Defense Cutbacks and the New England Economy

D efense is a regrettable expenditure. Like law enforcement and insurance, defense spending may be necessary but intrinsically it does not make us feel better off in the same way as, for example, housing, transportation services, and education. Thus the reductions in East-West tensions that enable us to allocate more dollars to items that directly improve living standards should be welcome.

Nevertheless, adjustment to a lower level of defense spending has costs. Reduced demand for defense services will cause disruptions for defense-oriented companies and their workers. Concern is especially high in New England, which is home to a disproportionate share of the nation's defense contractors.

This article examines New England's economic costs from lower defense spending. Although the reduced expenditures on defense will have a noticeable negative effect on the region's output, this will not be as great as in past cutbacks. However, the coincidence of defense reductions with other economic problems in New England will tend to magnify the difficulty of adjustment. Section I measures the defense intensity of the national economy, and indicates the budgetary changes expected through the mid 1990s. Section II provides information on the role of defense in New England, and Section III estimates the impacts of defense cutbacks. The following two sections of the paper examine in more detail the effects of falling defense budgets on businesses doing work for the Defense Department and on their workers, as well as indicating possible roles for government. Section VI is a summary.

I. Defense in the National Economy

Between 1979 and 1986, national defense spending rose from 4.8 percent to 6.5 percent of GNP, a large increase in a peacetime economy. Since 1986, defense spending growth has slowed, and the defense share

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Chart 1

*Defense Spending as a Percentage of
GNP, Fiscal Years 1940-95*
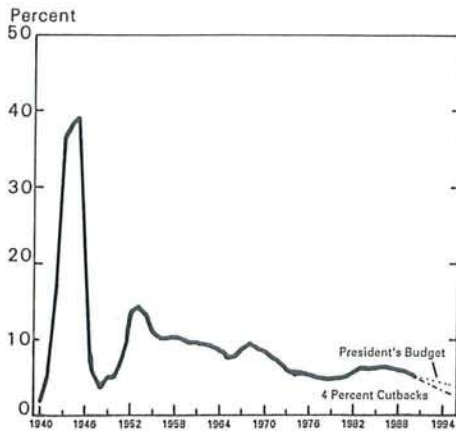
Source: Office of the Comptroller of the Department of Defense, *National
Defense Budget Estimates for FY 1991*; Executive Office of the President,
Budget of the United States Government Fiscal Year 1991;
Bureau of the Census, *Historical Statistics of the United States, Colonial Times
to 1970*; and *Economic Report of the President*, 1990.

of GNP fell to 5.9 percent in 1989. By the mid 1990s, assuming diminished international tensions, defense spending is expected to fall to its lowest share of the economy since the late 1940s, or perhaps even since before World War II. The further reduction in the defense intensity of our economy will pose new challenges for defense-oriented industries and their workers, as well as offering new opportunities for the government to finance other worthwhile activities, reduce its budget deficit, or lower taxes. However, the extent of these challenges and opportunities should not be exaggerated. Despite the buildup in the early 1980s, defense is a smaller share of our national economy than during most of the post-World War II period. Also, the reduction in defense spending will probably be small relative to those experienced after previous wars.

Historical Trends and Projections for the 1990s

The federal government spent about $300 billion for defense in fiscal year 1989. Adjusted for inflation, this was roughly the same as at the 1953 Korean War peak and the 1968 Vietnam War peak. But although the Carter-Reagan peacetime buildup left defense

spending near these wartime highs in real dollars, the U.S. economy has grown significantly over the past forty years, and the 1980s defense budget was not as large a share of the nation's resources as at the other peaks. Furthermore, it was lower than in every single year from 1951 to 1972 (Chart 1). This previous reduction limits the problems and the possibilities associated with future defense cutbacks.

Under the President's proposal, the defense budget would grow only modestly (in nominal dollars), and it would fall from its recent share of 5.9 percent of GNP to 4.2 percent by fiscal year 1995 (Chart 1). Other participants in the national budgetary debate envision sharper cutbacks. If the nominal defense budget were reduced by 4 percent annually starting next year, an example considered in this article, defense would be 3.2 percent of GNP by fiscal year 1995.[1] These reductions from the 1986 peak, between 2.3 and 3.3 percentage points, would be far less than after World War II and the Korean War, and somewhat less than after the Vietnam War.[2]

Similarly, relative to the federal government budget, defense spending's 1980s peak of 28.1 percent in 1987 was well below the Korea and Vietnam peaks of 69.5 and 46.0 percent (Chart 2). So the prospect of a reduction to between 21.6 percent and 16.4 percent in fiscal year (FY) 1995 offers less of a "peace dividend" than after those wars.
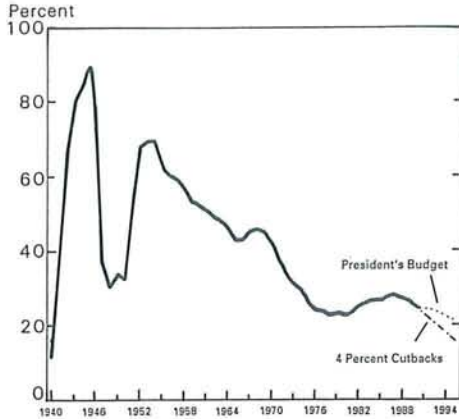
Composition of the Defense Budget

The largest components of recent military spending are operations and maintenance (29.5 percent in FY 1989), procurement (27.7 percent), and military personnel (27.4 percent). Research, development, testing, and evaluation (RDT&E) accounted for an additional 12.5 percent in FY 1989. The defense buildup of the 1980s consisted of increases in hard goods, services, and other items produced by private industry rather than growth of military personnel (Chart 3). Procurement spending more than doubled in constant dollars between the late 1970s and the late 1980s. Real RDT&E grew very rapidly (an annualized rate of 9.8 percent between 1979 and 1986), in order to support increasingly high-technology military hardware. RDT&E and operations are the only components of the defense budget that are significantly larger than they were three decades ago.

The composition of future defense budgets is highly uncertain. Under the President's budget for FY 1995, operations and maintenance would rise to 30.7 percent of total military spending authority,

Chart 2

Defense Spending as a Percentage of Federal Government Outlays Fiscal Years 1940-95

Percent

Source: Office of the Comptroller of the Department of Defense, *National Defense Budget Estimates for FY 1991*; Executive Office of the President, *Budget of the United States Government Fiscal Year 1991*; Bureau of the Census, *Historical Statistics of the United States, Colonial Times to 1970.*

Chart 3

Components of the Military Budget, Fiscal Years 1953 to 1989

Billions of 1989 dollars

* Includes military construction, family housing, and other.

Source: Office of the Comptroller of the Department of Defense, *National Defense Budget Estimates for FY 1991.*
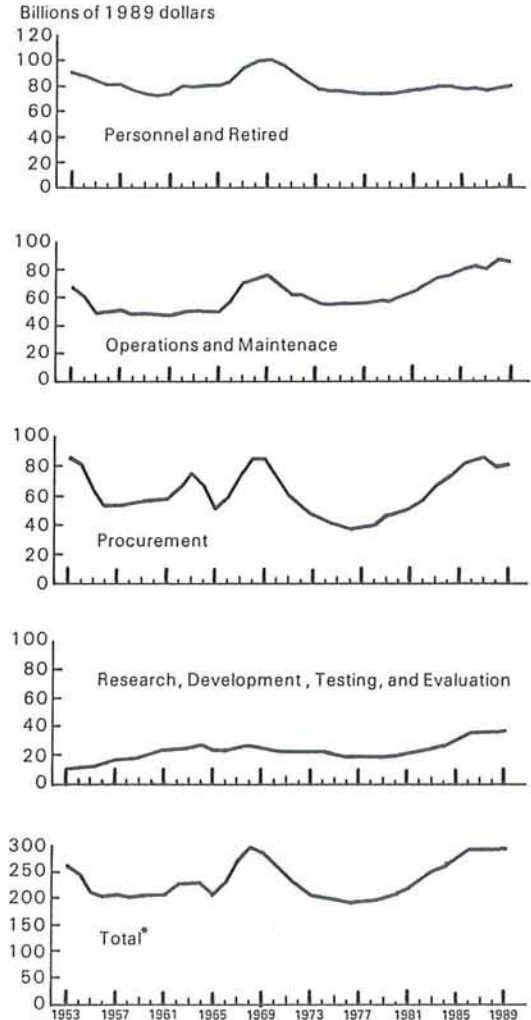
procurement would drop to 26.1 percent, and the shares for other components including personnel and RDT&E would remain approximately constant. Current Congressional sentiment appears to favor sharper cutbacks in the defense budget, but priorities under such a plan have not yet been established (see U.S. Congressional Budget Office 1990b for further discussion). One scenario would emphasize readiness while deferring investment in more modern defense systems. Accordingly, procurement would be reduced sharply, while personnel and operations and maintenance would be reduced only modestly. Alternatively, the armed forces might accede to larger cutbacks in personnel in order to preserve spending on desired weapons systems.

The future role of RDT&E is especially uncertain. If Congress chooses to delay the introduction of new weapons systems, it might also postpone RDT&E. On the other hand, continued research and development might be preserved on the view that it is a useful hedge against future international threats, as well as a source of commercial spin-offs.

