

The defense buildup, 1977–85: effects on production and employment

After several years of post-Vietnam decline, defense spending for major programs started the current peacetime buildup; the acceleration between 1980 and 1985 cushioned the decline in production jobs

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Much of the defense buildup during the 1980–85 period required production from durable manufacturing industries in which nondefense production was either declining or growing slowly.¹ Increasing defense outlays, therefore, cushioned a reduction in production jobs, even though defense accounted for only a small portion of total output and employment of these industries.

This article provides estimates of output and employment levels during the current defense buildup, which began in 1977. With special emphasis on the high growth 1980–85 period, the study shows the impact of increased U.S. military spending on industries with defense-related production.

Historical trends

The current peacetime buildup began in 1977. In 1976, \$157.5 billion (1982 constant dollars) were expended by the military, which represented 5.6 percent of the economy when measured as gross national product (GNP). The following tabulation shows national defense spending and GNP (in billions of constant 1982 dollars) beginning in 1977 and ending in 1985, the latest year for which data are available.

Year	Gross national product	National defense	Percent of GNP
1977	2,958.5	159.2	5.4
1978	3,115.1	160.7	5.2
1979	3,192.3	164.3	5.1
1980	3,187.0	171.2	5.3

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1981	3,248.7	180.3	5.5
1982	3,165.9	193.8	6.1
1983	3,279.0	206.9	6.3
1984	3,489.8	219.4	6.3
1985	3,582.1	235.7	6.6

Table 1 provides a comparison of the defense buildup that occurred during the Vietnam War and during the 1977–85 period. In addition to GNP and national defense spending, table 1 shows capacity utilization, unemployment, and the GNP deflator.

Between 1977 and 1980, real defense spending increased by about 2 percent annually. However, between 1980 and 1985, defense expenditures accelerated, increasing by 5.5 percent annually. By 1985, national defense represented \$235.7 billion or 6.6 percent of GNP—the largest proportion of the economy during the peacetime buildup.

In comparison, during the 1964–68 phase of the Vietnam War, real defense spending increased by 5.4 percent annually and reached \$236.6 billion (in 1982 dollars) in 1968—the peak year for spending. In constant dollars, the national defense level reached in the peak of the Vietnam buildup was about the same level as real defense spending in 1985. (See table 1.) Although real levels of spending have been approximately the same as those during the Vietnam War, national defense then represented 10 percent of GNP, about 4 percentage points greater than the level during the recent buildup. Between 1968 and 1976, real defense spending declined from 10.0 percent in 1968 to just over 5 percent when the current buildup began.

The buildup during the 1960's occurred during generally high capacity utilization rates for manufacturing industries, along with low unemployment. During the 1980's buildup,

capacity utilization was relatively low, with higher unemployment rates. Also, there was a gradual increase in the annual percentage change in the GNP deflator during the 1960's, compared with an accelerated increase of the annual percentage change of a relatively higher GNP deflator during the 1980's defense buildup.

Defense programs

Major programs included in the Department of Defense budget are military personnel, operations and maintenance, procurement, research and development, and all other budget categories including military construction, family housing, and nondepartmental defense. Outlays for these programs in 1977, 1980, and 1985 and the percent change from 1977 to 1980 and from 1980 to 1985 are shown in table 2. The percent distribution of expenditures among the programs for 1977 and 1985, highlighting the shift in program emphasis, is illustrated in chart 1.

The distribution of expenditures among the defense programs determines the impact of defense spending on output and employment by industry and occupation in the overall economy. In addition to the defense program redistribution, or change in spending patterns between 1977 and 1985, it should be noted that the pay portion of the 1968 budget was 52 percent compared with 41 percent in 1985. This suggests greater allocation of expenditures to industry sectors that support the military—the defense industrial base. During the Vietnam period, allocation of the nonpay portion of the defense budget was greater for war items consumed (for example, ammunition), compared with the increased share for major weapons systems acquisition during the current buildup.

Effects on output

Our analysis begins in 1977, when defense expenditures

Table 1. Comparison of selected economic indicators during the Vietnam War, 1964-68, and the current peacetime defense buildup, 1980-85
[In billions of 1982 dollars]

Period	GNP	National defense	Capacity utilization (percent)	Unemployment rate (percent)	GNP deflator 1982=100
Vietnam War:					
1964	1,973.2	189.4	86	5.2	39.6
1965	2,087.5	181.6	90	4.5	40.1
1966	2,208.3	207.6	91	3.8	41.1
1967	2,271.4	231.7	87	3.8	42.1
1968	2,365.6	236.6	87	3.6	43.7
Current peacetime:					
1980	3,187.1	171.2	79	7.1	86.1
1981	3,248.8	180.3	78	7.6	94.1
1982	3,166.0	193.8	70	9.7	100.0
1983	3,279.1	206.9	74	9.6	104.1
1984	3,489.9	219.4	81	7.5	108.3
1985	3,585.2	235.7	80	7.2	112.3

NOTE: Changes based on unrounded data.
SOURCE: GNP, national defense, and GNP deflator from the Bureau of Economic Analysis, U.S. Department of Commerce; capacity utilization (all manufacturing) from the Federal Reserve Board; and unemployment (total labor force) from the Bureau of Labor Statistics.

