A CBO STUDY

February 1983

Defense Spending and the Economy

Congress of the United States
Congressional Budget Office

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Congressional Budget Office

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PREFACE

The Administration's program for economic recovery has proposed reducing the share of gross national product devoted to federal government spending and taxation, increasing incentives for savings and investment, and strengthening the commitment to monetary policies designed to curb inflation. At the same time, the Administration has proposed large increases in defense spending, particularly for procurement and other investments, designed to upgrade the U.S.'s defense capital stock and counter recent Soviet arms buildups. From its unveiling in early 1981, the Administration's program has sparked debate over whether the proposed combination of economic and defense policies presents serious risks of rekindling inflation and undermining economic growth and productivity. At the request of the House Committee on Armed Services, this study analyzes these issues. In keeping with CBO's mandate to provide objective analysis, this study offers no recommendations.

The study was prepared by Lawrence R. Forest, Jr., of CBO's National Security and International Affairs Division, under the general supervision of Robert F. Hale and John J. Hamre. The author gratefully acknowledges the contributions of Stephanie M. Martin, who provided extensive research assistance, and of Patricia H. Johnston, who edited the manuscript. The author also acknowledges the valuable assistance of William J. Beeman, George R. Iden, Edward Swoboda, Michael A. Miller, Barbara J. Holinshead, and Peggy Gebhart of CBO, and of Lloyd C. Atkinson, George F. Brown, Jr., Ralph M. Doggett, Douglas Lee, Ronald Kutscher, Neil Rosenthal, Alan E. Fechter, Beatrice N. Vaccara, Kem Stokes, and David K. Henry. (The assistance of external reviewers and contributors implies no responsibility for the final product, which rests solely with CBO.) Janet R. Stafford typed numerous drafts of the manuscript.

Alice M. Rivlin
Director

February 1983

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SUMMARY

The Administration has proposed a succession of large increases in the defense budget for fiscal years 1984 through 1988, following substantial increases over the last several years. The Administration's plan would increase real (inflation adjusted) budget authority for the Department of Defense (DoD) by about 6.9 percent annually for 1984-1988. The 1981-1983 growth averaged about 10 percent annually. The plan emphasizes investment (which includes weapons procurement, military construction, and research and development); after adjustment for inflation, growth in these investment accounts would average 13 percent a year for the entire 1981-1988 period.

When the United States has expanded its arsenals this rapidly in the past, it has also experienced a substantial increase in inflation. The inflation rate rose an average of 3.7 percentage points during the last four major military buildups. Some influential economists have warned that the currently proposed buildup could have similarly deleterious effects on inflation and on productivity.1/

The choice of appropriate levels of defense spending essentially is a question of priorities, reflecting assessments of the requirements for national security and evaluations of the importance of alternative uses of resources. This choice probably should not be influenced unduly by the effects of defense spending on the economy, since those effects can, in principle, be offset or achieved by other policies. It is, nonetheless, important to be mindful of the economic effects of defense spending, since that knowledge can help in shaping appropriate overall budgetary and monetary policies. This report helps to identify the effects of higher defense spending on inflation, employment, and productivity over the next several years.

FEW ECONOMIC RISKS FROM BUILDUP IN THE SHORT TERM

According to the results of this study, the Administration's proposed defense buildup should neither rekindle inflation nor stunt employment

1. Among them are Henry Kaufman, Wall Street analyst, and Lester Thurow, MIT economist.

growth over the next few years. This conclusion rests on an assessment of the near-term economic outlook, which is influenced by all aspects of federal budgetary and monetary policies.

Most macroeconomic forecasters currently foresee a sluggish cyclical recovery and continued economic slack that, together, will contribute to a continued gradual slowing of inflation during the next few years. The Congressional Budget Office (CBO) forecast, for example, projects that inflation, as measured by the implicit price deflator for gross national product (GNP), will decline from about 6 percent in calendar year 1982 to less than 5 percent in 1985. 2/ This outlook suggests that neither the military buildup nor the stimulative posture of overall fiscal policy should pose much risk of rekindling inflation in the near term. On the contrary, the risk that appears most acute is that growing deficits and tight credit conditions will choke off interest-sensitive spending, thereby stalling the recovery.

Capacity Utilization. These aggregate forecasts are generally supported by this report's projections of demand and capacity in major defense-intensive industries. Capacity utilization for the total of all manufacturing industries, for example, should reach only 81 percent in 1985. This is below both the 85 percent threshold typically associated with full employment in the economy and the average 83 percent rate achieved between 1948 and 1980. It is also well below rates reached during previous military buildups since World War II.

There are, however, divergent trends within manufacturing. Capacity utilization rates in the defense-intensive, basic-materials industries--steel, nonferrous metals, fabricated metals--will remain far below rates achieved at previous business-cycle peaks. In the steel industry, for example, capacity utilization probably will not exceed 80 percent in 1985, compared with a peak of 96 percent in 1973. On the other hand, rates in the high-technology, defense-intensive sectors--the aerospace, electronics, and instruments industries--may approach levels achieved during the business cycle peaks of the 1970s. Capacity utilization in these sectors should, however, remain below levels reached during the Vietnam buildup. Capacity utilization in electronics, for example, may reach 87 percent in 1985, compared with previous peaks of 89 percent in 1979 and of 97 percent in 1965. Even though these numbers might suggest some tightness in industries like electronics, new capacity can be created quite quickly in such industries, thereby precluding accelerating price increases. One

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2. Congressional Budget Office, **The Outlook for Economic Recovery** (February 1983).

indication of this responsiveness is the rapid turnover of the capital stock--as often as every five to seven years in key segments of the electronics industry, for example. The defense buildup will, however, intensify pressures for the movement of resources from basic industries to high-technology sectors.

