat priorities over research during the Viet Nam war, cited by Flamm elsewhere in this volume.

played that role in any case. Up to World War II, the federal government accounted for only about 15% of research and development funding in the U.S., but the level had increased to above 60% by the 1960s and has not declined since. In computers, for example, the military and federal government accounted for virtually all of the market for computers in the decade following the war, an era which served as the entry point for all of the major computing firms (Flamm, elsewhere in this volume). In practice, the Pentagon has directed a highly successful industrial policy. It has targetted research and development, provided incentives for technological innovation, guaranteed procurements, pursued a "Buy America" policy, mounted a plant closing policy (in Office of Economic Adjustment), afforded employees lifetime job and income security (including retraining for retired officers), and offered Community impact aid.[3]

It is difficult to pinpoint the true political drives behind this melding of strategic and economic concerns. Take the new strategic computing initiative, for example. Department of Defense officials claim that promoting commercial spinoffs is the only way to make high levels of strategically mandated defense spending palatable to Congress. Defense-sponsored researchers and computer scientists express skepticism that strategic applications like Star Wars are at all feasible or that this is a likely route to commercial payoffs, but they claim that linking funds for basic computing to this type of initiative is the only way to get badly needed research dollars. Industrial policy advocates, at least those banking on "high tech" strategies, claim that the industrial applications are themselves the goal, but that this type of intervention into the marketplace is only possible when disguised as strategically necessary spending for defense.

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[3] Markusen, 1985a.

Ironically, in the vast majority of discussions about the strategic computing initiative, the enemy whom we must purportedly overcome is not the Soviets the Japanese. No one is contending that the Soviets are in any way equipped to compete with the U.S. on this type of high tech frontier. Indeed, it is widely acknowledged that they are far behind in basic computing capability. The motivating fear seems to be that efforts like the new Japanese 5th generation computer project will determine the U.S. as the historic progenitor of new computer breakthroughs.

The implicit belief is that defense research efforts promise, having delivered in the past, commercially applicable innovations which ensure the nation's rather euphemistically invoked "economic strength." They will do so by maintaining the position of U.S. firms on the leading edge of an increasingly permanent wave of innovation, one set in motion by military concerns to begin with. But this developmental dynamic will work only if the U.S. is best poised to take advantage of its results.

B. The Industrial Consequences of Defense-based Innovation

In purely Keynesian terms, the recent defense buildup has formed an innovative wedge out of the recession. Innovative, because the vast majority of new procurement dollars have gone to high tech industries, defined by their high shares of professional and technical employment and by their relatively high levels of research and development activity.[4] Table 1 gives the major manufacturing sectors classified as belonging to the "defense industrial base" by the

[4] For a discussion of the definition of high tech industries, see Markusen, Hall and Glasmeier, 1985. The most high tech industry, according to the occupational definition, is missiles (SIC 376).

Bureau of Industrial Economics with their recent levels of employment and defense shares as computed by two different federal government efforts (Henry, 1983; Shutt, 1984). The shares are underestimates, since defense demand is attributed to the DOD expenditures only, leaving out the defense components of NASA, DOE, FEMA, and other agency budgets.

Table 1. **Major Defense Industrial Base Sectors, Employment and Defense Shares**