Table 2. Defense budget outlays by program, 1977, 1980, and 1985
[Billions of 1982 dollars]

Defense program	1977	1980	1985 ¹	Percent change	
				1977-80	1980-85
Total defense ²	159.2	171.2	235.7	7.5	37.7
Military personnel	44.8	45.7	58.2	2.0	27.4
Operations and maintenance	56.4	59.2	76.6	5.0	29.4
Procurement:					
Aircraft	11.8	15.8	25.2	33.9	59.5
Missiles	5.7	6.5	10.4	14.0	60.0
Weapons and tracked vehicles	1.0	1.9	3.5	90.0	84.2
Ammunition	1.2	1.7	1.6	41.7	-0.6
Ships	5.3	6.0	8.0	13.2	33.3
Other	8.6	9.4	15.1	9.3	60.6
Research and testing	17.2	18.7	28.7	8.7	53.4
Military construction	3.3	3.4	4.7	3.0	38.2
Family housing	2.4	2.2	2.6	-8.4	18.1
Nondepartmental defense	0.8	0.9	0.7	12.5	-13.3

¹ Preliminary outlay estimates.
² Programs may not sum to total defense due to rounding.
SOURCE: U.S. Department of Commerce, Office of Business Analysis.

started to increase again after several years of post-Vietnam decline. Acceleration in defense spending between 1980 and 1985 provides another logical period for analysis. The analysis focuses on industries that produced more than 10 percent of their output directly or indirectly for defense in 1985. (See table 3.)

Of the 537 industries evaluated, 21 produced 10 percent or greater of their output for defense in 1977.² This output was either for direct military purchases, such as aircraft and other weapons systems, or indirect purchases for defense applications, such as forgings and castings used in tanks. In 1980, the number of industries that met the 10-percent criterion rose to 27. By 1985, this number had reached 45.

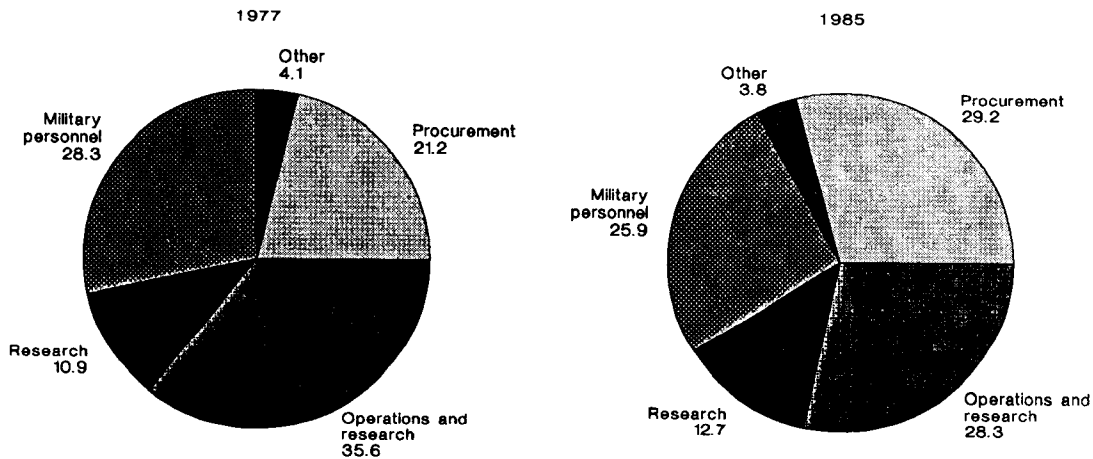
Real increases in expenditures for defense programs—in many cases, combined with declines in total output—made many of these industries more dependent on defense. Of the 45 industries with a defense share of total output greater than 10 percent, 29 experienced real declines in total output between 1980 and 1985. (See table 3.)

Some industries make products that are primarily or predominately for military use. In 1985, five industries had defense-related output of 75 percent or more: shipbuilding, including ship repair; ammunition, except small arms ammunition; ordnance, not elsewhere classified; missiles; and aircraft and missile engines. Four additional industries—tanks, aircraft, explosives, and radio and television communications equipment—produced between 50 and 74 percent of their output for defense, and nine other industries—small arms, aircraft and missile parts, small arms ammunition, cutting machine tools, engineering instruments, truck trailers, electron tubes, nonferrous mining (except copper), and nonferrous forgings—produced between 25 and 49 percent of their output for defense.

Shipbuilding. The shipbuilding industry was more de-

Chart 1. Distribution of total outlays in the defense budget, 1977 and 1985

(In percent of real dollars)



SOURCE: Office of Business Analysis, Department of Commerce

pendent on defense expenditures than any other industry in 1985. Nearly all (93 percent) of new ship construction and repair and renovation work was produced for the military. This is a dramatic increase from the 61-percent defense share of total output in 1980 and the 45-percent share in 1977. Naval construction and repair increased 42 percent between 1980 and 1985, while overall shipbuilding declined 15 percent.