As an illustration of one possible alternative, this study considers aggregate nominal spending cuts of 4 percent a year starting in FY 1991. This hypothetical scenario includes a sharp reduction in procurement, a somewhat reduced share of the budget for RDT&E, and relatively modest reductions in personnel and operations and maintenance.

The analysis in this study highlights possible results for the mid 1990s rather than distinguishing

year-by-year patterns. (See Appendix Table 2 for detailed projections of FY 1995 budget authority). For both the President's plan and the 4 percent cutbacks plan, near-term reductions in spending are likely to be more modest than reductions in budget authority. This discrepancy is due to procurement authorized (but not yet paid for) in previous years' budgets (see Kaufmann and Korb 1989). Because of this pattern, the impacts of defense cutbacks are likely to show up earlier in contractors' orders than in their production activity.

II. Defense in the New England Economy

The pattern of the military buildup in the 1980s, as well as the pattern of cutbacks in the 1990s, suggests that New England might be particularly prone to economic disruptions from defense cutbacks. As a region, we receive a disproportionately high share of prime contract awards while having a relatively low share of military personnel.

Measures of Defense Intensity

Table 1 presents some key indicators of the defense intensity for the New England states. The first two columns indicate defense spending through prime contracts to private companies. Prime contract awards include budgetary items found under procurement, RDT&E, operations and maintenance, and some smaller categories such as military construction. From FY 1987 to 1989, Massachusetts received an average of $1405 per resident and Connecticut received $1651 per resident. These figures are roughly three times the national average of $514 per capita. Massachusetts and Connecticut also defied the prevailing pattern of declining prime contracts in FY 1989, as both states received large increases, even after adjusting for inflation (Chart 4). Still, contracts in both states are below their earlier peaks. The other New England states were below the national per capita average during the FY 1987 to 1989 period, and together accounted for only 11 percent of the region's total awards. As shown in column 2 of Table 1, prime contract awards for RDT&E accounted for about 16 percent of the total. Most of these went to Massachusetts, which had a per capita figure over four times the national average. Partly as a result of this high share of research, prime contract awards to Massachusetts grew very rapidly through the mid 1980s (Chart 4).

Prime contract awards are a somewhat imperfect measure of private sector production for the Defense Department. First, these data indicate when awards are made, but spending occurs with a lag. A more serious limitation is that, at best, prime contracts indicate the location of only the final stages of production, not work performed by subcontractors and other vendors. Producers of aircraft engines in Connecticut, for example, may purchase metals from other parts of the country. Computer services companies in Massachusetts may do work for defense contractors in other regions. The further down the chain of production, the more difficult it is to identify goods and services as defense-oriented, since they tend to resemble goods and services produced for other applications. Also, in some cases prime contract awards are listed by a company's primary facility rather than taking into account other locations for production work. An important example in New England is the exclusive allocation of General Dynamics/Electric Boat contracts to Groton, Connecticut, although additional work is performed at Quonset Point, Rhode Island. As a result of these measurement problems, no definitive data are to be found on shares of total state or regional private-sector output related to defense.

A simulation model developed at the Department of Defense estimates, however, that New England receives almost as large a share of total defense work as it does of prime contracts. In 1989, 9.9 percent of goods and services purchased directly by the Defense Department came from New England (column 4 of Table 1). The model assumes that these prime contractors purchase required services locally, but that they spread their purchases of goods across all states in proportion to where the goods are produced. Adding in these assumed indirect purchases, 9.1 percent of the nation's defense production came from New England (column 5).[3]

By contrast with procurement from the private sector, Defense Department spending on personnel in New England has been relatively small (column 3 of Table 1). Personnel spending relative to gross state product was substantially above the 1989 national average of 1.8 percent only in Maine (2.8 percent). In Connecticut, Massachusetts, and Vermont, military payrolls were less than 1 percent of gross state product.

Even after taking into account the region's low share of military payroll, a higher than average percentage of total goods and services produced in the New England states is related to defense. The De-

fense Department model estimates that this share in 1989 was 6.2 percent for New England, compared to 4.7 percent for the nation (column 6). In Connecticut, the estimated share was 7.5 percent and in Massachusetts, it was 6.0 percent.

Finally, for the nation as a whole, value added by defense formed 5.9 percent of GNP in 1989. If the national relationship between value added and defense production applies to the region, then the Defense Department model suggests that defense

Table 1
Defense Indicators for New England and the Nation

	Prime Contract Awards per Capita, FY 1987–89 Average		Payroll as a Percent of Gross State Product, 1989[a]	Share of National Defense Purchases Excluding Pay, Estimate for 1989 (Percent)		Percent of Production Related to Defense, Estimate for 1989
	Total (1)	Research (2)	(3)	Direct (4)	Total (5)	(6)
Connecticut	$1651	$ 81	.6	3.5	3.2	7.5
Maine	$ 480	$ 5	2.8	.5	.5	5.8
Massachusetts	$1405	$364	.7	4.8	4.2	6.0
New Hampshire	$ 437	$ 51	1.2	.6	.6	5.2
Rhode Island	$ 446[b]	$ 29[b]	2.1	.3	.4	4.6
Vermont	$ 241	$ 30	.7	.2	.2	4.2
Total New England	$1176	$194	.9	9.9	9.1	6.2
Total United States	$ 514[c]	$ 89[c]	1.8	100.0	100.0	4.7

[a]1989 Gross State Product is estimated by assuming that GSP grew at the same rate as personal income between 1986 and 1989.
[b]Excludes General Dynamics, whose contracts are officially allocated to Connecticut.
[c]Excludes prime contracts not allocated to particular states.
Source: Columns 1 and 2: U.S. Department of Defense, (1990d) and U.S. Bureau of the Census (1989); column 3: U.S. Department of Defense (1990a) and U.S. Bureau of the Census (1989); columns 4,5,6: U.S. Department of Defense, (1989b).

Chart 4

Indexes of Real Prime Contract Awards, Fiscal Years 1958 to 1989

Index 1958=100
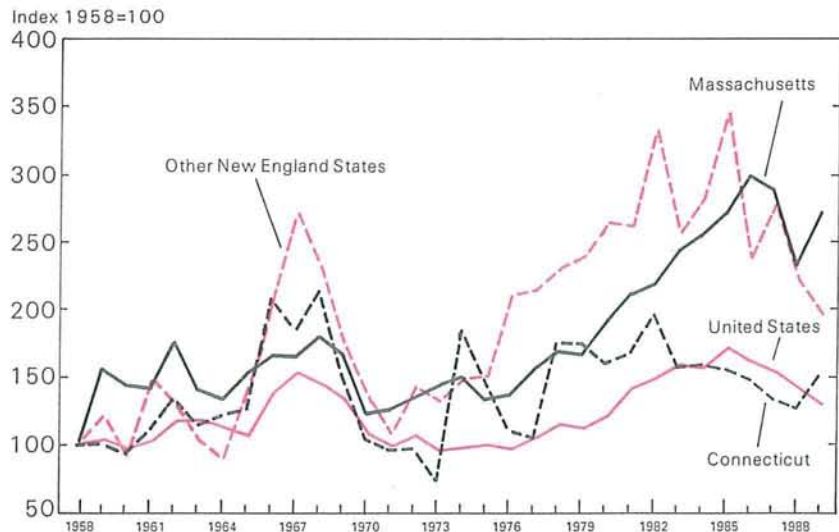
Source: Department of Defense, Directorate for Information, Operations and Reports, *Prime Contract Awards by Region and State*, various issues; and Office of the Comptroller of the Department of Defense, *National Defense Budget Estimates for FY 1991*.

might account for about 8 percent of gross regional product in New England.[4]

These results indicate that New England's concern about the impact of defense cutbacks is quite appropriate, since defense is a larger share of the region's economy than it is of the national economy. On the other hand, the results should allay the fears of anyone who might have guessed that the fate of the defense industry is the dominant factor determining New England's future.

The Composition of Demand

The Defense Department's direct purchases from New England consist mostly of durable manufactured goods. Large corporations dominate these "hard goods" procurement programs. Among the region's major defense contractors, General Dynamics, manufacturer of submarines through its Electric Boat division, has large operations in both Connecticut and Rhode Island. Connecticut is also home to United Technologies, which manufactures aircraft engines at Pratt & Whitney and airframes at Sikorsky Helicopter, as well as to Kaman Aerospace. In Massachusetts, the largest defense industries are missiles (for example, Raytheon, General Electric, Textron Defense Systems, Draper Labs), aircraft engines (General Electric), and electronics and communications equipment (GTE and Raytheon). Raytheon also has defense-related electronics operations in Rhode Island. Because of MIT and the Mitre Corporation, Massachusetts is first in the nation for defense research dollars awarded to the nonprofit sector. Shipbuilding, represented by Bath Iron Works, is the predominant defense industry in Maine. Electronics and communication equipment account for the bulk of the prime contracts in New Hampshire (for example, Lockheed Sanders). Guns are the largest defense industry for Vermont (manufactured mostly at General Electric).