Labor Availability. An evaluation of probable labor-market developments similarly shows no inflationary wage pressures. The defense buildup may contribute to future shortages of some scientists, engineers, skilled machinists, and tool-and-die makers--categories of workers that are heavily employed in defense production. But, in the next few years, these will be exceptional cases in a generally bleak labor market. Less than 3 percent of the work force falls into these categories, and current employment and unemployment data suggest that labor-market tightness is not pervasive even in these occupations.

Employment Growth. Increased defense spending should not adversely affect overall employment. Contrary to the assertions of some observers, the results of this analysis suggest that additional dollars spent on defense should provide more or less the same employment as additional dollars spent on most nondefense products. Simulations performed on econometric models suggest that an additional $10 billion in defense spending in fiscal year 1983 could create up to 250,000 additional jobs; the same $10 billion spent on purchases of nondefense goods and services could also create almost 250,000 jobs. An additional $10 billion spent entirely on defense purchases might induce an additional 210,000 jobs. The smaller effect from this added spending reflects the greater proportion of highly paid workers in defense industries.

SOME RISKS POSED BY BUILDUP

Although the foregoing analysis suggests that the defense buildup should not contribute much to increased inflation or lower employment during the next few years, the buildup does raise some economic risks. These risks may grow as time passes and as more is known about the projected economic recovery.

Increases in Weapons Prices

Although bottlenecks in major defense-related industries seem unlikely, some may occur in smaller industries specializing in defense production. Such bottlenecks are unlikely to spawn widespread inflation,but they could drive up some weapons prices and increase the costs of the defense buildup.

Growth rates will be high in many specialized defense-intensive industries. After adjustment for inflation, median annual growth from calendar years 1983 to 1985 could be 7.5 percent in the 100 small industries that are most involved in defense production. This is more than double the 3.6 percent growth rate CBO projects for the economy as a whole. For some of these industries, annual real growth rates may run as high as 20 percent over these years. Production is currently depressed in many of these industries, however, and thus these high growth rates might not lead to bottlenecks.

Unfortunately, available data on industrial capacity are too aggregated to permit careful analysis of possible bottlenecks in these smaller industries. Nonetheless, when compared to production trends in the recent past, projected growth rates suggest that 36 of the 100 industries will be well above their production trends by 1987. These 36 industries include predominantly ordnance, aerospace, selected segments of the electronics and instruments industries, specialty metals, and metal fabrications important for defense, particularly forgings. Together, the industries that could be well above trend account for only 3.7 percent of GNP, which suggests that they would not contribute to widespread inflation. Defense production by these industries, however, accounts for 37 percent of all industrial defense production. This suggests that tightness in these industries could substantially raise defense weapons prices, but not the overall price level.

Reductions in Productivity

The defense buildup could also adversely affect increases in productivity in the late 1980s. A strong surge in private demand for capital goods might occur in those years as a result of economic recovery, pent-up demands for business and consumer capital goods, and investment incentives embodied in current tax laws. In such circumstances, the proposed rapid increase in military spending on procurement, construction, and research and development (R&D) could contribute to shortages of capacity to produce capital goods and to shortages of industry engineers and scientists. Nondefense demands might be curtailed disproportionately in the resulting competition for limited resources, resulting in lower private investment and R&D and, hence, lower productivity. The associated imbalances in markets for capital goods and for technically trained personnel could contribute to a slowdown in economic activity that, in itself, could delay private-sector productivity gains. Note that these risks hinge on the possibility that shifts in demand might be unusually sudden or large, rather than on the theory that defense spending invariably retards productivity. The statistical evidence for this latter proposition is ambiguous.

Increased Inflation Through Faster Economic Growth

The analysis thus far has assumed that the economy will recover sluggishly, in line with the CBO forecast. The future always holds surprises, however. If the private economy recover more rapidly than currently forecast, then the proposed buildup could increase risks of renewed inflation and of crowding out of private borrowing in financial markets.

The economy might, for example, experience an average cyclical recovery. This would entail real GNP growth of more than 6 percent in 1983 and about 16 percent cumulatively for the 1983-1985 period, compared with the CBO forecast of only 2.1 percent in 1983 and about 11 percent cumulatively from 1983 through 1985. If this more robust recovery occurred, capacity utilization in manufacturing would edge above the 85 percent level associated with full employment by the end of 1985. Capacity utilization in each of the seven major, defense-intensive manufacturing sectors, except steel, would exceed historical averages by a wide margin. The outlook for business investment is particularly important. A surge in investment--which is characteristic of an average cyclical recovery--could overextend the high-technology industries which are already forecast to be operating at rather high rates in 1985.