The increased dependence of the shipbuilding industry on military orders has been sustained in the 1980 through 1985 period because of the Administration's commitment to a 600-ship fleet by the end of the decade. In 1980, the number of deployable naval battle forces was 479. By 1985, that number reached 542. The increase was mainly attributed to the addition to the fleet of frigates, nuclear attack submarines, and surface support ships (transport ships similar in construction to commercial ships). At the rate of 20 to 25 new deployable ships per year (new construction and conversions) throughout the remainder of this decade, the 600-ship goal should be attained.

On January 1, 1985, commercial ship construction showed 340,000 tons of gross tonnage on order, compared with 1,900,000 tons in 1980. In 1975, gross tonnage on order was 5,061,000 tons. These declines in overall ship construction were countered and have been more or less replaced by military ship construction. The "T" ship or transport ship program provided for much of the industry's

offset of continued declining orders for commercial ships. The T-ship program is part of the Navy's Military Sealift Command and includes such ships as oilers, ocean surveillance ships, and maritime repositioning ships. Of the 77 ships on order or under construction for the Navy on October 1, 1984, 22 were T-ships. In October 1985, 13 commercial shipyards had been awarded contracts for construction of 29 new T-ships and for major renovation of 23 merchant ships.

Repair of ships declined substantially between 1980 and 1984, except for repair of Navy ships. In 1984, 30 percent of Navy repair work was done in private shipyards, as opposed to naval shipyards, compared with 15 percent in 1980.

Ammunition and ordnance. From 1980 to 1985, output for defense in the ammunition industry (except small arms) increased 98 percent and for ordnance (not elsewhere classified), 83 percent. These increases compare with the 16- and -7-percent changes registered between 1977 and 1980. Domestic military purchases accounted for 88 percent of the total for ammunition and 86 percent for ordnance for the 1980-85 period. A small portion was purchased by State and local governments. The remaining (12 and 14 percent) output was mainly for export. Here and elsewhere in this article, defense purchases do not include U.S. foreign military sales or licensed commercial exports of military items.

The increase in defense purchases from the ammunition and ordnance industries seems inconsistent with the near-zero increase in budget outlays for the ammunition procurement program. This difference is attributed to the diverse mix of products made by these industries. The large ammunition industry produced such products as arming and fusing devices for missiles, missile warheads, and torpedoes and parts that are purchased for the missiles procurement and research and testing programs, in addition to ammunition over 30 millimeters in diameter.

Aerospace. Aerospace industries showed a dramatic increase in reliance on military orders between 1980 and 1985, while total output increased only slightly, 2 percent. The slowdown in commercial orders was attributed mostly to lower production of large and medium-size transport aircraft resulting from deferments of new equipment purchases by financially troubled airlines during this period. From 1977 to 1980, defense aircraft production increased about 6 percent, compared with the 80-percent increase between 1980 and 1985. Production of aircraft and missile engines for defense increased by 14 percent between 1977 and 1980, compared with the 69-percent increase from 1980 to 1985.

Because of the decline in the rate of civilian purchases—combined with an increase in defense purchases—the defense share of aircraft output equaled 66 percent in 1985, compared with 43 percent in 1977. The aircraft and missile engine industry showed a similar increase in defense market share, rising from 47 to 78 percent between 1977 and 1985. The defense share of the aircraft and missile parts market remained stable—at about 40 percent—for the period.

Between 1980 and 1985, the volume of aircraft production declined substantially, from 14,660 units costing \$18.8 billion to 3,620 units costing \$25.4 billion. Of the 3,620 units produced in 1985, 935, or 26 percent, were military. However, while military aircraft cost \$17.4 billion, an average unit cost of \$18.6 million, civilian aircraft unit costs averaged only \$3.0 million.

Total output in the missile industry increased by 35 percent between 1980 and 1985, after declining 8 percent between 1977 and 1980. Of the markets for missiles, defense showed the greatest growth. Civilian markets for missiles include purchases by the National Aeronautics and Space Administration and production used for export. After declining 6 percent over the 1977-80 period, missiles for the military increased 65 percent between 1980 and 1985, while missile output for civilian use declined 12.4 percent. The defense share of missile industry output increased from 67 percent in 1977 to 84 percent in 1985.

This substantial rise in the missile industry's dependence on defense purchases can be attributed to: (1) the 60-percent growth in the defense missile program; (2) a slowdown in the space program; and (3) a decline in exports of space-based services, which include the launching and maintaining of satellites in orbit for communications, navigation,

measurement of earth resources, and weather sensing. Between 1970 and 1980, almost all space-based services were provided by U.S. companies. After 1980, however, the European and Japanese space programs provided competition to the U.S. missile industry.