Many smaller companies in the region also receive defense contracts, especially for construction and other services. (Appendix Table 1 provides a detailed list of New England facilities receiving prime contract awards in FY 1987; this was the most recent disaggregated information available.) Looking also at indirect effects (that is, suppliers to prime contractors), business services, including repairs and maintenance of equipment and computer software development, are a significant component of defense purchases.

III. Defense Expenditure Cuts in New England

This section provides projections of prime contract awards to New England through the mid-1990s assuming enactment, in turn, of the President's budget and 4 percent annual cutbacks. These projections should be viewed as illustrative because they assume a continuation of past geographic patterns. For example, it is assumed that 15 percent of missiles procurement contracts will be awarded to New England companies, as in recent years. Alternatively, the Defense Department could choose to de-emphasize or cancel particular weapons systems that disproportionately affect certain regions of the country. Indeed, the larger the cutbacks in national defense, the more likely it is that entire systems would be eliminated. Also, because of changes in costs or technologies, New England suppliers may gain or lose market share relative to competitors elsewhere in the country.

With these caveats in mind, the results through 1995 indicate that the New England region as a whole will experience percentage cutbacks in prime contracts of about the same magnitude as the nation, using the FY 1987–89 average as the base. Cutbacks in Connecticut are projected to be more severe, while those for Massachusetts are projected to be milder. Given the heavy orientation toward defense in these states, these percentage reductions would amount to significant dollar losses.

The Effects of Defense Cutbacks on Prime Contracts

The projections entailed three major steps (see the Appendix for further details). First, budget authority assumptions were developed through FY 1995. The President's budget contains breakdowns for four major categories: operations and maintenance; procurement; research, development, testing, and evaluation; and military construction. For the 4 percent cutbacks plan, the assumptions for these categories are consistent with a policy of emphasizing readiness and deferring investment. Within procurement, assumptions were developed for six subtotals: aircraft, missiles, ships, weapons and tracked vehicles, ammunition, and other. These percentage allocations are the same for both scenarios, and are based on extrapolations of information found in the President's budget through FY 1991. The second step was to use these budget authority figures to project national prime contract awards, based on regression

Table 2
Department of Defense Prime Contract Awards, Actual FY 1987–89 and Projections for FY 1995
Millions of Dollars

	FY 1987–89 Average[a]	FY 1995		FY 1995 (FY 1989 Dollars)[b]		Compound Annual Real Rate of Change, FY 1987–89 Average to FY 1995[b]		Memo: Percent Change, FY 1988 to FY 1989[a]
		President's Proposal	4 Percent Cutbacks Plan	President's Proposal	4 Percent Cutbacks Plan	President's Proposal	4 Percent Cutbacks Plan	
Hard Goods, Excluding RDT&E								
Aircraft	23,740	23,710	16,964	18,739	13,410	−4.5	−9.7	4.6
Missiles	13,890	14,892	9,159	11,770	7,240	−3.3	−10.9	2.2
Ships	11,620	10,374	8,066	8,199	6,376	−6.3	−10.1	−32.3
Weapons and Tracked Vehicles	5,380	5,084	4,047	4,018	3,199	−5.4	−9.0	−18.7
Ammunition	3,673	2,077	1,242	1,641	982	−13.2	−20.3	−12.2
Electronics	16,651	18,201	13,937	14,384	11,017	−3.1	−7.3	7.0
Total Hard Goods	74,954	74,338	53,415	58,750	42,225	−4.6	−9.7	−4.8
Construction	7,971	7,706	5,356	6,090	4,234	−5.0	−10.6	−7.4
Services and Other Non-RDT&E	21,535	25,792	21,234	20,384	16,786	−1.5	−4.7	−6.6
Research, Development, Testing, and Evaluation	21,856	23,486	17,798	18,561	14,070	−3.3	−7.7	−1.1
Total[c]	126,315	131,322	97,803	103,786	77,315	−3.8	−8.5	−4.7

[a]Not adjusted for inflation.
[b]Assuming an annual inflation rate of 4 percent from FY 1990 to FY 1995.
[c]Excludes prime contract awards not allocated to particular states.
Source: U.S. Department of Defense (1990d) and author's estimates (see the Appendix).

analysis for the 1980s. For example, aircraft prime contract awards (excluding research) were projected from the assumed budget authority for aircraft procurement. Finally, these national prime contracts were allocated to states according to their shares in the most recent three fiscal years.

Table 2 presents estimates of national prime contract awards by category, and Table 3 indicates the associated projections for New England. Under the President's proposal, total prime contract awards would increase at only a 0.6 percent rate through FY 1995. (In this section, rates of change are calculated using the average of FY 1987 to FY 1989 as the base period. Averaging reduces somewhat the problems associated with interpreting volatile historical data.) Contracts for aircraft and ammunition would decline. Contracts for ships and for weapons and tracked vehicles are also shown to decline, but these reductions are largely already complete, as a result of sharp cutbacks in FY 1989. Assuming an annual inflation rate of 4 percent, total prime contracts in constant dollars would decrease at a rate of 3.8 percent. No category would show a real increase, although reductions in services, electronics, RDT&E, and missiles would be relatively small compared to the other categories. The sharper cutbacks scenario would translate into a real rate of decline of 8.5 percent for total prime contracts, with even larger cuts for procurement of hard goods and construction. This budget would require allocating a greater share of the remaining resources to maintaining existing equipment, so contracts for services would decrease considerably less than average.

In New England, total prime contracts in constant dollars would decrease at an annual rate of 4.0 percent under the President's proposal. Under the alternative case, they would fall at a rate of 8.7 percent. These rates of reduction are similar to national averages. Thus, the projections assume that the unusually strong performances of Connecticut,

Table 3
New England Prime Contract Awards, Actual FY 1987–89 and Projections for FY 1995
Millions of Dollars

	FY 1987–89 Average[a]	FY 1995		FY 1995 (FY 1989 Dollars)[b]		Compound Annual Real Rate of Change, FY 1987–89 Average to FY 1995[b]		Memo: Percent Change, FY 1988 to FY 1989[a]
		President's Proposal	4 Percent Cutbacks Plan	President's Proposal	4 Percent Cutbacks Plan	President's Proposal	4 Percent Cutbacks Plan	
Connecticut	5,341	5,202	3,878	4,111	3,064	−4.8	−9.4	23.8
Maine	573	531	411	420	325	−5.8	−9.7	−28.6
Massachusetts	8,218	8,738	6,392	6,906	5,052	−3.5	−8.4	21.4
New Hampshire	476	510	383	403	303	−3.3	−7.8	−0.6
Rhode Island	441	468	367	370	290	−3.5	−7.4	−2.7
Vermont	133	131	99	103	78	−4.7	−9.0	34.2
New England	15,182	15,580	11,530	12,313	9,112	−4.0	−8.7	19.0

[a]Not adjusted for inflation.
[b]Assuming an annual inflation rate of 4 percent from FY 1990 to FY 1995.
Source: U.S. Department of Defense, (1990d) and author's estimates (see the Appendix).

Massachusetts, and Vermont in FY 1989 were temporary aberrations. Contracts to these states are not expected to continue to rise sharply in the context of weakening defense orders nationwide.

Over the FY 1987–89 average to 1995 period, Connecticut is expected to fare substantially worse than the nation in percentage terms because of its reliance on aircraft and submarine contracts, while the decline in Massachusetts would be somewhat tempered by the comparatively gradual reductions expected for missiles, electronics, and research contracts. Given the high concentration of defense-related activity in these states, both these percentage changes would cause relatively large reductions in production. Maine is projected to suffer as a result of its reliance on shipbuilding, but much of this decline already took place in sharp cutbacks at Bath Iron Works since FY 1987. Vermont would be hard hit in percentage terms because of its high share of weapons production among prime contracts. This cutback would not have a large impact on the statewide economy, but might be a significant factor in the Burlington area, where the General Electric plant is located. New Hampshire and Rhode Island would also feel the effects of cutbacks in prime contracts, but less intensely because of their concentration in electronics. The results for Rhode Island should be interpreted with extreme caution because they implicitly omit activities of General Dynamics/Electric Boat. More generally, as noted

above, prime contracts do not take into account the activity performed by subcontractors and other vendors. This may cause distortions in the results, especially for the smaller states.

The outcomes for particular contracts to particular companies potentially could cause a very large difference in the actual results. Contracts to most of the New England states are very highly concentrated in a few companies. For example, in FY 1989, the five largest recipient firms in Connecticut (United Technologies, General Dynamics, Textron, Kaman, and Analysis & Technology) received about 90 percent of prime contract awards. In Vermont, three-quarters of the total went to General Electric alone. The projections for Massachusetts may be subject to a smaller margin of error, because contracts are spread out over a relatively larger number of companies than is the case in the other New England states. But even in Massachusetts, higher contracts awarded to GTE more than accounted for the entire increase in FY 1989.