Serious Risk in Longer Run If Buildup Financed with Deficits

In the longer run, as the economy approaches full employment of resources, deficits caused by the defense buildup and other fiscal policies could pose a serious risk. Risks would derive, in part, from budget initiatives taken over the last two years. The Administration and the Congress have boosted defense spending while reducing taxes burdens and curbing growth in nondefense spending. The combination of higher defense spending and lower tax revenues, even after offsetting tax increases in 1982, added more to the deficit than nondefense spending reductions cut from it. As a result, CBO projects that--without further Congressional action--the unified federal deficit will remain around $200 billion through fiscal year 1985 and increase to nearly $270 billion by 1988. Even measured at high-employment levels of income and employment, the deficit is projected to increase from $90 billion in fiscal year 1984 to $130 billion in 1985 and to more than $200 billion in 1988. This suggests that, without changes in current policies, fiscal policy will remain stimulative, with attendant inflationary pressures, as the economy approaches full employment.

The nature of the growing defense budget--with its emphasis on procurement--increases long-run concerns. The Congress, in appropriating money for defense procurement, commits funds years in advance of actual spending. Indeed, one dollar in an average defense procurement contract produces outlays of only about 12 cents in the first year, and outlays from that contract may continue over five years or more. If the Congress commits itself to high levels of defense procurement spending, it could have difficulty moderating fiscal stimulus in the future when the economy approaches full employment of resources.

These observations suggest that some combination of prospective reductions in defense or nondefense spending or increases in taxes are critical to avoid over-stimulating the economy after 1985. Without them, higher inflation would, in time, be likely. If inflation was restrained by monetary rather than fiscal policy, then high interest rates and sluggish economic growth would be probable.

CONCLUSION

The ultimate decision on procurement and other defense spending principally should depend on considerations of national security and priorities for the use of resources. Current forecasts suggest that the proposed rapid defense buildup need not rekindle inflation in the near term. The buildup could, nonetheless, contribute to tightness in some particular industries that do a great deal of defense work. This could raise risks of cost growth and delivery delays in weapons systems. Moreover, a defense buildup financed by large federal deficits that continue even after the economy recovers could damage economic performance in the longer run.

CHAPTER I. INTRODUCTION

The Administration has proposed a succession of large increases in the defense budget for fiscal years 1984 through 1988, following substantial gains in 1980 through 1983. 1/ Defense budget authority was $214 billion in fiscal year 1982. After adjusting for inflation, this was 12 percent higher than in 1981 and 28 percent higher than in 1979. If the Administration's proposed supplemental appropriation is approved, defense budget authority in fiscal year 1983 would be $239 billion, up 7 percent in real terms from 1982. The Administration's defense budget would further increase real defense budget authority by about 6.9 percent annually from 1984 through 1988 (see Table 1).

Large increases in real outlays follow from past and planned increases in real budget authority. Defense outlays in fiscal year 1982 totaled nearly $183 billion, up 7.5 percent in real terms from 1981. The Administration proposes real increases averaging 7.6 percent annually between 1983 and 1988 (see Table 1). Such rapid increases imply substantial shifts in resources from nondefense to defense production. According to Administration estimates, the defense share of gross national product (GNP) will rise from its 1982 level of about 6 percent to 7.7 percent by 1987. 2/

The proposed increases in real defense spending contrast with the marked decline in the early 1970s and the relatively flat trend in the middle of that decade. Consequently, even if defense spending rises as fast as the Administration proposes and thereby reaches 7.7 percent of GNP in 1987, the defense share of GNP will remain substantially below levels

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1. Unless otherwise indicated, defense budget and spending figures in this report refer to the Department of Defense's military budget and spending totals.

2. See Secretary of Defense Caspar W. Weinberger, **Report of Secretary of Defense to the Congress on the FY 1983 Budget, FY 1984 Authorization Request and FY 1983-1987 Defense Programs** (February 8, 1982), p. I-4. The 7.7 percent figure for 1987 is based on the Administration's defense-spending plans announced last year and the current CBO economic forecast, which is less optimistic than the Administration's 1982 economic forecast.

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TABLE 1. DEFENSE BUDGET TRENDS, FISCAL YEARS 1950-1988
(In billions of fiscal year 1983 dollars)