Defense dependent industries with declining output. Several industries, important to defense, had dramatic declines in total output, despite increasing military purchases. For example, total output in the explosives industry declined 28 percent between 1977 and 1980, and fell an additional 23 percent by 1985. Defense purchases of explosives rose 22 percent between 1977 and 1980, increasing the defense

Table 3. Changes in total output and estimated defense output and defense share of total output, by industry, 1977-80 and 1980-85
[In percent]

Industry	Defense output change		Total output change		Defense share of output		
	1977-80	1980-85	1977-80	1980-85	1977	1980	1985
Shipbuilding	44	42	6	-15	45	61	93
Ammunition, large	16	98	-15	70	65	88	88
Ordnance, n.e.c.	-7	83	-28	43	61	79	86
Missiles	-6	65	-8	35	67	69	84
Aircraft and missile engines	14	69	22	-5	47	44	78
Tanks	48	110	13	105	40	68	69
Aircraft	6	80	22	2	43	37	66
Explosives	-19	22	-28	-23	36	41	65
Radio and TV communications	73	73	46	46	35	42	50
Small arms	14	110	-15	15	20	26	48
Aircraft and missile parts	42	67	73	26	38	31	41
Ammunition, small	-13	51	6	17	37	30	39
Machine tools—cutting	226	65	18	-60	3	8	34
Truck trailers	72	114	-16	-23	5	10	29
Engineering instruments	25	55	4	28	19	23	28
Electron tubes	-5	75	-15	-5	12	14	26
Mining, nonferrous, except copper	-4	63	-33	-31	8	11	26
Nonferrous forgings	11	73	88	-16	21	12	25
Transmission equipment	1	65	-56	-28	5	10	24
Optical instruments	71	189	85	51	14	13	24
Turbines	-31	55	1	-53	5	7	23
Aluminum, primary	2	67	-20	-33	7	9	22
Zinc, primary	3	68	-15	-18	9	11	22
Industrial trucks	325	54	11	-46	2	8	22
Electronic components	40	76	27	44	15	16	20
Ferrous forgings	9	74	-7	-13	8	10	19
Copper, primary	3	66	-27	-11	7	10	18
Nonferrous rolling, n.e.c.	28	70	-22	24	8	13	18
Nonmetallic mineral products	37	67	6	-15	7	9	17
Lead, primary	6	63	-4	-36	6	7	17
Castings, nonferrous	15	80	1	5	9	10	17
Copper rolling	0	275	-28	9	5	7	17
Machine tools—forming	290	56	1	-34	2	6	15
Electrometallurgical products	5	63	-10	-34	6	6	15
Ball bearings	-15	68	-60	-27	7	7	15
General industrial machinery	47	57	33	-18	3	8	15
Carbon products	31	67	-1	-37	5	7	15
Screw machine products	12	67	7	-15	6	7	13
Hoists and cranes	52	81	33	-49	3	4	13
Plating and polishing	6	74	4	50	11	11	13
Steel mills	6	63	-13	-20	5	6	12
Boot and shoe stock	1	-35	-18	-24	11	14	12
Conveyors	103	58	10	-25	3	6	12
Copper mining	34	64	6	-14	5	6	11
Industrial controls	5	51	7	-6	5	6	11

n.e.c. = not elsewhere classified

SOURCE: U.S. Department of Commerce, Office of Business Analysis.

share of the industry's output from 36 to 65 percent. Total output in the cutting machine tool industry declined dramatically, 60 percent, between 1980 and 1985. Defense purchases of machine tools rose 65 percent, increasing the defense market share from 3 percent in 1977 to 34 percent in 1984. Total output in the primary lead industry dropped 36 percent between 1980 and 1985. However, a 63-percent jump in purchases by the military for defense (all indirect purchases) increased the defense share of this industry's output from 6 to 17 percent. The industrial truck industry, through a similar combination of falling total output and increasing defense purchases, showed an increased dependence on defense, from 2 percent in 1977 to 22 percent in 1985. Other industries in this same general situation—declining total output, but increasing output for the military—include nonferrous mining, transmission equipment, ferrous forgings, primary zinc and copper, nonmetallic mineral products, forming machine tools, electrometallurgical products, screw machine products, steel mills, conveyors and conveying equipment, and copper mining.

Defense dependent industries with increasing output. During the latest defense buildup, some industries increased production for both defense and civilian markets. For example, the radio and television communications equipment industry increased its output for all customers by 46 percent, while increasing output for defense by 73 percent. The defense output share, therefore, changed only slightly, from 42 percent in 1980 to 50 percent in 1985. Total output of the engineering and scientific instrument industry increased 28 percent, while defense output increased 55 percent. As a result, the defense market share rose from 23 percent in 1980 to 28 percent in 1985. Total output in the optical instruments industry rose 189 percent, increasing the defense market share from 13 to 24 percent.

Top 20 defense industries. The top defense-supplying industries in terms of real output were identified as producers for whom defense materials account for a large share (40 percent or more) of output; namely, radio and television communications equipment, aircraft, aircraft and missile engines, shipbuilding, missiles, aircraft and missile parts, and tanks. However, as the following tabulation shows, defense is not the major market for the remainder of the top 20:

Industry	Defense output (billions of 1977 dollars)	Defense share (percent)
Radio and television communications equipment	15.7	50
Aircraft	11.7	66
Wholesale trade	6.3	2
Aircraft and missile engines	5.9	78
Shipbuilding	5.7	93
Missiles	5.3	88