SIC	Industry	Employment (000) 1977	1982	% Change 1977-82	Defense 1982 BIE[a]	Defense Share 1983, DEIMS[b]	Output Growth[a] 1982-87
3721	Aircraft	222.8	286.6	+29%	270%	65%	+59%
3761	Missiles	93.9	99.6	+ 6%	68%	65%	+64%
3724	Aircraft Engine	106.3	128.6	+21%	54%	64%	+33%
3764	Missile Propulsion	17.0	25.2	+48%	54%	64%	+33%
3728	Aircraft Parts	101.9	146.1	+43%	41%	57%	+35%
3769	Missile Parts	10.9	20.5	+88%	41%	57%	+35%
3662	Radio, TV Comm Equip	333.0	471.3	+42%	58%	61%	+54%
3811	Eng & Sci Inst	42.2	43.1	+ 2%	34%	49%	+60%
3674	Semiconductors	114.0	164.5	+44%	13%	23%	+51%
3675-9	Other Elec Dev	228.0	315.8	+39%	17%	29%	+49%
3822	Measuring Dev	197.0	246.0	+20%	n.a.	35%	n.a.
3883	Optical Instr	29.9	50.6	+69%	28%	17%	+38%
3489	Ordnance	19.0	27.4	+44%	78%	100%	+35%
3731	Shipbuilding	176.4	168.5	-05%	62%	75%	+24%
3483	Ammunition, Exc Small	20.6	23.3	+13%	91%	98%	+56%
2892	Explosives	11.5	11.9	+ 3%	34%	44%	+59%
3795	Tanks	12.1	18.0	+49%	94%	99%	+47%
3484	Small Arms	17.5	17.5	0	14%	66%	-43%
3482	Small Arms Ammo	12.2	10.1	-17%	25%	n.a.	+130%
3573	Computers	193.7	339.6	+75%	7%	n.a.	+141%

a Henry, 1983. From Bureau of Industrial Economics, Department of Commerce, input-output model. These appear to be lower than the following column because of different methods of incorporating foreign sales. Both chart indirect as well as direct demand impacts.

b Shutt, 1984. From the Department of Defense, DEIMS (Defense Economic Impact Monitoring System), using an input-output model from DRI.

The defense build-up has been a major boon to these sectors, whether measured by employment or output. Since 1977, job gains have been in excess of 30% for many of these sectors. All sectors in the table except small arms will enjoy an increase of 30% or more in demand emanating directly and indirectly from the Department of Defense from 1982 to 1987. Computers, a sector in which successful commercialization had pushed the military share down to a modest 7% by 1982, will be the single greatest beneficiary of new defense spending, slated for an increase of 141% in Defense Department demand in just five years, which will increase its defense share to 12%.

The heart of this military hardware complex is the aerospace industry, which in addition to producing the big ticket items like aircraft and missiles, is a big consumer of TV and radio communications equipment, scientific equipment, semiconductors and other electronic devices. As a whole, this group will experience a growth in defense-oriented output of about 60%.

Even these figures understate the impact of the aggressive defense posture of the Reagan administration. The reversal of detente and the lifting of limitations on the trade of first generation technologies and on defense research aimed at international markets, has created an additional round of impacts from a boom in the arms trade. The significance of the arms trade is not new; the aerospace industry alone has been responsible for the largest U.S. trade surpluses of manufactured goods of any single industry in the postwar period (Boretsky, 1975:81). But the U.S. has been increasing its share of that trade. Weaponry produced in the U.S. accounted for about 45% of total world arms transfers by the early 1980s, compared with 20% in 1970 (Boston Study Group, 1982:258). More than 840,000 domestic jobs are currently generated by foreign military sales (Gansler, 1980:208-9).

As the military-related sectors have flourished under the present administration, the more commercially oriented manufacturing sectors have languished. The heavier, capital goods industries are particularly in distress. Partly this is a result of the shift in federal budget priorities toward military procurement and away from social spending and infrastructure provision, with their adverse multiplier effects on commercial sectors. Partly it is a function of growing imbalances in public commitments of funds for research; compare, for instance, the $30 billion Star Wars program with an endangered $15 million the steel industry is requesting for research on leapfrog technologies. Partly it is a loss of third world markets, particularly in the increasingly troubled basic capital goods industries (farm machinery, construction machinery, machine tools) due to debt crises, continued recession and rising bellicosity which is shifting larger shares of third world GNP into arms purchases. While not all of heavy industries' ills are attributable to military preoccupations—the overvalued dollar and poor management are also at fault—the role of the former looms much larger than is commonly understood.