	Budget Authority					
	Total		Investment Accounts a/		Operating Accounts b/	
Year	Amount	Percent Change	Amount	Percent Change	Amount	Percent Change
1950	79.4		20.8		58.6	
1951	224.5	182.9	107.7	418.3	116.8	99.4
1952	288.8	28.6	150.1	39.3	138.7	18.8
1953	235.0	-18.6	106.7	-28.9	128.3	-7.5
1954	175.9	-25.1	51.3	-51.9	124.6	-2.9
1955	149.5	-15.0	40.2	-21.7	109.3	-12.2
1956	153.6	2.7	49.1	22.1	104.5	-4.4
1957	163.2	6.3	57.6	17.4	105.6	1.1
1958	159.6	-2.2	59.4	3.2	100.1	-5.2
1959	170.9	7.1	73.0	22.8	97.9	-2.3
1960	166.0	-2.8	69.0	-5.5	97.1	-0.8
1961	165.5	-0.3	69.1	0.2	96.4	-0.7
1962	188.5	13.9	83.7	21.1	104.8	8.7
1963	191.8	1.7	89.8	7.3	102.0	-2.7
1964	184.6	-3.7	82.4	-8.2	102.2	0.1
1965	177.0	-4.1	72.5	-12.1	104.5	2.3
1966	213.1	20.4	93.2	28.7	119.9	14.7
1967	232.3	9.0	94.0	0.8	138.4	15.4
1968	235.4	1.3	92.2	-1.9	143.2	3.5
1969	226.5	-3.8	79.5	-13.8	147.0	2.7
1970	204.4	-9.7	69.2	-12.9	135.3	-8.0
1971	183.8	-10.1	60.3	-12.8	123.5	-8.7
1972	178.9	-2.7	63.3	4.9	115.6	-6.4
1973	170.8	-4.5	59.6	-5.8	111.2	-3.8
1974	165.2	-3.3	56.4	-5.3	108.8	-2.2
1975	161.5	-2.3	53.2	-5.7	108.3	-0.5
1976	168.2	4.2	60.0	12.8	108.2	-0.1
1977	177.2	5.3	67.7	12.8	109.5	1.2
1978	174.2	-1.7	65.0	-4.0	109.2	-0.3
1979	174.4	0.1	64.3	-1.1	110.1	0.8
1980	178.3	2.3	64.5	0.3	113.8	3.4
1981	200.3	12.3	78.8	22.2	121.5	6.8
1982	223.8	11.7	96.8	22.8	127.1	4.6
1983 c/	239.4	7.0	111.1	14.8	128.3	1.0
1984 d/	263.6	10.1	125.4	12.8	138.2	7.8
1985 d/	292.6	11.0	148.4	18.4	144.2	4.3
1986 d/	308.4	5.4	157.6	6.2	150.9	4.6
1987 d/	320.7	4.0	163.2	3.6	157.6	4.4
1988 d/	333.5	4.0	172.0	5.4	161.5	2.5

(Continued)

SOURCES: Department of Defense; and CBO projections based on DoD estimates.

a. Includes the following accounts: procurement; research, development, testing, and evaluation; military construction; family housing.

b. All accounts not included in footnote a, primarily the following: military personnel, retired pay, operations and maintenance.

TABLE 1. (Continued)

	Outlays					
	Total		Investment Accounts a/		Operating Accounts b/	
Year	Amount	Percent Change	Amount	Percent Change	Amount	Percent Change
1950	69.1		13.2		55.9	
1951	107.3	55.3	21.6	64.3	85.6	53.2
1952	193.9	80.7	58.7	171.4	135.1	57.8
1953	207.3	6.9	81.1	38.0	126.3	-6.6
1954	194.9	-6.0	77.2	-4.8	117.7	-6.8
1955	168.4	-13.6	64.9	-15.9	103.5	-12.1
1956	162.5	-3.5	60.7	-6.5	101.8	-1.6
1957	166.5	2.5	62.4	2.8	104.1	2.3
1958	162.7	-2.3	63.1	1.2	99.6	-4.4
1959	165.4	1.7	66.4	5.1	99.1	-0.5
1960	164.3	-0.7	68.1	2.6	96.2	-2.9
1961	166.9	1.6	70.7	3.8	96.2	0.0
1962	179.6	7.7	75.5	6.7	104.2	8.3
1963	182.6	1.6	82.5	9.3	100.1	-3.9
1964	181.6	-0.6	78.8	-4.4	102.7	2.6
1965	165.6	-8.8	63.6	-19.3	102.0	-0.7
1966	183.2	10.7	69.4	9.1	113.8	11.6
1967	216.1	18.0	82.0	18.2	134.1	17.9
1968	236.0	9.2	90.8	10.8	145.2	8.3
1969	229.6	-2.7	89.5	-1.4	140.1	-3.5
1970	211.6	-7.8	78.1	-12.8	133.5	-4.7
1971	191.9	-9.3	67.7	-13.2	124.2	-7.0
1972	179.4	-6.5	62.0	-8.4	117.4	-5.5
1973	164.0	-8.6	56.9	-8.2	107.1	-8.8
1974	160.5	-2.1	53.9	-5.3	106.5	-0.5
1975	160.6	0.1	52.0	-3.6	108.6	1.9
1976	155.1	-3.4	49.7	-4.4	105.4	-3.0
1977	157.9	1.8	51.8	4.2	106.1	0.7
1978	158.7	0.5	52.4	1.1	106.3	0.2
1979	165.0	3.9	57.5	9.8	107.4	1.0
1980	170.0	3.0	59.8	4.0	110.2	2.5
1981	177.8	4.6	63.8	6.6	114.0	3.5
1982	191.1	7.5	69.5	9.0	121.6	6.7
1983 c/	208.9	9.3	83.2	19.7	125.7	3.4
1984 d/	230.2	10.2	96.2	15.6	134.0	6.6
1985 d/	252.1	9.5	111.3	15.7	140.8	5.1
1986 d/	271.8	7.8	124.7	12.1	147.1	4.5
1987 d/	284.8	4.8	131.3	5.4	153.4	4.3
1988 d/	295.8	3.9	138.0	5.1	157.8	2.9

c. Estimated. Includes Administration's proposed supplemental appropriations.

d. Projected.

routinely achieved in the 1950s and 1960s. In 1969, as well as in 1950-1969 on average, defense outlays were 8.6 percent of GNP.