Petroleum refining	5.2	6
Aircraft and missile parts	4.5	41
Crude petroleum	4.3	10
Steel mills	3.4	12
Electronic components	3.0	19
Air transportation	3.0	8
Real estate	2.7	5
Automobiles	2.6	3
Miscellaneous repair shops	2.5	10
Computers	2.3	5
Industrial chemicals	2.0	5
Semiconductors	1.6	5
Railroads	1.5	7
Tanks	1.1	65

Productive capacity. Available data indicate that productive capacity in the durable and nondurable manufacturing industries was not strained to meet military and civilian requirements during the buildup. Fourth-quarter utilization of the durable manufacturing sectors declined from 79 percent in 1977 to 76 percent in 1980 and 74 percent in 1984.³ Nondurable capacity utilization dropped from 77 percent in 1977 to 72 percent in 1980 and 71 percent in 1984. Defense-intensive industry groups displayed the following capacity utilization rates in 1984: steel, 63 percent; steel foundries, 74 percent; metal forgings, 81 percent; metalworking machinery, 68 percent; communication equipment, 76 percent; aircraft, 60 percent; and instruments and related products, 78 percent.

Effects on employment

Defense employment requirements were estimated directly from the results of the input-output model and include both the direct and indirect jobs in each industry. The defense share of industry output was used as the defense share of actual employment. Thus, for example, if defense output was 20 percent of total industry output, then estimated employment to meet defense needs was assumed to also be 20 percent of actual total industry employment. Differences reflect industry sector aggregation differences between the Commerce and Labor Departments' input-output models. Defense occupational requirements were derived by applying surveyed occupational patterns for 3-digit SIC industries to the defense share of employment in these industries. Thus, the occupational mix of the labor force specializing in defense work was assumed to be the same as that prevailing in the industry as a whole.

Total defense-related employment is estimated to have increased by less than 4 percent from 1977 to 1980, with all of the increase occurring in private sector jobs. From 1980 to 1985, total defense jobs increased almost 22 percent, while private sector jobs attributable to defense purchases increased 45 percent. The 1980–85 defense buildup occurred initially during a period of slow employment growth. Total private and public jobs in 1979 were at 103.6 million and had reached only 104.6 million by 1983. In the 1977–80 period, while defense outlays increased only modestly, total

employment grew at an annual average rate of 2.9 percent. Conversely, during the major buildup of 1980-85, total employment grew at half that rate, or 1.4 percent per year. In the private sector, employment increased from 80.0 million in 1977 to 87.5 million in 1980 and 93.3 million in 1985. However, in 1982 and 1983, private employment fell below its 1981 level, because of the recession. Total public jobs increased slightly from 1980 to 1985, as the number of both Federal civilian and State and local government employees increased by about 1 percent. The size of the Armed Forces declined 4 percent from 1977 to 1980 and then increased by about 5 percent from 1980 to 1985. This increase, of course, was substantially less than the increase in defense outlays for this period.

Total defense jobs. All defense-generated jobs were estimated, using the methodology described in the appendix, to have increased only slightly from 1977 to 1980 and then to have grown substantially from 1980 to 1985. Defense-related employment moved counter-cyclically during the recessions of the early 1980's. However, with defense representing only 5 to 6 percent of GNP in that period, defense-related employment increases were not sufficient to offset job losses from declining demand in other sectors. Defense-generated private employment rose from an estimated 2.2 million in 1980 to 3.2 million in 1985. The following tabulation shows estimated defense-related employment (in thousands) in 1977, 1980, and 1985, and the changes over the 1980-85 period:

	1977	1980	1985	Change, 1980-85
Total	5,309	5,498	6,680	1,182
Private	1,913	2,214	3,207	993
Public:				
Armed Forces ..	2,133	2,041	2,151	110
Federal				
civilian	1,263	1,243	1,322	79
Percent of total:				
Private	2.4	2.5	3.4	—
Public:				
Armed Forces	100.0	100.0	100.0	—
Federal				
civilian	46.3	43.4	46.0	—

The defense share of all jobs dropped from 5.5 percent in 1977 to 5.3 percent in 1980, and then increased to 6.0 percent in 1985. The net increase in total jobs in the private sector was 5.8 million over the 1980-85 period, with defense-generated jobs accounting for 17 percent of the increase. Private sector defense jobs, both direct and indirect, represented 2.5 percent of all private jobs in 1980 and 3.4 percent in 1985. Defense accounted for about 5 percent of all manufacturing jobs in 1977, 6 percent in 1980, and about 9 percent in 1985. In durable manufacturing, more than 8 percent of all jobs were generated by defense in 1980 and 14 percent in 1985. Defense-generated jobs in transportation, communications, and public utilities were about

6 percent of the total in 1980, and 4 percent in 1985. Defense-related government civilian jobs, including both civil service and wage board, increased almost 7 percent over the period, accounting for nearly one-half of all Federal civilian jobs. All defense-generated jobs, including the Armed Forces, rose from 5.5 million in 1980 to 6.7 million in 1985, an increase of almost 1.2 million jobs.