All of this might be tolerable in the short run if it were true that defense initiatives eventually bear fruit in beneficial products and new technologies for basic industry. But the evidence is far from comforting on this front. Indeed, Japanese firms, without the benefit of a huge defense budget and with a second rate university research establishment, appear to be much better positioned to take U.S. defense-generated technologies and apply them to basic industrial production. Elsewhere in this volume, analysts of the Japanese ability to translate basic innovations into commercial hardware concur that the following features are key: an evaluation of innovation in light of overall social goals; an emphasis on certain targetted 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 farms; lifetime job security and superior labor relations, and a system geared to "technology pull"—the concentration of the nation's scientific expertise on production technologies and product quality. In the U.S., in contrast, the domination of many high tech industries by military priorities, the relatively low status of industrial engineers compared with aerospace and electrical engineers and physicists, and the absence of any explicit commitment to targetting certain commercial sectors as the core of the economy, all contribute to a relatively poor record of translation of such innovations into high performance in basic industry.

Ironically, the present explicit shift in emphasis from competing with the Soviets to competing with the Japanese, and the choice of the strategic defense computing initiative as a primary vehicle for doing so, threatens to exacerbate the situation. Each round of defense-bred innovation has to date resulted in the successful Japanese entry into a once strong domestic and export sector. This is most recently evident in the deterioration in the domestic machine tool industry, where Japanese sales of small and medium sized machine tools have cut deeply into the markets of domestic firms.

A further concentration of U.S. research talent into another round of strategically oriented research will invite another such translation, 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 latter have surpassed American products in performance. In return, the Japanese are asking for access to the newest generation of defense-funded research results, and DOD appears willing to accede to the bargain (see Borrus elsewhere in this volume). These kinds of arrangements will accelerate the rate at which the major industrial competitor of the U.S. receives and

commercializes the latter's high tech inventions, presumably with further depressive effects on basic industrial sectors within the U.S.

Put another way, the enemy of U.S. industrial viability is not the Japanese, but the policymaker's own proclivity to run faster in the innovation race, fearing the shadow on their heels and forgetting that it is entirely of their own making. Without past generations of defense-generated technologies, the U.S. would not be experiencing the present destabilizing impact on economic restructuring, at least not at the present pace. Indeed, the entire phenomenon of competition in high tech or the innovation race as I like to call it, bears an uncanny yet understandable, given its origins, resemblance to the arms race.

C. The Consequences for Occupations and Work

So far, I have restricted myself to asking whether or not defense-led innovation "works" at the level of the economy as a whole, especially as a development strategy. But the more profound question might be "for whom does it work?" It turns out that defense-related manufacturing has quite different impacts on the composition, level and location of employment than does commercially oriented industry.

Because the product of military-related industries does embody continual innovation, the workforce in these industries is highly skewed toward those professional and technical occupational categories which are associated with scientific research. In manufacturing as a whole, the jobs going to engineers, engineering technicians, computer scientists, life and physical scientists and mathematicians account for less than 6% of employment. In missiles, they account for 41%, in computers 27%, in communications equipment 22% and in aircraft 19% (Markusen, Hall and Glasmeier, 1985). Studies from the early 1970s (no recent data has been found) show that between 22% of all U.S.

electrical engineers, 48-59% of aeronautical engineers, and 23-38% of physicists work on military-related projects (Dempsey and Schmude, 1971; Rutzick, 1970).

The current military buildup has created an enormous, unsatiated demand for engineers and related high tech professionals. The current demand for college engineering graduates on the part of California firms cannot be met by California universities (Parzen, 1982), resulting in aggressive recruitment campaigns aimed particularly at the better engineering institutions in the Midwest. The job opportunities are not lost on young college students worried about their futures—electrical engineering is widely acknowledged to be the most sought after major for entering freshmen at California's top academic institutions.