Recent Congressional action on the defense budget suggests that the Administration's proposals may be cut. The First Concurrent Resolution on the Budget for Fiscal Year 1983 reduced budget authority for the Department of Defense (DoD) and the defense functions of other agencies by 3.8 percent in 1983 and proposed similar reductions for 1984 and 1985. The recently passed Continuing Resolution pared the 1983 budget an additional 4 percent. In analyzing the effects of higher defense spending on the economy, however, this report assumes that real defense budget authority will attain the levels proposed by the Administration for 1984 and beyond. If further cuts occur, the economic effects of the defense buildup will be less profound than suggested in subsequent chapters.

LARGE BUILDUP AND ECONOMIC PERFORMANCE

If the Congress enacts the Administration's current budget proposals, real defense outlays in fiscal year 1985 would be the largest since World War II, and the overall 1982-1987 increase would be the greatest since the Korean conflict (see Table 1). The Administration's plan for 1982-1987 calls for 60 percent real growth in outlays, compared with 43 percent during the Vietnam buildup (1966 to 1968) and 200 percent from a low base during Korea (1951 to 1953). Real defense spending on weapons procurement, research and development, and other investment accounts would grow 106 percent from 1982 through 1987, compared with 43 percent during Vietnam. The investment accounts, representing about one-third of 1982 defense outlays, would contribute nearly 70 percent of the proposed 1982-1987 increase in defense outlays. This reflects the Administration's view that modernization and expansion of the defense capital stock deserves highest priority. 3/

At no time in its history has the United States increased defense spending so rapidly without encountering, at about the same time, a substantial increase in inflationary pressures (see Table 2). In each of the past four major armed conflicts, inflation rose following the outbreak of hostilities (see Table 2). Speculative surges in prices occurred at the beginning of U.S. involvement in World War I, World War II, and the Korean conflict. In the latter two, price controls throughout the period of hostilities suppressed continued inflation. Most recently, the Vietnam buildup is widely regarded as a major cause of accelerating inflation during the 1970s.

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3. Ibid., p. I-6.

TABLE 2. ACCELERATION OF INFLATION DURING PREVIOUS MILITARY BUILDUPS (By calendar year; average annual percent increase)

Start of Buildup	Inflation Rate for Three Prior Years a/	Inflation Rate for Three Subsequent Years b/
1917	8.7	16.0
1941	1.5	6.2
1950	2.6	3.6
1965	1.4	3.3

a. Average annual rate of increase in Consumer Price Index for three years ending in the year when the buildup began.

b. Average annual rate of increase in Consumer Price Index for three years following the year the buildup began (for example, in the case of World War II, 1942-1944).

Some respected economists have warned that the prospective buildup would likely have similarly deleterious effects, not only on aggregate prices but also on productivity and on the efficacy of the defense budget itself. Wall Street economist Henry Kaufman has voiced concern that the defense buildup--if it is financed through greater deficits--could contribute to renewed acceleration of inflation and greater instability and crowding out in financial markets. 4/ MIT economist Lester Thurow has expressed similar concerns. In addition, he has suggested that the proposed buildup would drain critical resources from civilian production, thereby undermining productivity and international competitiveness. 5/ Charles Schultze,

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4. Henry Kaufman, Speech to the National Press Club (April 22, 1981).

5. Lester Thurow, "How to Wreck the Economy," **The New York Review of Books** (May 14, 1981), vol. 28, pp. 3-5.

former chairman of the Council of Economic Advisers, has cautioned that the proposed buildup may be too rapid, risking bottlenecks, cost overruns, and later deep compensating cuts in defense readiness. 6/

Conversely, Administration analysts do not foresee such problems. In a statement delivered by the then chairman of the Council of Economic Advisers in October 1981, the Administration suggested that the problems with bottlenecks and inflation associated with past military buildups would not plague the current buildup, in part because "the expansion of defense production is not an unplanned surprise, but rather a gradual planned buildup over several years." 7/ Casper Weinberger, in his Annual Report to the Congress for Fiscal Year 1983, stated that "fears that the defense budget of this Administration will strain the economy are unfounded." 8/ He noted that inflation rates averaged much lower in the 1950s and 1960s when defense commanded a much higher share of GNP than in recent years.

PLAN OF THIS STUDY

This report evaluates these conflicting claims by analyzing how the proposed buildup would affect the balance between demand and supply in key product and resource markets. The analysis emphasizes sectors of the economy that may be influenced substantially by a growing defense budget. Even in most of these sectors, however, economic developments reflect predominantly the far greater spending that is unrelated to the defense effort. This report does not analyze all of the varied factors influencing nondefense spending. Instead, it examines whether the proposed increases in defense spending, when combined with likely nondefense spending, would risk adverse economic consequences.

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6. Charles Schultze, "Economic Effects of the Defense Budget," **The Brookings Bulletin** (Fall 1981), vol. 18, no. 2.

7. Murray L. Weidenbaum, **Defense and the Economy in the 1980s,** Statement before the Subcommittee on Economic Goals and Intergovernmental Policy of the Joint Economic Committee (October 7, 1981).

8. Caspar W. Weinberger, **Report of Secretary of Defense to the Congress on the FY 1983 Budget, FY 1984 Authorization Request and FY 1983-1987 Defense Programs,** p. I-9.