Defense jobs in the private sector. In 1977, about 54 percent of defense-generated private employment was concentrated in the manufacturing sector and this share was only slightly higher during the 1980-85 period. Although manufacturing employment declined by almost 1 million from 1980 to 1985, defense requirements added about 600,000 manufacturing jobs. These jobs were primarily in durable manufacturing. In the same period, total jobs in durable manufacturing fell by almost 680,000, while defense-generated jobs in durable manufacturing increased by about 580,000. The service sector accounted for most of the remaining defense-related jobs. Table 4 shows the sector distribution of defense-generated private employment during this major buildup period.

Defense-related industry jobs. Total employment in the five major defense hardware industries increased by 260,000 jobs from 1977 to 1980, reflecting increases in both defense and civil demand.⁴ From 1980 to 1985, the total increase in these industries was just 172,000 jobs, as much larger defense orders were offset by drops in civil requirements. The combined employment in ordnance, missiles, aircraft, ships, and communications equipment, where much of the buildup was directed, moved from 1.4 million

Table 4. Estimates of defense-related private employment, by industry, 1977, 1980, and 1985

Sector	1977	1980	1985
Total (thousands)	1,912.6	2,214.2	3,206.8
Agriculture, forestry, and fisheries	25.8	28.7	23.9
Mining	27.5	29.7	48.0
Construction	100.0	76.2	89.0
Manufacturing	1,037.7	1,199.5	1,812.2
Transportation, communications, and utilities	163.9	180.9	211.2
Trade	177.4	224.3	310.0
Finance and insurance	43.5	43.9	58.9
Services	336.9	430.9	653.6
Percent distribution			
Total	100.0	100.0	100.0
Agriculture, forestry, and fisheries	1.4	1.3	.8
Mining	1.4	1.3	1.5
Construction	5.2	3.4	2.8
Manufacturing	54.3	54.2	56.5
Transportation, communications, and utilities	8.6	8.2	6.6
Trade	9.3	10.1	9.7
Finance and insurance	2.3	2.0	1.8
Services	17.6	19.5	20.4

NOTE: Employment includes wage and salary workers, self-employed and unpaid family workers, but excludes those in government and the Armed Forces.
SOURCE: Estimates derived using methodology described in appendix.

in 1980 to 1.6 million in 1985. The defense portion of employment in these industries increased by almost 400,000 jobs. (See table 5.) This apparent unresponsiveness of total employment in these hardware industries primarily reflects significant drops in civil demand for aircraft and shipbuilding after 1981. Aircraft employment dropped by 66,000 from 1980 to 1983, while the defense jobs in this industry increased by 48,000. Similarly, defense jobs in shipbuilding increased by almost 24,000 from 1980 to 1983, as total industry jobs dropped by 34,000. Total employment in the aircraft industry did not turn around until 1984, when increased military shipments coincided with a reviving economy. Aircraft employment did not reach the 1980 level until 1985. Shipbuilding jobs in 1985 were 32,000 less than in 1980 as the industry continued to suffer from weak civil demand.

The defense share of employment of these industries, of course, increased substantially from 1977 to 1985. In the overall ordnance industry, including tanks, defense moved from 45 percent of the total in 1977 to 60 percent in 1980 and 70 percent in 1985. About two-thirds of the jobs in the missile-space industry were attributable to defense in 1977 and in 1980, but in 1985, the portion rose to more than 80 percent. Defense employment in the aircraft and parts industry accounted for 43 percent of the total in 1977 and only 37 percent in 1980 during substantial commercial production. This share increased to more than 60 percent in 1985. Defense-related shipbuilding employment was only 31 percent of the industry's jobs in 1977, but rose to almost 50 percent in 1980 and 85 percent in 1985, as defense orders increased and commercial business continued to decline.

There was a net increase in defense-generated jobs in the private sector of almost 1 million jobs from 1980 to 1985; only a few industries showed a drop in defense-related jobs. The 20 industries adding the most direct and indirect jobs in this period accounted for about three-quarters of this total or an estimated 744,000 jobs. (See table 6.) These industries were about equally divided between durable manufacturing

Table 5. Estimates of defense employment in major defense industries, 1977, 1980, and 1985

Industry	1977	1980	1985
Total defense (in thousands)	471.6	624.1	1,018.9
Ordnance	30.9	44.3	69.1
Missiles, space	44.4	60.4	112.9
Communications equipment	110.8	157.9	254.6
Aircraft	214.9	251.5	419.3
Shipbuilding	70.6	110.0	163.0
Percent of industry			
Ordnance	44.8	59.9	70.5
Missiles, space	67.3	68.7	84.2
Communications equipment	35.2	41.8	49.6
Aircraft	43.0	37.2	62.0
Shipbuilding	30.7	49.3	85.3

SOURCE: Estimates derived using methodology described in appendix.