Blue collar workers in certain skilled categories have traditionally been well-represented in defense manufacturing. In 1970, 54% of tool and die makers, 25% of sheet metal workers, 19% of machinists and airplane mechanics and 14% of draftsmen worked in military production. But the shares of these occupations within the defense workforce are declining as defense-related production becomes even more high tech. This is occuring for two reasons. First, the quantity of weaponry produced is diminishing as its quality and price rise. Many fewer fighter planes are built now for the same real dollar expenditure than was true in the 1960s. Second, major defense contractors have pioneered the adoption of many types of automation within the production process, supported by Pentagon incentives. There is also some anecdotal evidence that firms are engaging in explicit union-busting, again with Pentagon encouragement (Markusen, et al, 1985).

The sexual and racial composition of the defense manufacturing workforce is also relatively less balanced than in the society as a whole, with a couple of exceptions. Women are underrepresented among defense workers. While this is

largely a function of economywide occupational segregation, there is evidence that within some occupations, women are found in fewer numbers than their presence in those occupations economywide would explain. For instance, in a study of defense-dependent communities in California, we found that women engineers in Livermore were underrepresented compared with their shares of the state's engineering jobs as a whole (Markusen, et al, 1985).

The participation of minorities in defense production is a bit more complicated. Because of massive recruitment campaigns in World War II, black men are found in relatively large numbers in the production of big ticket items like aircraft assembly and shipbuilding. But this cadre is a relatively older group, whose ranks are not being replenished with younger black skilled workers. Hispanics, a more recent group of migrants by and large, have not been incorporated into defense-related production at anywhere near their participation in the workforce. White collar jobs in defense-related manufacturing show very low groups of Asians.

The defense manufacturing workforce may also be getting younger. In a recent interview with Lockheed, which by 1984 was hiring on the order of 700 engineers a year at their Sunnyvale plant alone, a recruiter noted that most current hires are young, new college graduates, whereas a decade ago, about half of the new job slots would have been filled by older more seasoned engineers (Dietrich, 1984). The trend is partly explained by the lower cost of young, unmarried engineers who are willing to occupy apartments in expensive housing markets like Silicon Valley and don't require much in moving costs to relocate them. But it is also partly a function of the stepped up pace of innovation, so that engineering skills become obsolete at a faster pace than was true in the past, favoring the recent college graduate who presumably receives the most modern training.

In contrast, defense-led innovation has had a strong adverse impact on those members of the workforce engaged in basic manufacturing, a group which has also consisted traditionally of white males but which in the past decade or so had welcomed increasing numbers of women and minorities into its ranks. The adversity experienced by this group is in large part a function of the relative neglect of these sectors under the defense-oriented industrial policies at the national level and by relatively poor performance of management in many of these sectors.[5] However, job loss in these sectors has also been hastened by the application of defense-bred technologies to the production process in basic industry. Why defense-oriented research should have produced this particular type of technological change, rather than say the improvement of mass transit systems or better, cheaper-to-build housing, requires some explanation.

Defense-oriented innovation has ultimately been aimed at the flexibility, maneuverability, invisibility, undetectability and infallibility of lethal weapons and their delivery systems. One of the most outstanding features of the products of this process is their *mobility*, whether on land, in air or on water. This mobile weaponry requires immense investments in computing, electronics, communications and instrumentation equipment to make it perform reliably. Thus the sizable proportions of output of these industries currently accounted for by DOD, not to mention to leading role of DOD in their inception.

To use some examples from the present Strategic Computing Program, its goals are to "extricate the soldier from hazardous situations" (presumably obviating the hazardous situation itself is impossible), and to help human decision-

[5] There is not room in this essay to probe the culpability of industrial corporate management in these developments, especially in those industries which enjoyed long term oligopolistic dominance of the domestic market until recently. For an account of industry evolution, and the role of oligopoly, see Markusen, 1985c.

makers cope with the pace of conflict" (Nielson, elsewhere in this volume). The Pilot's Associate, for instance, the Air Force's share of this project, will help the pilot (who is not going to be removed form the hazardous situation as will the tank operator in the autonomous land vehicle) who is "overwhelmed with incoming data and communications." Similarly, the Navy's Battle Management System, its share of the pie, will "generate potential courses of action, evaluate them and give supporting documentation" to naval officers in battle (Suchman, elsewhere in this volume).