Chapter II examines the outlook for inflation. The chapter first reviews the near-term outlook. It then discusses possible inflationary risks, which arise mainly after 1985. The chapter focuses on likely developments in sectors affected disproportionately by rising defense spending. This focus reflects the concern that the buildup could cause bottlenecks in particular industries.

Chapter III reviews evidence on how the defense buildup might affect growth in productivity and in employment. Both issues relate to the particular pattern of resource demand implied by the buildup. The chapter begins by examining how the defense buildup might affect demand for the specific resources that are often considered important to productivity growth. The chapter concludes with an analysis of the types and numbers of jobs that are created through defense and nondefense spending.

THE DEFENSE BUDGET, NATIONAL PRIORITIES, AND ECONOMIC POLICY

The choice of an appropriate defense budget is primarily a question of national priorities, involving assessments of the requirements for national security and of the importance of alternative uses of resources. This choice probably should not be influenced greatly by the economic outlook, since short-term effects of defense spending on the overall economy can, in principle, be offset or achieved by other policies. For example, the decision to procure the B-1 bomber should not be influenced by the observation that production of that aircraft would provide employment or add to the deficit. Employment that would be attributable to the B-1 could be achieved by other means. The deficit could be reduced even while buying the B-1. The crucial question is whether the B-1 adds enough to national security to justify its cost.

The choice of an appropriate overall fiscal and monetary policy is both a question of national priorities and a question of economic stabilization and growth. In this latter regard, the choice will be influenced by the economic outlook and would be assisted by information on how the defense budget influences that outlook. Thus, especially in a period of great concern over the performance of the U.S. economy, questions are often raised about the economic effects of defense spending. This report helps answer those questions.

CHAPTER II. DEFENSE SPENDING AND INFLATION

The near-term outlook for the economy and defense-intensive industries is analyzed in the first part of this chapter. Macroeconomic forecasts for 1983-1985 generally foresee sluggish economic growth and depressed resource utilization that will contribute to continued moderation of inflation. This suggests that neither the proposed military buildup nor the current stimulative fiscal policy poses much risk of rekindling inflation in the near term. Analysis of major industries influenced by defense spending generally bears out this assessment. Most manufacturing industries, and the basic materials industries in particular, should have ample capacity through 1985. Although a few defense-intensive, high-technology industries may, by the end of 1985, reach the capacity utilization rates of business cycle peaks in the 1970s, even these industries should operate at rates below those attained during the Vietnam buildup. Moderately tight capacity limited to these sectors should not add significantly to inflation overall, particularly since these industries have, in the past, demonstrated the capability to expand rapidly in response to growth in demand.

Although current forecasts predict a continued downtrend in inflation, the proposed defense buildup does entail risks. These risks are discussed in the second part of this chapter. The buildup could contribute to bottlenecks in smaller, industrial sectors that are strongly affected by defense spending. Such bottlenecks are most likely to affect only defense prices rather than prices throughout the entire economy, however. The buildup could contribute to more general inflationary pressures if the pending recovery in private spending is much more rapid than currently projected. Finally, the buildup could adversely affect economic performance in the longer run, if it is financed by continued high deficits as the economy approaches full use of resources.

NEAR-TERM OUTLOOK FOR THE ECONOMY

Most macroeconomic forecasts now predict a slow recovery, with inflation trending down during the next few years, despite an expansionary federal budget policy that includes tax cuts, high deficits, and rapid rises in defense spending. 1/ The most recent CBO baseline forecast, for example,

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1. See Data Resources, Inc., **The Data Resources Review of the U.S. Economy** (October 1982); Wharton Econometric Forecasting

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projects that inflation, as measured by the implicit price deflator for gross national product (GNP), will decline from an annual rate of increase of 6 percent in calendar year 1982 to less than 5 percent in 1985. 2/ The following factors account predominantly for the projected slowing of inflation:

- o Resource utilization in 1982 stood at its lowest point since the beginning of World War II; the unemployment rate averaged almost 10 percent for the year, higher than at any time since 1941; and manufacturing capacity utilization languished around 70 percent, a near record low.

- o The projected economic recovery is unusually slow, largely because the Federal Reserve's monetary policy is expected to be restrictive, leaving little room for economic expansion.

- o Increases in food and energy prices are expected to remain moderate because of continued bountiful harvests and ample supply in the world oil market.

The projected moderation in food and energy price increases obviously contributes directly to moderation in overall inflation. More fundamentally, the inflation forecast reflects the view that low and only slowly climbing resource utilization will temper both wage demands by workers and price markups by producers. Several studies of price behavior substantiate the view that slack demand gradually slows inflation and that excess stimulus increases inflation. 3/ In fact, widespread weaknesses in product and resource markets during the past three years already appear to

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Associates, **Quarterly Report** (Third Quarter 1982); Chase Econometrics Associates, **Long Term US Macroeconomic Forecast and Analysis** (Third Quarter 1982); and Organization for Economic Cooperation and Development (OECD), **OECD Economic Outlook** (September 1982).

2. See Congressional Budget Office, **The Outlook for Economic Recovery** (February 1983) for detailed descriptions of the current CBO forecast.