Table 6. Industries with largest estimated growth in defense-related employment, 1980 and 1985

[In thousands]

Industry	1980	1985	Increase
Total	1,312.2	2,055.7	743.5
Aircraft	251.5	419.3	167.8
Communications equipment	157.9	254.6	96.7
Business services	137.8	234.1	96.3
Wholesale trade	143.3	203.3	60.0
Shipbuilding, repair	110.0	163.0	53.0
Missiles, space vehicles	60.4	112.9	52.5
Hotels, lodging places	41.8	69.7	27.9
Professional services	49.2	75.0	25.8
Ordnance	44.3	69.1	24.8
Eating, drinking places	65.8	88.8	23.0
Educational services	62.4	83.1	20.7
Metalworking machinery	20.3	35.3	15.0
Truck transportation	45.6	59.7	14.1
Crude petroleum	14.1	26.8	12.7
Transportation services	13.4	25.9	12.5
Maintenance, repair construction	42.9	52.3	9.4
Nonelectrical machinery	13.4	22.0	8.6
Electrical industrial apparatus	12.1	19.8	7.7
Optical equipment	7.9	15.5	7.6
Personal, repair services	18.1	25.5	7.4

NOTE: Employment is total of all workers. Industries are generally 3-digit divisions from the *Standard Industrial Classification Manual*.

SOURCE: Estimates derived using methodology described in appendix.

and service industries. The manufacturing industries generally reflected cases where the increased defense demand was a significant part of total output. However, the service industries, in most cases, reflected much larger employment bases, with increased defense requirements accounting for only a small percent of total output.

The direct and indirect employment effects of defense outlays during the buildup appear to have principally benefited the "smokestack," or durable goods manufacturing industries. The industries with 10 percent or more of their jobs attributable to defense in 1985 were all in durable manufacturing. These included the defense equipment, metals, and metalworking equipment industries. Service industries, in general, had 3 percent or less of their employment generated by defense purchases. Of the 17 most defense-dependent industries shown in the following tabulation, the 5 major hardware industries had, by far, the highest percentage of defense jobs, generally more than 50 percent. The optical industry had an estimated 24 percent of its employment in 1985 attributable to defense purchases. The other industries, largely metals and metalworking, had a little more than 10 percent of their jobs in defense production.

Percent of defense-generated jobs

Shipbuilding, repair	85.3
Missiles, space vehicles	84.2
Ordnance	70.5
Aircraft	62.0
Communications equipment	49.6
Other nonferrous mining	25.7

Optical equipment	24.3
Material handling equipment	14.4
Screw machine products	13.1
Copper mining	13.0
Iron ore mining	12.8
Scientific, control instruments	12.4
Primary nonferrous metal products	11.7
Primary aluminum products	11.5
Blast furnaces, steel products	11.3
Iron, steel foundries, forgings	11.3
Metalworking machinery	11.1

Occupational distribution of defense employment. The distribution of defense jobs by occupational group, as shown in table 7, remained relatively stable from 1977 to 1985. The percent of defense jobs in each group shows insignificant year-to-year variations. The pattern for defense jobs, however, was different from the distribution for overall manufacturing. Substantially more professional and technical workers, including engineers, scientists, and technicians, were required in defense jobs than the average for

Table 7. Estimates of defense-related employment by occupational group, 1977, 1980, and 1985

Occupation	1977	1980	1985
Total (thousands)	1,801	2,087	2,897
Managers	190	224	316
Professionals, technical	240	310	437
Marketing, sales	73	84	116
Administrative support	306	355	490
Services	143	183	261
Mechanics, installers	85	99	133
Precision production Machine setters, operators	114	134	191
Handworkers	186	194	269
Construction trades	146	174	243
Transportation operators	57	58	78
Helpers	94	94	125
Others	92	96	128
	75	83	110
Percent distribution			
Total	100.0	100.0	100.0
Managers	10.5	10.7	10.9
Professionals, technical	13.3	14.8	15.1
Marketing, sales	4.1	4.0	4.0
Administrative support	17.0	17.0	16.9
Services	8.0	8.8	9.0
Mechanics, installers	4.7	4.8	4.6
Precision production Machine setters, operators	6.4	6.4	6.6
Handworkers	10.3	9.3	9.3
Construction trades	8.1	8.4	8.4
Transportation operators	3.2	2.8	2.7
Helpers	5.2	4.5	4.3
Others	5.1	4.6	4.4
	4.2	4.0	3.8

NOTE: Occupational employment is based upon wage and salary jobs, while industry employment also includes the self-employed and unpaid family workers and is somewhat higher.

SOURCE: Estimates derived using methodology described in appendix.

Table 8. Occupations estimated to have a high percentage of defense jobs, 1985

Occupation	Defense jobs (In thousands)	Percent defense
Precision aircraft assemblers	14.7	70.0
Shipfitters	8.9	63.6
Electrical installers, repairers	3.7	61.7
Aero, astronautical engineers	22.2	46.3
Milling machine setters, operators	8.4	24.0
Pattern, model makers, wood	2.4	21.8
Riggers	4.1	18.6
Numerical control machine tool operators	10.6	18.6
Metallurgical engineers	3.5	18.4
Electric, electronic equipment precision assemblers	30.7	17.4
Numerical control tool programmers	1.9	17.3
Mechanical engineering technicians	8.9	16.2
Heating equipment setters, operators	1.3	16.2
Pattern, model workers, metal	2.1	16.1
Lathe machine setters, operators	15.5	15.8
Electric, electronic engineers	57.9	15.1
Inspectors, testers, precision	37.4	14.7
Industrial engineers	18.1	14.6
Industrial engineering technicians	3.9	14.4
Sewing machine setters, metal and plastic	2.6	14.4
Electric, electronic assemblers	37.0	14.3
Drilling machine setters, operators	8.8	13.7
Grinding machine setters, operators	12.3	13.4
Heat treating machine operators, metal and plastic	2.8	13.3
Tool and die makers	20.7	12.8
Aircraft mechanics	13.1	12.7
Mechanical engineers	29.3	12.6
Machinists	43.5	12.5
Production clerks	26.4	12.4
Welders, cutters	32.3	11.6
Precision layout workers, metal	2.4	11.4
Founding mold workers	2.1	11.1
Electronic semiconductor processors	3.3	11.0