It is the past research products of just such priorities that have given us the flexible production technologies, whether it be integrated circuits, numerically-controlled machine tools, on CAD/CAM systems, which have proved so potent in reorganizing the process of work (Noble, 1972). Just as these past generations of technological breakthroughs have permitted pilots to rely on auto piloting, they have provided the tools for removing the machinist from his or her lathe. As several recent scholars have argued (Shaiken, 1985; Noble, 1984 and Melman, 1983), the types of automation which are presently driving the restructuring of manufacturing are not products of a natural evolutionary process, but explicit products of defense-driven priorities. And yet ironically, the commercial applications of these innovations cannot generally be credited to American firms, but to Japanese industrial engineers whose products have displaced workers in machine tool producing industries and in the industries that use them.

Many new questions are raised by this reorganization of work. The new technologies may leave production more vulnerable to errors which would shut down the production line completely, arguing that new types of labor management systems, with a different structure of commitment to workers, will be required (Alic, elsewhere in this volume). The nature of work will also be

altered. Human operators will be made to conform to the new machinery, including for instance the eliminate of dialects, accents and slang to permit voice recognition by computers. And the level of work demanded under new, automated lines is not easily predictable. The total level of new jobs created by high tech sectors, especially in a stepped up innovation race, may not be sufficient to absorb the workers laid off in other sectors.

D. The Regional Consequences

Elsewhere we have argued that military-related industry in the U.S. has generally snubbed the midwestern industrial heartland and gravitated to ward the defense perimeter (Markusen and Block, 1985). Furthermore, defense-oriented plants from the 1930s onward seem to have been more suburban and even nonmetropolitan in orientation than basic manufacturing. In a study of industrial location in the 1970s, we found that defense spending, even in an era of builddown, was a significant positive factor explaining recent high tech plant and job growth patterns across the country (Markusen, Hall and Glasmeier, 1985). The broad trend, then, is the rebuilding of industrial capacity in relatively virgin locations, drawn heavily by defense spending priorities.

This pattern is occuring because defense-oriented firms face quite different locational determinants 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 a tiny fraction of total costs for weapons system producers, and the location of the client (Washington, D.C.) is unimportant, since the produce itself is mobile and its destination often dispersed, secret, and/or changeable.[6]

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[6] These arguments, and those which immediately follow, are developed at much greater length in Markusen, 1985b.

What does matter to defense-related manufacturers is access. They need access to the type of labor they need for innovative product development. They need access to other firms in the same business and military bases or launch sites where their equipment will be tested. Military-related plants do tend to agglomerate, as most innovative, youthful sectors do. But these agglomerations are somewhat surprisingly not to be found along side older centers of innovation in basic manufacturing but in entirely new or revitalized centers typified by Silicon Valley; Orange County; Huntsville, Alabama; Titusville-Melbourne, Florida; and southern New England. With the exception of the latter, these areas were not pre-existing pools of skilled, professional/technical labor, but were created in the process of setting up defense camp.

Political and strategic factors have played an important role in this shift; especially the opening up of the Pacific Front in the second World War, and the rise of new sunbelt politicians such as Johnsons, Nixon, Reagan and their Congressional counterparts. But it is also true that much of the wartime build-up, including new plant construction, took place in the industrial heartland; afterwards it was rapidly dismantled to make way for residential development or reconverted back to producing autos, machine tools and other basic capital goods. The concerted building of new defense-industrial complexes in new regions like the outer Los Angeles area may be attributable in part to a repulsion on the part of defense contractors as a whole, many of whom were former military men, for cosmopolitan, industrial culture as found in the cities stretching for Buffalo to Baltimore, St. Louis to Milwaukee—a repulsion for the adversarial relationship between capital and labor acknowledged in the system of industrial labor relations, so different from that in the military itself, and for the type of urban, democratic political regimes in that region whose posture has included defending the social contracts engineered in the New Deal.[7]

[7] See Fallows, 1981, for a description of how military manpower is structured in contrast to private labor markets.