Comparisons with the Post-Vietnam Era

Cutbacks in procurement after the Vietnam War had a very large impact on New England (Chart 4 and Table 4). In a five-year period, inflation-adjusted contracts to the region fell by half, a much greater drop than for the nation. Reduced orders for aircraft

caused especially large disruptions in Connecticut. Although Massachusetts did not experience as large a decline overall, the state suffered a 31 percent drop in prime contracts over an interval of just two years (FY 1968 to FY 1970). The current retrenchment will be much milder, for two reasons. First, the mix of production is much more favorable than in the earlier period. Relatively high concentration in areas such as electronics and research should prevent New England from experiencing percentage cutbacks in prime contracts that are more severe than the national average. Second, the reductions in the defense budget are now much more gradual, having started in the mid 1980s. So, for example, although *total* percentage cutbacks in New England under the 4 percent cutbacks plan might be comparable to those of the post Vietnam era, the *annual rate* of cutback would be only half as large. This fact allows defense contractors more time to consider pursuing alternative lines of business. It also means that laid-off workers have greater chances of being absorbed elsewhere in the economy.

The Effects of Cutbacks in Military Personnel

Prospective budgets also make reductions in military personnel. Assuming a 4 percent inflation rate, President Bush's proposal would cause an annualized real cutback of 2.8 percent. The assumptions under the alternative plan entail devoting a larger share of the defense budget to personnel. Nonetheless, it would result in a 5.9 percent rate of real cutback, which would exceed the 4.3 percent rate of reduction during the de-escalation of the Vietnam War (FY 1968 to FY 1974). In both cases, these decreases are still less than for contracts to private industry. Also, because of the relative dearth of young workers compared to the situation in the early 1970s, the U.S. economy now has less difficulty absorbing cutbacks in military personnel.

As noted above, of the New England states, only Maine and Rhode Island have above-average concentrations of defense personnel, and therefore would appear to be the most vulnerable to cutbacks in terms of potential economic damage. However, reductions in this category of the budget would probably involve closing particular military bases rather than making widespread cuts. Pease Air Force Base in New Hampshire is already slated to be closed, for example. Specific plans for shutting additional military bases are subject to Congressional approval, and have not been finalized. In an effort to save domestic jobs,

Congress could possibly vote, for example, to close more bases abroad. For this reason, it is impossible to have confidence in any projection of the geographic allocation of personnel cutbacks.[5]

Total Effects and Macroeconomic Feedbacks

This section discusses aggregate economic impacts of defense cutbacks in New England. For the nation as a whole, the President would cut roughly $50 billion (FY 1989 dollars) from the defense budget by FY 1995. The sharper cutbacks proposal has over twice this reduction. As the section on defense intensity indicated, it is difficult to derive regional measures of total private defense-related activity solely from information on prime contract awards. Nevertheless, for policymaking purposes, a "ballpark" estimate is probably useful. A rough estimate of total impacts for New England might assign 2.5 percent of the military personnel cuts and 10 percent of the remaining cuts to the region. (This takes into account the data in Table 1, the estimates in Tables 2 and 3, and information on New England gross regional product relative to GNP.) These assumptions produce a total impact in New England of about $4.1 billion (FY 1989 dollars) from the President's budget and $9.6 billion (FY 1989 dollars) from the alternative

Table 4

Changes in Real Prime Contract Awards after the Vietnam War and Current Projections
Percent

	Post Vietnam: FY 1968 to FY 1973[a]	Current Projections FY 1985 to FY 1995[b]	
		President's Proposal	4 Percent Cutbacks Plan
Connecticut	−65	−35	−51
Massachusetts	−20[c]	−21	−42
Total New England	−47	−30	−48
United States	−34	−35	−51

[a]Actual peaks were: FY 1967 for the United States and FY 1968 for Connecticut, Massachusetts, and total New England. Actual troughs were: FY 1970 for Massachusetts and FY 1973 for Connecticut, total New England, and the United States.
[b]Actual peaks were: FY 1982 for Connecticut, FY 1985 for total New England and the United States, and FY 1986 for Massachusetts.
[c]Reduction between FY 1968 and the actual trough in FY 1970 was 31 percent.
Source: U.S. Department of Defense (1990b); U.S. Department of Defense (1990c); and author's estimates described in the Appendix.

budget. Relative to gross regional product in New England, these impacts are fairly moderate. (In 1986, the latest year available, gross regional product was $246 billion.)

Related industries would also be affected. For example, lower expenditures by defense employees would affect sales of consumer items. Macroeconometric models compute such multiplier effects to be between one and one-half and two times the direct impacts (U.S. Congressional Budget Office 1983). Even so, while the aggregate economic effects would be noticeable, they would not be out of line with the magnitude of shocks that the New England economy has felt with the usual ups and downs of business cycles. The timing of the cuts is particularly unfortunate, however, given the generally weaker economic growth that the region is experiencing compared to its performance in the 1980s.

According to mainstream macroeconomic theory (for example, Dornbusch and Fischer 1984), output does not remain permanently depressed when one component of aggregate demand is reduced. After a time, weaker demand, such as that generated by a reduction in defense spending, tends to lower prices. The near-term impact is a decline in output and employment, but eventually wage demands also fall in response to weak labor market conditions. The lower real cost of labor causes firms to hire more workers and expand production. Eventually (perhaps after three to seven years) national production is no lower than it would have been without the reduction in government spending.[6]

In the longer run, a decline in defense activity may even lead to higher national output if it is replaced by more productive activity. For example, it is widely felt that research and development in defense industries leads to some positive technological benefits for the economy at large, but that these spillovers are not as great as from other forms of industrial research. On the other hand, cutting defense expenditures does not guarantee productivity gains because many nondefense activities (whatever their other merits) could not be characterized as high technology. So the actual productivity gains depend very much on the new economic activity that replaces defense spending.[7]

Particular regions of the country might still suffer reductions in output for longer periods than the nation, depending on migration patterns caused by the initial downturn and the composition of new economic activity. For example, if new business opportunities were to develop faster in the rest of the country than in New England, professionals such as engineers and scientists might leave the region. Such a "brain drain" would hinder future expansion of technology-oriented businesses in the region. New business patterns depend partly on the federal government's allocation of the "peace dividend." Most alternatives would be significantly less targeted toward New England than defense spending has been. Nevertheless, some exceptions exist to this general rule. For example, for every dollar of defense-related research and development diverted to government-sponsored nondefense research and development, New England would expect to receive back about 60 cents. However, the region would probably recoup funds dollar for dollar if the additional resources were targeted toward health, transportation, or university-based research as opposed to agriculture or energy.[8]

IV. Consequences for Defense Contractors

The region's defense contractors vary widely in their reliance on defense. Table 5 provides information on the ratio of defense contracts as a percent of revenues for some of the largest recipient companies in New England. At one extreme, Bath Iron Works, General Dynamics, and Lockheed Sanders receive over three-quarters of their New England business from the Defense Department. Despite a long-term program of diversification, over half of Raytheon's business is still in defense. The shares for Colt Industries and United Technologies may seem surprisingly low, given their perceived association with defense work; both companies have diversified considerably into other lines of business. Some large computer companies including Digital and Wang receive business from the Defense Department, but these contracts amount to well under 10 percent of their overall revenues.

Some observers advocate widespread conversion of defense-related industrial facilities to nondefense applications (see, for example, the volume edited by Gordon and McFadden 1984). There are many cases of successful conversion of former military bases, involving joint planning by government and private industry, to uses such as industrial parks and commercial airports (see U.S. Department of Defense 1985). But most people would agree that our market-oriented economic system is not well suited to a similar process for adjustments for private industrial plants. In most cases, government cannot contribute

detailed knowledge about new products that businesses would need in a diversification effort. Business can obtain this information more effectively by developing it in-house, acquiring other companies, or purchasing consulting services.

Nevertheless, governments could provide other types of information. Advance notification of specific budget cuts by the Pentagon would help companies plan adjustment strategies. Also, both state and federal governments might serve as clearinghouses of information for contractors seeking new markets overseas or with other government agencies. For example, governments could identify how political and economic developments in other countries might increase demand for various goods and services produced in the United States, and they could explain the legal and other requirements for exporting. The expected cutbacks in defense should spur governments to survey the adequacy of their current informational services to business. Efforts in this area might be particularly helpful for the smaller companies involved in defense contracting. The actual

choice of an adjustment strategy, however, should be left to the companies themselves.

Companies' responses to defense cutbacks are likely to vary from industry to industry. In the aircraft industry, companies already tend to produce for both defense and commercial markets. The need to modernize commercial airplanes as well as increased orders from abroad may provide some manufacturers with enough business to take up the slack left by defense. In shipbuilding and weapons production, other markets are very limited, so defense cutbacks will probably lead to decreased production at most facilities, and perhaps even some plant closings. In general, defense contractors that have produced a diversified mix of products in the past will benefit from the experience of marketing to customers outside of the defense area. They are likely to choose among a variety of options, including conversion, production cutbacks, and acquisitions of nondefense lines of business.

No matter how defense contractors adjust their production, it is likely that the new configuration will require a somewhat different mix of labor market skills. When defense-oriented companies have acquired nondefense businesses in the past, they still tended to lay off at least part of the work force in declining lines of business.[9] What amounts to a very successful adjustment by a company may look very different from the standpoint of its employees and the surrounding community. Income support for unemployed workers and assistance for finding new jobs are the topic for the next section. Community impacts are likely to be most severe in the case of a specialized defense plant operating in an area with little other industrialized activity. In these situations, the joint public-private planning process used in adjusting to base closings could be quite valuable.