SOURCE: Estimates derived using methodology described in appendix.

total manufacturing jobs. Relatively more administrative support workers, including clerical and computer support jobs, were required in defense production, as well as service workers. However, substantially fewer machine setters and operators and handworkers were required. The jobs added during the defense buildup were primarily in the managerial, administrative support, professional, and technical and service groupings.

Table 8 shows that occupations with 10 percent or more of defense-related jobs in 1985 were largely in metalworking, equipment assembly, and the professional and technical categories. The most defense-dependent occupation was the precision aircraft assembler, with an estimated 70 percent of their jobs in defense production. Electrical installers and shipfitters followed closely, with over three-fifths their jobs related to defense. Almost one-half of the aeronautical and astronautical engineer jobs were in defense production. Defense job requirements for milling machine setters and operators and wood pattern and mold makers were over one-fifth of the total in these occupations. About 19 percent of rigger jobs, numerical control machine tool operators, and metallurgical engineers were defense-related in 1985. □

¹ This article summarizes a study conducted jointly by the U.S. Department of Commerce's Office of Business Analysis and the Bureau of Labor Statistics' Office of Economic Growth and Employment Projections, to estimate the output and employment effects on U.S. industries of the increases in defense spending which began in 1977. The study uses the total industry production as published by the Bureau of the Census and total industry employment as published by the Bureau of Labor Statistics. The defense portion of production and employment is estimated using interindustry models which attempt to capture the relationship between defense purchases, industry production levels, and associated employment requirements.

² Industries analyzed in the production analysis are classified by the 537-sector 1977 Bureau of Economic Analysis Input-Output table. These sectors are basically 4-digit Standard Industrial Classification sectors. However, of the major defense industries, Aircraft (sic 3724) and Missile Engines and Engine Parts (sic 3764) are combined as well as Aircraft (sic

3728) and Missile Parts (sic 3769).

³ *Survey of Plant Capacity*, Annual Report, MQ(C)-1 (Bureau of the Census, 1985). It should be noted, however, that capacity utilization measures are subject to considerable doubt and controversy. The preferred rate of capacity utilization (the level of plant operations which produces maximum profits) published by the Census Bureau and summarized in the text is the result of industry surveys and subject to interpretation by respondents. The capacity utilization estimates are also fourth-quarter rates, and do not reflect annual averages.

⁴ Industry sectors used in the employment model are broader or consist of more aggregate categories than those used in the more detailed production model, except for Missiles (sic 3761) and Radio and Television Communication Equipment (sic 3662). Shipbuilding is all of sic 373, Ordnance includes sic 348 and 3795, and Aircraft and Parts includes sic 372, 3764, and 3769.

APPENDIX: Methodology

Federal Government spending for national defense is allocated to budget programs from the Department of Defense outlay budget. The budget outlay data, originally in current Federal fiscal year dollars, were deflated to constant 1977 dollars and converted to calendar years. The deflation is accomplished using a combination of Office of Management and Budget and Department of Commerce defense program price deflators. The Commerce Department's defense program deflators incorporate the detailed distribution of expenditures for each of the programs.

The budget outlay data are broken down into categories of industrial final demands using a series of bridge tables developed by the Commerce Department. These bridge tables break down defense budget outlay categories to industrial composition of what defense buys, using an assumed distribution of spending within a budget category. That distribution is based on spending patterns of prior years.

The estimates of final defense demand were verified whenever possible. Estimates of defense demands were compared with actual data or other estimates. The Census Bureau collects and reports direct shipments to Federal Government agencies. Some estimates are made in Commerce's annual *U.S. Industrial Outlook*, and separate estimates are also made by the Defense Department.

Indirect defense production requirements are calculated using the 1977 Bureau of Economic Analysis 537-sector input-output matrix. The input-output matrix multiplication estimates the interindustry transactions necessary to supply the military. The defense final demands, calculated using the series of bridge tables described above, are multiplied by the matrix to provide the estimate of total output for defense production.

Defense employment in the private sector was estimated using the total direct and indirect production requirements for each industry as developed in the interindustry model. Labor models were then applied to the gross outputs of each industry to develop labor requirements. The models are all based on linear relationships that determine average requirements for each industry. An increase in purchases made by any demand sector is assumed, therefore, to require a proportional increase in output and labor requirements. Thus, for example, if 20 percent of industry output is estimated to be devoted to defense-generated production, the employment estimates assume that 20 percent of industry employment is also defense-related. The labor models required an aggregation of the 537 producing industries used in the step to derive production requirements to employment for 378 industries and 550 occupations.