3. See Arthur Okun, "Efficient Disinflationary Policies," **American Economic Review**, vol. 68, no. 2 (1978); Robert J. Gordon and Stephen R. King, "The Output Cost of Disinflation in Traditional and Vector-Autoregressive Models," **Brookings Papers on Economic Activity** (1982:1), pp. 205-44; and Charles Schultze, "Some Macro Foundations for Micro Theory," **Brookings Papers on Economic Activity** (1981:2) pp. 577-592.

have caused more than a two percentage point drop in the underlying inflation rate. 4/

This view helps explain not only why inflation is expected to slow during the next few years, but also why inflation accelerated during earlier military buildups. In contrast to the current outlook, rising defense spending during the earlier buildups contributed to widespread overheating of product and resource markets. In each earlier period, the speed of GNP growth and the utilization of resources ranged above bounds believed to be associated with accelerating inflation (see Table 3).

A more vigorous recovery than that forecast by CBO certainly is possible, particularly if the Federal Reserve pursues a much less restrictive monetary policy than anticipated in the current CBO baseline forecast. In such a case, the risks of rekindling inflation would increase markedly, especially after 1985. These risks are discussed later in this chapter. For the near term, however, many analysts believe that the principal risk is that the recovery will be even weaker than shown in the CBO baseline forecast. Weaker growth, and possibly another recession, could occur if burgeoning budget deficits in combination with restrictive monetary policy created tighter credit conditions than assumed in the forecast. 5/ Such developments would, of course, reduce even further the risks of renewed inflation.

NEAR-TERM OUTLOOK IN MAJOR DEFENSE-INTENSIVE INDUSTRIAL SECTORS

Analysis of capacity utilization rates in major industrial sectors strongly influenced by defense spending generally corroborates the overall projections just discussed. Inflationary bottlenecks appear unlikely through 1985. Markets for high-technology products probably will be tighter than those for basic materials.

Capacity Utilization in Major Defense Sectors

Defense spending clearly influences some sectors more than others. Table 4 shows the ten major industrial sectors that have the greatest shares of their output induced by defense purchases. Ordnance, aerospace,

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4. Congressional Budget Office, **The Outlook for Economic Recovery** (February 1983).

5. As an example of such a slow-growth scenario, see the CBO low-growth path in **The Outlook for Economic Recovery**.

TABLE 3. MEASURES OF DEMAND STIMULUS DURING MILITARY BUILDUPS (By calendar years)

	Real GNP Growth (percent, annual rate)		Civilian Unemployment Rate (percent)		Capacity Utilization in Manufacturing (percent)	
Year	Actual for Three Prior Years a/	Average in Expansions b/	Actual	At Full Employment c/	Actual	At Full Employment d/
1944	12.4	4.4	1.2	NA e/	NA e/	NA e/
1953	5.2	4.4	2.9	4.0	89	85
1968	4.4	4.4	3.6	4.5	87	85
1985	3.6f/	4.4	9.0f/	6.0	81 f/	85

SOURCES: Bureau of Economic Analysis, Department of Commerce; Bureau of Labor Statistics; and CBO projections.

a. Average annual rate of increase in real GNP for three years following the year the buildup began (for example, in the case of World War II, 1942-1944).

b. Average annual rate of growth in periods of cyclical expansion since 1949.

c. Estimates of the full-employment unemployment rate based on estimates of potential GNP compiled by the Council of Economic Advisers. According to some theories, lower unemployment rates cause inflation to accelerate.

d. Levels of manufacturing capacity utilization associated historically with full employment of labor. Estimated by least-squares regressions relating the potential GNP gap to manufacturing capacity utilization.

e. NA = not available.

f. Forecast.

TABLE 4. INDUSTRIES AFFECTED SUBSTANTIALLY BY DEFENSE EFFORT IN CALENDAR YEAR 1980

Industry	Share of Industry's 1980 Gross Output Induced by Defense Purchases a/	Defense Generated Value Added as a Share of 1980 Total Defense Outlays
Ordnance	60.9	4.8
Transportation Equipment	15.9	9.0
Aerospace	39.3	8.0
Shipbuilding	54.2	2.1
Electrical Equipment/ Components	11.2	5.6
Mining	6.7	4.5
Instruments	6.2	1.1
Primary Metals	5.8	2.0
Iron and steel	5.2	1.1
Nonferrous metals	6.5	0.9
Petroleum	5.6	1.8
Transportation/ Communications	3.4	7.9
Fabricated Metals	3.3	1.3
Machinery	2.7	2.0
All Industry	3.2	50.0

a/ Shares include production of finished goods for defense and intermediate goods to be used for production of those finished goods.

shipbuilding, and electrical equipment head the list--each with more than 10 percent of their output induced by defense--because they supply a large share of the finished goods acquired by the Department of Defense (DoD). Primary and fabricated metals industries are important, because other industries require their products for the manufacture of ships, aircraft, and tracked vehicles. The importance of mining reflects both DoD's substantial use of petroleum products and defense producers' substantial use of metals.