Table 5
Defense as a Percent of New England Revenues for Selected Contractors

At least 75 percent	Bath Iron Works, General Dynamics, Lockheed Sanders
50 to 74 percent	Bolt Beranek & Newman,[a] Raytheon[b]
25 to 49 percent	Textron
10 to 24 percent	General Electric,[b] Kaman Corporation, United Technologies[b]
Less than 10 percent	Colt Industries,[b] Digital Equipment,[b] GTE,[c] RCA,[d] Wang Laboratories[d]

Note: Estimate provided by the company unless otherwise noted.
[a]Excluding subcontracts, Bolt Beranek & Newman would fall into the 25 to 49 percent category.
[b]Classification based on nationwide prime contract awards during U. S. government fiscal year 1988 relative to company's sales or revenues reported in Standard & Poor's (1989).
[c]Estimate provided by the company includes operations outside New England. Estimate for New England operations alone is not available, but would probably be considerably higher because the company estimates that over half its defense-related operations are headquartered in New England.
[d]Classification based on average of prime contract awards in New England during U.S. government fiscal years 1985, 1986, and 1987 relative to company's sales or revenues reported in Standard & Poor's (1989).
Source: U.S. Department of Defense, [1988]; Standard & Poor's (1989); and company representatives.

V. Consequences for Employment

Estimates of job losses associated with defense cutbacks vary widely. (For example, see Adams and Gold 1987 and The Massachusetts Jobs with Peace Campaign 1986). A compromise estimate might be 14,000 jobs at defense contractors and their suppliers per billion-dollar cutback. (See U.S. Congressional Budget Office 1983. This estimate does not include multiplier effects.) Thus, if defense spending is cut by $4.1 billion in New England under the President's budget, about 57,000 jobs would be lost in defense sectors by 1995. This is about 0.9 percent of the

current nonagricultural work force in the region. Using the assumption of a sharper cutback in defense yields a loss equal to about 134,000 jobs in the region, or about 2.0 percent of current employment.

Despite their differences, all analyses of job market effects agree that cutbacks (increases) in defense spending generate fewer job losses (gains) than most other forms of either public or private spending.[10] The lower jobs-per-dollar ratio is largely the result of defense-related industries paying higher wages. For example, a study of seven heavily defense-oriented industries in Massachusetts indicated that average annual wages in 1987 were 26 percent higher than in other manufacturing industries and 57 percent higher than in nonmanufacturing industries (Massachusetts Department of Employment and Training 1989a). By contrast with defense spending, when government or consumers cut their demand for production in sectors with lower wages or with a higher labor-to-capital ratio, more jobs are lost per dollar of spending reduction. In other words, defense cutbacks affect fewer jobs, but these are "better" jobs.

Defense workers are paid more than other workers because on average they are more highly educated and more skilled, and because, judging by their age distribution, they have more work experience. In the 1987 sample from Massachusetts, 33 percent of the defense workers were in the highly paid professional and technical category, including 15 percent engineers and 7 percent engineering and science technicians. In other manufacturing industries, only 14 percent of the workers were classified as professional or technical, and in nonmanufacturing, only 24 percent.[11]

Existing Programs to Assist Unemployed Workers

The distinctive characteristics of defense workers suggest that they may have different access to assistance when they become unemployed, and also that they have different needs from other workers. The evidence indicates that displaced defense workers on average have more access to income support programs than many other unemployed workers. However, unemployment benefits and job placement assistance vary widely from state to state, and from company to company. The prospect of layoffs in defense industries should prompt governments and companies to reexamine the adequacy of their programs in light of workers' needs and the programs available in other states.

The primary U.S. income support program is unemployment insurance.[12] Only about 30 percent of unemployed persons receive benefits, however, since new entrants into the labor force and people who leave their jobs voluntarily are not covered. But in the case of laid-off defense workers, almost all will be eligible. In New England, the maximum weekly unemployment benefit in 1989 ranged from $162 in New Hampshire to $382 in Massachusetts. Observed average weekly benefits were much more generous in Connecticut, Massachusetts, and Rhode Island than in the northern New England states (Table 6).

In the case of large plant closings (as opposed to layoffs of selected employees), federal law requires companies to give employees sixty days advance notice, enabling them to start looking for other jobs. State plant closing statutes provide additional benefits in some cases. Employers in Connecticut and Massachusetts must provide continued health benefits, while those in Maine must provide severance pay (Table 6). The remaining New England states have no plant closing statutes.

Table 6
State Programs to Assist Displaced Workers in New England

State	Unemployment Insurance		Plant Closing Law
	Maximum Weekly Benefit[a]	Average Weekly Benefit	
Connecticut	$284	$192	120 days' group health insurance[b]
Maine	$270	$148	Severance pay of one week for each year of service to employees who have been at the firm for three or more years.[b]
Massachusetts	$382	$211	90 days' group health insurance.
New Hampshire	$162	$124	—
Rhode Island	$300	$183	—
Vermont	$178	$137	—

[a]A maximum of 18 additional weeks of benefits is available to workers in state training programs beyond the maximum of 26 weeks (30 in Massachusetts).
[b]Covers businesses with at least 100 employees.
Source: U.S. Congressional Budget Office (1990a), state statutes, and conversations with state officials.

If previous data on layoffs of skilled workers are a useful guide, displaced defense workers are likely to require assistance in finding new positions. Historically, a substantial portion of experienced workers have remained without a job for long periods of time following layoffs. For example, of prime-age men (twenty-six to fifty-five years old) who lost their job over a year prior to being surveyed in January 1984, only 75 percent were working, 19 percent were unemployed, and 6 percent had dropped out of the labor force. The nonemployed proportions were even higher among older men and among women (Osterman 1988).

Defense companies can help to minimize the unemployment spells of their employees. For example, GTE laid off 2,000 workers in California over a two-year period in the early 1980s. By identifying openings at other company locations and with other area employers and by holding on-site job fairs and workshops on job search techniques, the GTE plant closed with 85 percent of its workers having found employment elsewhere (U.S. Department of Defense 1985).[13] This example demonstrates the possibility of advance planning to minimize unemployment spells, but does not control for general labor market conditions. However, an econometric study of layoffs in three aerospace companies (Boeing, Martin, and Republic) in the mid 1960s confirmed these results. After controlling for the general strength in the local labor market, it found that definite information regarding the chances of recall and organized information about other job possibilities significantly lowered the economic loss from unemployment (Fishman et al. 1968).

Some states provide reemployment assistance apart from funding company-specific programs. For example, the new Employment Express program in Massachusetts offers help to unemployed workers in targeting their job searches toward industries with growing demands for their skills.[14]

The federal government provides some reemployment support through Title III of the Job Training Partnership Act (JTPA) of 1982. (The President's budget for FY 1991 includes $400 million for this program.) Under JTPA, local councils composed of both private and public sector representatives devise programs aimed at persons who have been displaced from their jobs or are about to be laid off.[15] At least in the past, most of the New England experience has been with relatively low-skilled workers. For example, in Maine, workers laid off from the shoe industry have been one target group, and in Massachusetts,

programs provided basic job skills to young people needed to fill jobs in the booming economy of the 1980s. But JTPA could also address the needs of defense workers because the program's design is very flexible. So far, the federal government does not appear to be considering increased funding for the program to address declining defense-related jobs.

Further Assistance for Defense Workers?

The prospect of layoffs in the defense industry has prompted a debate on special income maintenance and job search assistance for the workers affected. Advocates of targeted programs point out that society as a whole would benefit from the resources freed up as a result of reduced East-West tensions, and should therefore share this windfall to reduce the disproportionate costs borne by defense workers. These advocates also feel that the federal government encouraged these workers to develop specialties that are of limited use in nondefense sectors of the economy, and therefore has a particular obligation to assist them.

Opponents of specialized assistance present several counterarguments. First, if labor markets work efficiently, employees in industries with a high risk of demand reduction such as defense receive a risk premium in their salaries and therefore do not deserve further compensation when they become unemployed. Special treatment also may violate horizontal equity, if laid-off defense workers receive benefits in excess of those received by workers unemployed as a result of new federal legislation on, for example, environmental cleanup or product safety. Finally, in a society with competing demands on government resources, it is not obvious that defense workers should be singled out, given that other social needs were neglected during the recent defense buildup. Helping relatively well-to-do defense workers may be particularly unpalatable in the context of previous reductions in assistance to low-income persons, including welfare, housing grants, and health care.

The decision on whether to provide special assistance should also take into account the practical lessons from federal trade adjustment assistance. This program has been available since 1962 for workers in industries, geographic areas, or firms affected by import competition. For many years, the program emphasized income support, but more recently it has shifted more toward training and job search assistance. A major administrative difficulty of trade adjustment assistance has been certification of layoffs as

being trade-related, which has caused significant delays in awarding benefits. According to the review of this program by the Defense Department (1985), workers affected in the initial round of layoffs at their plant waited 488 days on average to receive an assistance check. Over half of all workers in the program were back at work before receiving aid. A separate adjustment program for defense workers would encounter this same problem because defense contractors also do nondefense work, and because workers in related industries would lose jobs as an indirect consequence of defense cutbacks. The need to certify eligibility for the program might severely reduce its effectiveness.