Military contractors enjoyed a hidden incentive to form their own local labor pools in the Defense Department's willingness to pay for relocation costs of workers recruited from other parts of the country. Not only could these costs be charged to the Pentagon; a normal rate of return could be assessed on them as well. One might conclude that the Pentagon was underwriting and contracting out the business of relocating large proportions of the U.S. workforce via this method. Firms found relocating this workforce profitable. While this was clearly not the intent of defense policy, it proved a very effective population redistribution mechanism over the postwar period.[8] In contrast, no other major industrialized nation, none of whom engage in defense innovation at the rate of the U.S., has experienced similar wholesale shifts in population in the postwar period.

What the evidence suggests, then, is that the defense-related workforce, the fastest growing segment of manufacturing at present, is disproportionately a young, white, male, suburban or exurban, and concentrated on the "defense perimeter." This argument is tentative, since more research needs to be done to confirm these hypotheses. If true, this tendency could be playing a major role in the emerging patterns of geopolitics in this country, where states south and west of the industrial heartland are becoming increasingly Republican, and where young white males voted for Reagan in 1984 in larger proportions than almost any other population group.

Disproportionately bearing the costs of this industrial shift are blue-collar workers in the industrial heartland, who are on average older, and more female

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[8] No work to my knowledge has been done estimating the size of this migration. Research cited in Weinstein and Firestine, 1978, shows that about 12% of net migration in the period 1969-76 can be accounted for by moves associated directly with military service, since soldiers are recruited relatively ubiquitously but remain near their bases, disproportionately in the south and west, on retirement or discharge.

and minority, than their defense industrial counterparts. Their communities are shouldering part of the burden, too, by coping with the consequences of industrial and population outmigration-underutilized public sector capacity, higher social service costs, tax burdens spread over a shrinking base.

E. Summary

The question of how defense-generated innovation performs as an economic policy must thus be answered along two axes. As a developmental path, it has the potential to ameliorate the stagnation associated with troughs in long waves, by artificially and continuously sponsoring basic research breakthroughs when they would likely not be undertaken by the private sector. But crises in the development process may then assume new forms. An escalating round of innovation may be set off in which resources are diverted from basic consumption at rates which sorely tax the societies' (and business) tolerance. Furthermore, a nation channelling its best talent into the leadership of this type of invention may find that it is not equally well equipped to transform the results into the desired commercial performance.

But crises could occur along another axis as well. The incidence of the benefits and costs of this type of development path are distributed very unevenly across industries and occupations, race, gender, and age groups, regions and communities. Continual defense-led innovation may prove extraordinarily destabilizing and may engender new forms of social revolt. While the form this response will assume is not yet clear, it will almost certainly be in the political arena, where the decisionmaking responsible for defense-led innovation lies.

It would be more rational for the U.S. to abandon this type of defense-led innovation and concentrate the same resources on improving productivity and

product quality in basic industry, if industrial performance is really the goal. Otherwise, the U.S. may find itself a specialist only in arms production, a logical consequence of the quiet industrial policy the Pentagon implements. This would leave the U.S. as the major arms peddlers to the world, saddling the nation with an immense economic stake in the continuation of the arms race. That stake would be heightened by the continued failure of basic industrial sectors domestically. Instead, an emphasis on redirecting resources into domestic, peacable sectors would slow down the innovation spiral, increase the production of socially useful commodities, and stabilize jobs and communities.

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