By contrast with specialized assistance, many company- and JTPA-funded programs have been implemented very quickly, and therefore appear to be more promising and less controversial vehicles for helping displaced defense workers.[16] Impending layoffs by defense contractors may justify spending part of the "peace dividend" to increase funding for Title III of JTPA.

Furthermore, because new job opportunities depend on patterns of growth, governments might usefully take into account the job skills of former defense workers when designing their industrial policies. For example, the federal government might increase its sponsorship of nondefense research and development or expand its tax incentives for private R&D. The general slowdown of economic activity in New England will make it harder for displaced defense workers to find jobs locally. But state government officials should emphasize the quality of this labor pool when trying to attract new manufacturing and high technology businesses.

VI. Summary and Conclusions

The shrinking of the national defense budget will continue to create a drag on the New England economy in coming years. For the nation, defense spending is currently just under 6 percent of GNP, and is expected to fall to between 3 percent and 4 percent of GNP by the mid 1990s. In New England, the current defense share of the economy is higher, perhaps about 8 percent, and is expected to fall by a somewhat greater proportion than in the nation because of the high share of expenditures on military procurement rather than personnel and other operating costs. Also, it is likely that the surge in prime contracts to New England in FY 1989 will be reversed in coming

years. Under the scenarios examined, prime contracts to New England companies are projected to fall at real rates of between 4 percent and 9 percent annually between FY 1987–89 and the mid 1990s. Because Connecticut and Massachusetts typically receive about 90 percent of the region's prime contracts, most of the cutbacks will occur in these two states. By the mid 1990s, reductions in defense sector employment could total between 1 percent and 2 percent of the New England work force. For state economies, these projected slowdowns in defense-related activities are far from devastating, but they will feel burdensome in the context of simultaneous weakness in the real estate, financial services, and computer industries.

For individual companies, the damage imposed by defense cutbacks will vary widely, depending on how large a fraction of their business is related to defense, which specific defense systems are canceled, and other business prospects. Companies in the aircraft industry are expected to receive disproportionate defense-related cuts, but will probably successfully expand their nondefense work. Military orders for ships and submarines have already fallen considerably, and will result in lower production for contractors because they face limited alternative markets. Electronics companies will probably receive moderate-sized cutbacks in defense, and are often quite diversified already in their lines of business. Direct conversion of defense plants to nondefense work would not be desirable as a general policy. For many contractors, it may make more sense to scale down their level of operations at defense facilities. New production opportunities may have to come in other locations and other companies.

Displaced defense workers are a valuable resource. They have above-average skills and experience, and could make a significant contribution toward raising the productivity of our economy if they find good nondefense jobs. Evidence indicates, however, that mature workers find it difficult to find new employment following layoffs. This article suggests that companies and government can significantly minimize the costs of unemployment by helping to match displaced workers with job opportunities. Such a policy would be more equitable and effective if applied to all workers, and not just those directly affected by defense cutbacks. Finally, the availability of former defense workers is an advantage to businesses starting or expanding manufacturing and to high technology operations. To the extent possible, governments should encourage this type of business activity to assure future growth and job opportunities in the New England economy.

Appendix

Defense Contractors in New England

Appendix Table 1 lists New England facilities receiving at least $5 million in prime contracts from the Defense Department in FY 1987. These were the most recent data we were able to obtain on such a disaggregated basis. For each facility, the table also indicates the total value of awards between FY 1985 and FY 1987 and the major categories of goods and services purchased by the Defense Department. (It is possible that the table omits some relatively large defense contractors, if they happened to receive less than $5 million in orders during FY 1987.) All contracts awarded to General Dynamics are reported under Connecticut, despite the company's additional facilities at Quonset Point, Rhode Island. Submarine contracts to United Nuclear are not included in Appendix Table 1 because they are issued by the Department of Energy rather than the Defense Department. Additional details on defense-related activity in Connecticut may be found in Bean et al. (1986).

Methodology for Projecting Prime Contracts

The projections for prime contracts were based on the President's recently requested budget authority through FY 1995, and corresponding assumptions for a plan that would reduce spending by 4 percent a year starting in FY 1991. The relevant categories of budget authority were: operations and maintenance; procurement; research, development, testing and evaluation (RDT&E); and military construction (Appendix Table 2). The allocations in the latter plan were based on the flat defense spending plan in Kaufmann and Korb (1989). Within procurement, assumptions for six components (aircraft, missiles, ships, weapons and tracked vehicles, ammunition, and other) for each spending plan were developed from the President's detailed budget requests.

Since we had detailed plans on the composition of procurement budget authority only through FY 1991, we assumed that the composition of procurement would re-

main fixed thereafter at the estimated average for 1990 and 1991. Thus aircraft would continue to be 33.7 percent of procurement budget authority, missiles 18.8 percent, ships 13.8 percent, weapons and tracked vehicles 12.1 percent, ammunition 2.9 percent, and other 18.9 percent.

In order to develop a formula to translate budget authority into prime contracts, we estimated separate regressions of national prime contract awards on each non-personnel component of defense budget authority using 1980 to 1989 data. In addition to the six hard goods categories ("other" budget authority was allocated to electronics), we estimated regressions for total RDT&E, operations and maintenance, and construction. Thus we developed a formula for translating aircraft budget authority into non-RDT&E aircraft prime contract awards, missile budget authority into non-RDT&E missile prime contract awards, and so forth. Appendix Table 3 shows these estimates. In addition, a separate projection of prime contracts for petroleum was developed using assumptions for oil prices. Finally, the national forecasts make a partial adjustment for the estimation error in FY 1989.

To allocate the prime contract dollars among the New England states, we took the average prime contract awards for each state from 1987, 1988, and 1989. It was necessary to subtract out RDT&E because RDT&E is presented separately from procurement in the national budget. We subtracted out the RDT&E part of state prime contracts by first assuming that the state RDT&E percentage for each category (that is, the percentage of aircraft prime contracts dollars spent on RDT&E, the percentage of missile prime contract dollars spent on RDT&E, and so forth) was the same as the national percentage. We then scaled these components of RDT&E by a state-specific multiplicative factor so that their total matched the known figure for RDT&E for the state.

Finally we multiplied each state's percentage of the national total for each component by our national forecast for that component.

Appendix Table 1

Department of Defense Prime Contractor Plants in New England with Awards Totaling at least $5 Million during Fiscal Year 1987

Company and Location of Plant	Total Awards Fiscal Years 1985-87 (Millions of Dollars)	Principal Programs[a]
Connecticut		
General Dynamics Corporation (Groton)	$ 4,691.9	Ships
United Technologies Corporation (Stratford)	3,479.0	Airframes and spares; other aircraft equipment
United Technologies Corporation (East Hartford)	2,565.1	Aircraft engines and spares
Avco Corporation[b] (Stratford)	1,760.1	Combat vehicles
Norden Systems, Inc. (Norwalk)	360.8	Electronics and communication equipment; missile and space systems
Kaman Aerospace Corporation (Bloomfield)	328.4	Airframes and spares
United Technologies Corporation (Windsor Locks)	318.5	Other aircraft equipment; airframes and spares; ships
Colt Industries, Inc. (Hartford)	175.4	Weapons
Purdy Corporation (Manchester)	67.7	Aircraft engines and spares; airframes and spares
Analysis & Technology, Inc. (North Stonington)	66.6	Services
Colt Industries (West Hartford)	62.1	Aircraft engines and spares
United Technologies Corporation (Southington)	57.3	Aircraft engines and spares
Dataproducts New England (Wallingford)	55.5	Electronics and communication equipment
Electro-Methods, Inc. (South Windsor)	50.4	Aircraft engines and spares
Condec Corporation (Waterbury)	43.5	All other supplies and equipment; non-combat vehicles
Raymond Engineering, Inc. (Middletown)	39.2	Electronics and communication equipment
Analysis & Technology, Inc. (New London)	34.4	Services
United Technologies Corporation (Shelton)	29.6	Airframes and spares
Perkin-Elmer Corporation (Danbury)	27.1	Electronics and communication equipment; weapons
Kaman Corporation (Bloomfield)	21.8	Weapons
The Torrington Company (New Britain)	21.8	All other supplies and equipment; aircraft engines and spares; other aircraft equipment
J.T. Slocomb Company (South Glastonbury)	20.7	Aircraft engines and spares
Howmet Turbine Components, Inc. (Winsted)	19.8	Aircraft engines and spares
Sonalysts, Inc. (Waterford)	19.3	Services
Dynamic Controls Corporation (South Windsor)	19.1	Other aircraft equipment; weapons
Treadwell Corporation (Thomaston)	18.7	Ships
Yale University (New Haven)	18.4	Services
J.S. Nasin Company (Groton)	18.3	Construction
AIW-Alton Iron Works, Inc. (Windsor)	16.8	Other aircraft equipment; airframes and spares; all other supplies and equipment; electronics and communication equipment
The Boeing Company (Stratford)	10.2	Other aircraft equipment
Arnold M. Diamond Company (Stratford)	9.2	Construction
Tech Systems Corporation (Thomaston)	8.7	Ships; electronics and communication equipment
Delta Industries (East Granby)	8.4	Aircraft engines and spares
La Pointe Industries, Inc. (Somers)	7.8	Electronics and communication equipment
Carlin Contractors Company, Inc. (Groton)	6.0	Construction
Total	$14,453.1	
Maine		
Bath Iron Works Corporation (Bath)	$ 1,975.5	Ships
Maremont Corporation (Saco)	101.6	Weapons
Fiber Materials, Inc. (Biddeford)	24.3	Missile and space systems
Total	$ 2,101.4	

Department of Defense Prime Contractor Plants in New England with Awards Totaling at least $5 Million during Fiscal Year 1987

Company and Location of Plant	Total Awards Fiscal Years 1985-87 (Millions of Dollars)	Principal Programs[a]
Massachusetts		
General Electric Company (Lynn)	$3,712.7	Aircraft engines and spares
Raytheon Company (Andover)	3,177.2	Missile and space systems
GTE Government Systems (Needham)	1,636.3	Electronics and communication equipment
General Electric Company (Pittsfield)	1,433.2	Missile and space systems; combat vehicles
Raytheon Company (Lowell)	1,388.3	Missile and space systems
Raytheon Company (Bedford)	1,301.1	Missile and space systems
Massachusetts Institute of Technology (Lexington)	1,018.9	Services
Raytheon Company (Wayland)	977.0	Missile and space systems; electronics and communication equipment
Avco Corporation[b] (Wilmington)	921.0	Missile and space systems
The Mitre Corporation (Bedford)	907.1	Services
Charles Stark Draper Laboratories (Cambridge)	802.7	Missile and space systems
Raytheon Company (Marlborough)	557.2	Electronics and communication equipment
Raytheon Company (Sudbury)	392.5	Missile and space systems
Raytheon Company (West Andover)	307.0	Missile and space systems
RCA Corporation (Burlington)	267.5	Electronics and communication equipment; combat vehicles
GTE Products Corporation (Needham)	246.7	Electronics and communication equipment
Bolt Beranek & Newman, Inc. (Cambridge)	219.0	Services
Chamberlain Manufacturing (New Bedford)	199.1	Ammunition
GTE Products Corporation (Westborough)	182.5	Missile and space systems
Braintree Maritime Corporation (Quincy)	168.1	Ships
Dynamics Research Corporation (Wilmington)	164.3	Services; missile and space systems
Northrop Corporation (Norwood)	162.9	Missile and space systems
Wang Laboratories, Inc. (Lowell)	150.7	Electronics and communication equipment
Raytheon Company (Waltham)	128.1	Electronics and communication equipment; missile and space systems
Massachusetts Institute of Technology (Cambridge)	123.7	Services
General Electric Company (Fitchburg)	105.1	Ships
General Ship Corporation (Boston)	101.3	Ships
Sippican, Inc. (Marion)	99.8	Electronics and communication equipment
General Electric Company (Wilmington)	98.9	Other aircraft equipment; aircraft engines and spares
Honeywell, Inc. (Lexington)	96.2	Photographic supplies and equipment; electronics and communication equipment
The Analytic Sciences Corporation (Reading)	88.9	All other supplies and equipment; services; ships
Varian Associates, Inc. (Beverly)	74.7	Electronics and communication equipment
Avco Corporation[b] (Everett)	71.4	Weapons
Kollmorgen Corporation (Northampton)	70.1	Electronics and communication equipment; weapons
Raytheon Company (Marlborough)	64.7	Electronics and communication equipment
Analytical Systems Engineering (Burlington)	63.1	Services
Computervision Corporation (Bedford)	58.0	Electronics and communication equipment
GTE Products Corporation (Billerica)	55.9	Electronics and communication equipment
Nuclear Metals, Inc. (Concord)	49.0	Ammunition
Itek Corporation (Lexington)	42.2	Electronics and communication equipment
Woods Hole Oceanographic Institute (Woods Hole)	40.2	Services
TRW, Inc. (Boston)	34.9	All other supplies and equipment
Softech, Inc. (Waltham)	34.2	Electronics and communication equipment
Digital Equipment Corporation (Maynard)	32.7	Electronics and communication equipment

Appendix Table 1 continued
Department of Defense Prime Contractor Plants in New England with Awards Totaling at least $5 Million during Fiscal Year 1987

Company and Location of Plant	Total Awards Fiscal Years 1985-87 (Millions of Dollars)	Principal Programs[a]
Arthur D. Little, Inc. (Cambridge)	$ 32.2	Services; missile and space systems
Computer Technology (Burlington)	28.4	Electronics and communication equipment
Spears Associates, Inc. (Norwood)	28.2	Electronics and communication equipment; services; ships
Belcher New England, Inc. (Revere)	25.5	All other supplies and equipment
BBN Communications Corporation (Cambridge)	24.5	Electronics and communication equipment
Raytheon Service Company (Burlington)	26.7	Electronics and communication equipment; services; ships
All others (33 companies)	455.5	
Total	$22,477.2	
New Hampshire		
Sanders Associates, Inc.[c] (Nashua)	$ 869.5	Electronics and communication equipment
Sequa Corporation (Merrimack)	91.3	Missiles and space systems; other aircraft equipment
Digital Equipment Corporation (Salem)	53.5	Electronics and communication equipment
Sanders Associates, Inc.[c] (Hudson)	28.1	Electronics and communication equipment
Simplex Wire & Cable Co. (Portsmouth)	23.3	Electronics and communication equipment
New Hampshire Ball Bearing (Laconia)	17.4	Aircraft engines and spares; airframes and spares
Norden Systems, Inc. (Merrimack)	16.0	Missile and space systems
Granite State Machine Company (Manchester)	13.8	Electronics and communication equipment
MPB Corporation (Lebanon)	13.4	Aircraft engines and spares; all other supplies and equipment
Harvey Construction Company (Portsmouth)	9.2	Construction
Total	$ 1,135.5	
Rhode Island		
Raytheon Company (Portsmouth)	$ 501.6	Electronics and communication equipment
Mine Safety Appls. Company (Esmond)	59.6	Textiles, clothing, and equipage
Blue Cross & Blue Shield (Providence)	41.1	Services
CFS Aircargo, Inc. (Providence)	38.5	Services
Syscon Corporation (Newport)	24.6	Services
Purvis Systems, Inc. (Newport)	17.8	Services
McLaughlin Research Corp. (Middletown)	16.8	Services; electronics and communication equipment
Aquidneck Systems International (Middletown)	16.7	Services; electronics and communication equipment
PCC Technical Industries (Newport)	11.7	Services
Gilbane Building Company (Newport)	8.1	Construction
The Worcester Company, Inc. (North Providence)	7.7	Textiles, clothing, and equipage
A. F. Lusi Construction, Inc. (Newport)	6.9	Construction
Digital Equipment Corporation (Naval Underwater)	6.0	All other supplies and equipment
Louis Berger International (Newport)	5.6	Construction
Total	$ 762.7	
Vermont		
General Electric Company (Burlington)	$ 305.7	Weapons; other aircraft equipment
Simmonds Precision Products (Vergennes)	32.0	Other aircraft equipment; airframes and spares
Joslyn Defense Systems (Shelburne)	6.7	Airframes and spares
Total	$ 344.3	

[a]Totaling at least two-thirds of prime contract awards FY 1985-87.
[b]Merged into Textron in 1985.
[c]Renamed Lockheed Sanders in 1990.
Source: U.S. Department of Defense [1988].

Appendix Table 2

Department of Defense Military Budget Authority, Actual FY 1989 and Proposed FY 1990 and FY 1995

| | Billions of Dollars | | | | Billions of FY 1989 Dollars[a] | | Compound Annual Real Growth Rate FY 1989 to 1995 | | Percent of Total Military Budget Authority | | |
| | | | FY 1995 | | FY 1995 | | | | | FY 1995 | |
	FY 1989	FY 1990	President's Proposal	Nominal Cutbacks	President's Proposal	Nominal Cutbacks	President's Proposal	Nominal Cutbacks	FY 1989	President's Proposal	Nominal Cutbacks
Military Personnel	78.5	78.5	83.9	69.1	66.3	54.6	−2.8	−5.9	27.0	26.9	29.1
Operations and Maintenance	86.2	86.8	95.6	77.6	75.6	61.3	−2.2	−5.5	29.6	30.7	32.7
Procurement	79.4	82.6	81.5	55.8	64.4	44.1	−3.4	−9.3	27.3	26.1	23.5
Research, Development, Testing, and Evaluation	37.5	36.8	40.1	29.0	31.7	22.9	−2.8	−7.9	12.9	12.9	12.2
Military Construction	5.7	5.3	5.9	3.7	4.6	2.9	−3.5	−10.6	2.0	1.9	1.6
Family Housing	3.3	3.2	3.7	2.3	2.9	1.8	−2.1	−9.4	1.1	1.2	1.0
Other	0.2	−1.8	1.1	0.1	0.9	0.1	28.0	−14.3	0.1	0.4	0.0
Total Military Budget Authority	290.8	291.4	311.8	237.6	246.4	187.8	−2.7	−7.0	100.0	100.0	100.0
Addenda											
Other Defense-Related Activities	8.7	10.3	13.9	10.7							
Total National Defense Budget Authority	299.6	301.6	325.7	248.3							
Outlays:											
Total Military Budget	294.9	286.8	304.8	228.1							
Other Defense-Related Activities	8.7	9.6	13.7	10.3							
Total National Defense	303.6	296.3	318.6	238.4							

[a]Assuming an annual inflation rate of 4 percent.
Source: Executive Office of the President of the United States (1990) and author's estimates.

Appendix Table 3

Regression Results for Translating Budget Authority into Prime Contract Awards

Dependent Variable (Prime Contract Awards)[a]	Independent Variable (Budget Authority) Coefficient[b]	Constant	Adjusted R^2	Durbin-Watson Statistic
(1) Aircraft	.78 (.05)	3.17 (1.48)	.96	1.60
(2) Missiles and Space Systems	.88 (.08)	.98 (.96)	.93	1.33
(3) Ships	.65 (.14)	3.01 (1.52)	.71	1.76
(4) Weapons and Tank-automotive	.34 (.14)	2.89 (1.44)	.33	.47
(5) Ammunition	1.37 (.19)	0.08 (.47)	.85	1.75
(6) Electronics and Communication Equipment	.85 (.13)	4.43 (1.58)	.83	2.62
(7) Operations and Maintenance (Excluding Petroleum)	.21 (.03)	1.49 (2.16)	.84	1.51
(8) Research, Development Testing, and Evaluation	.51 (.04)	3.17 (1.09)	.95	1.40
(9) Construction	1.11 (.27)	1.46 (1.29)	.64	1.31

[a]In regressions (1) to (6), as well as (9), the dependent variable is non-RDT&E prime contract awards for the listed category. In regression (7), the dependent variable is the sum of prime contracts for nondurables and services excluding construction and petroleum. Petroleum contracts were forecasted separately using assumptions about oil prices.

[b]In regressions (1) to (6), the independent variables are estimated procurement budget authority for aircraft, missiles, ships, weapons and tracked vehicles, ammunition, and other, respectively. For regressions (7) to (9), the independent variables are budget authority for operations and maintenance, RDT&E, and construction, respectively.

Note: Equations were estimated using annual data for 1980 to 1989. Numbers in parentheses are standard errors.

Source: Executive Office of the President of the United States, (1990a); U.S. Department of Defense (1990d); and U.S. Department of Defense (1990b).

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[1] The example of 4 percent cutbacks in defense outlays corresponds to an extrapolation of the Frank-Boxer proposal reported in Kaplan (1990), but also resembles several more recent Congressional suggestions. The ratios of defense spending to GNP and the total federal spending use the projections of GNP and spending from the President's budget.

[2] The ratio of defense spending to GNP fell by over 35 percentage points between 1945 and 1948, about 7 percentage points between 1953 and 1965, and about 5 percentage points between 1968 and 1978 (Chart 1).

[3] For FY 1979, the Defense Department compiled information on the location of work performed by subcontractors in connection with large prime contract awards (U.S. Department of Defense 1980). The results have been used by some analysts to suggest that Massachusetts retains very little defense activity after adjusting for flows of subcontracts across states. However, the data in the study seem flawed, because prime contractors in Massachusetts (as well as Minnesota, Vermont, and Wyoming) reported distributing subcontracts in excess of the prime contracts they received. An-

other source of information is a survey of shipments to government agencies, last published for 1983 and since discontinued (U.S. Bureau of the Census 1985). In this survey, New England firms accounted for 10.8 percent of total shipments to the federal government, largely under prime contracts to the Defense Department, and 16.6 percent indirectly through subcontracts. For Massachusetts, the fractions were 4.8 percent and 5.3 percent, respectively. For Connecticut, they were 3.3 percent and 9.4 percent. In general, estimates for the New England region as a whole are probably more accurate than estimates for individual states.

[4] Total output consists of output produced to satisfy final demand plus output for other industries. Total output may also be expressed as the sum of value added (equal to gross national product for the nation) plus purchased inputs. The calculation of defense as a share of value added (or gross regional product) for New England is subject to great uncertainty because there is no direct information on value added by New England firms as opposed to their purchases of goods and services from other parts of the country.

⁵ The figures on personnel spending as a share of the economy (Table 1) might serve as a guide to maximum effects. These numbers should be reduced by about 20 percent in Connecticut, Maine, Massachusetts, and Rhode Island—and about 40 percent in New Hampshire and Vermont—to account for the portion of pay going to retirees. Retirement pay could be cut, for example, by scaling back cost-of-living adjustments, but such a policy would not disrupt individual state economies to the same degree as base closings would. Other categories of the military budget also include a payroll component. A substantial share of the operations and maintenance budget goes to pay civilian Defense Department employees (in addition to private contractors). In FY 1988, civilian pay relative to total Defense Department payroll was 50 percent in Maine, 43 percent in Massachusetts, 37 percent in Rhode Island, 26 percent in both Connecticut and Vermont, and 17 percent in New Hampshire.

⁶ The composition of output does change. In the case where lower government expenditures reduce the deficit, production of investment and export goods would probably increase.

⁷ International comparisons among industrialized nations suggest that defense spending and productivity growth are negatively related, but time series analysis within countries indicates that, at least through the 1970s, slowing productivity growth has coincided with a decline in the share of output devoted to defense (U.S. Congressional Budget Office 1983). Individual econometric studies obtain various results. Deutsch and Schopp (1987) found that the share of government-sponsored research and development devoted to the military had a negative effect on productivity growth in the United States and Canada, but an insignificant effect in France, Germany, Japan, and the Netherlands. Alexander [1989] found that growth in military expenditures had a positive effect, but military purchases of capital goods as a share of manufacturing output a negative effect, on productivity growth in the United States. Together, the net impact of the military role was very slightly positive for the period 1951 to 1982. Adams and Gold (1987), Rosenberg (1987), and Weston and Gummett (1987) provide useful surveys of this literature.

⁸ In fiscal year 1987, New England received 9.7 percent of the federal government's overall research and development spending. The region received 14.4 percent of R&D spending by the Department of Transportation, 11.8 percent by the Department of Health and Human Resources, 11.3 percent by the Department of Defense, and 10.8 percent by the National Science Foundation. Of the national total for R&D, 64.9 percent was administered by the Defense Department. Of the remainder, the largest amounts were spent by the Department of Health and Human Services, the Department of Energy, the National Aeronautics and Space Administration, and the National Science Foundation (National Science Foundation 1988).

⁹ For examples of previous case studies in Massachusetts and the nation, see Massachusetts Department of Employment and Training (l989b).

¹⁰ A study by Employment Research Associates (Anderson,

Frisch, and Oden 1986) found that the military buildup between 1981 and 1985 cost the nation over a million jobs, compared to the number that would have been generated by an equivalent increase in nondefense private and public spending.

¹¹ Thirty-four percent of the defense workers in this sample were college graduates, compared to 26 percent in other manufacturing and 29 percent in nonmanufacturing. The fraction of young workers (15–24 years) in defense was only one-half that in other manufacturing and one-third that in nonmanufacturing. Also, defense-oriented industries may be able to afford paying higher wages because they can pass on these costs to the Pentagon more readily than industries serving the private sector. Another factor explaining earnings differences may be that two-thirds of the Massachusetts manufacturing jobs (including defense-related) were held by men, whereas nonmanufacturing jobs were held by approximately equal numbers of men and women. Holding constant education, skill level, and occupation, women may be paid less than men because they tend to have less experience and work fewer hours, or because they face discrimination.

¹² Unemployment insurance is financed by federal and state payroll taxes and covers 97 percent of all wage and salary workers. The goal of UI is to replace about half of the recipient's pretax income (up to a limit) until he/she finds a new job or reaches the maximum duration of 26 weeks (30 weeks in Massachusetts). In addition, extended benefits go into effect automatically if the state's unemployment rate reaches a certain threshold, and Congress also enacted special extended benefits during the last two major national recessions. By federal law, employers must allow laid-off workers formerly covered by group health insurance to continue to purchase this insurance at the group rate for a period of up to eighteen months, or until they find a new job. This provision allows significant saving compared to purchasing health insurance on one's own. Massachusetts is planning to implement universal health insurance by 1992, but this program may be endangered by the state's fiscal crisis.

¹³ Closer to home, General Electric (with the assistance of state and federal government) set up a center in Lynn, Massachusetts that provided information and training for its displaced workers. Within two years, about three-quarters of the workers found jobs paying at least 92 percent of their former wage (Victor 1990). This example indicates a slower response than in the GTE case.

¹⁴ The state unemployment offices also provide telephones and personal computers for the use of workers in their job search. In addition, the agency holds job fairs and prepares resume books of available workers for potential employers.

¹⁵ Three-quarters of JTPA is in the form of matching block grants to states, and the remainder is allocated at the discretion of the Secretary of Labor.

¹⁶ Under a proposal in President Bush's budget, trade adjustment assistance would cease to exist as a separate category, but would be merged into Title III of JTPA.

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