Projections of capacity utilization for these major industries were derived from CBO forecasts of the Federal Reserve Board's indexes of industrial production and capacity. The industrial production forecasts were developed from the Data Resources, Inc. (DRI) economic model, assuming that real defense outlays will grow as projected by the Administration and that private spending will recover sluggishly as shown by the CBO forecast. 6/ CBO used its own procedure to produce the forecasts of the corresponding industrial capacity indexes (see Appendix C for a description). The following discussion focuses on the outlook for the six most critical of these industries and for manufacturing overall, which are shown in Table 5. 7/

In manufacturing industries, including those most influenced by defense spending, projections show utilization rates bottoming out at low levels in 1982 because of the recession (see Table 5). As the economy recovers and defense spending climbs from 1982 to 1985, output in these

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6. These projections of industrial production indexes reflect the use of detailed information on how defense expenditures for each year from 1982 through 1985 will translate into purchases of end products from different industries. This represents a refinement of the conventional DRI model, which uses 1977 expenditure shares in breaking down defense spending into purchases from various industries.

7. Data limitations precluded development of capacity forecasts for ordnance, transportation, and communications. Ordnance accounts for a tiny share of nondefense spending and therefore should have little effect on overall inflation. Business conditions in transportation and communications parallel those of the general economy. As already noted, forecasts foresee a slack economy through 1985. There is no discussion of results for petroleum and mining. High oil prices and energy conservation should keep petroleum refiners in a slump. Weaknesses in metals industries and in petroleum imply the same for mining.

TABLE 5. OUTPUT GROWTH AND CAPACITY UTILIZATION IN DEFENSE-INTENSIVE INDUSTRIES FOR CALENDAR YEARS 1981-1985, PROJECTIONS AND HISTORICAL COMPARISONS

	Output Growth (annual percent rates)			Capacity Utilization Rates (percent)						
	Actual	Average	Projected	Actual	Projected		Cyclical Highs			Average
Components	1971-1973	1948-1980	1982-1985	1980	1982	1985	1978-1979	1973-1974	1965-1966	1948-1980
Aerospace and Shipbuilding	14.5a/	5.6	9.5	87	70	87	89	74	92	73
Instruments	12.1	6.2	5.4	83	75	86	87	88	90	82
Electrical Equipment and Components	15.2	6.5	7.7	85	77	87	89	87	97	83
Fabricated Metals	9.8	3.1	6.7	73	60	75	84	85	87	79
Iron and Steel	12.8	1.3 b/	13.8	70	48	77	86	98	94	84
Nonferrous Metals	11.9	3.5 b/	7.9	80	67	85	92	96	100	85
All Manufacturing	9.5	4.1	5.9	79	70	81	86	88	91	83

NOTE: Projections based on about 8.5 percent annual real growth in defense outlays through fiscal year 1985.

a/ 1977-1979 growth rate.

b/ 1948-1979 average growth rate.

industries will grow at above-average rates, though short of the very rapid pace achieved in 1971-1973. Despite this growth, however, capacity utilization for manufacturing as a whole should remain below average rates through 1985. Specifically, capacity utilization for all manufacturing is projected to be 81 percent in 1985, compared with an average of 83 percent in 1948-1980 and recent cyclical peaks of 86 to 91 percent.

There are divergent trends within manufacturing. Projections show that capacity utilization rates in three high-technology, defense-intensive industries--aerospace, instruments, and electronics--may by the end of 1985 reach levels near those achieved during cyclical peaks in the 1970s (see Table 5). Even though capacity utilization should not rise as high as during the Vietnam buildup, these utilization rates suggest some pressure on prices may develop. Fortunately, these high-technology industries are dynamic sectors that have, in the past, experienced moderately high operating rates and fast growth without sharp increases in prices. As the detailed discussion below suggests, there are reasons why this experience may recur. Moreover, none of these industries are basic-materials industries, which could spread rising costs to the economy as a whole.

In contrast to the high-technology industries, the basic materials industries--fabricated metals, iron and steel, and nonferrous metals--should have substantial surplus capacity through 1985. Capacity utilization in these industries will be at or below average levels and well below levels of past cyclical peaks (see Table 5).

Analysis of the Outlook for Selected Defense-Related Industries

The evidence presented in the preceding section suggests a guardedly optimistic outlook for inflation. This cautious optimism is generally supported by further analysis of the specific circumstances of six defense-intensive subsectors within the broader industries analyzed above.

Primary Metals. 8/ Although limited rebounds in product prices will doubtless occur as the economy recovers, capacity constraints and accelerating price increases are unlikely in primary metals industries during the next few years. Capacity utilization is currently depressed and is projected to increase only gradually, in part because of ample foreign supplies. The long-term viability of many metal producers depends on

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8. Primary metal industries include firms primarily engaged in the refining and alloying of metals and the production of metal shapes and forms such as sheet, bar, and plate.

restoration of more typical levels of demand for domestic motor vehicles and construction. Increased defense-related orders, while welcome, are not enough by themselves to raise capacity utilization significantly.

The outlook for the U.S. steel industry, for example, is grim, offering little chance of a rebound to high capacity utilization rates or of much increase in prices. Assuming substantial improvements in automobile and construction markets, capacity utilization should increase from 1982's depressed level of below 50 percent--the lowest annual level in 40 years--to near 80 percent in 1985 (see Figure 1). This would represent a return to nearly average operating levels, but not to the excessively tight conditions of 1973-1974, when utilization rates often stood near 100 percent. Rather than the risk of bottlenecks, there is more chance that demand will remain soft, eventually causing major shutdowns and bankruptcies. This possibility hinges largely on future foreign competition.

The outlook for aluminum producers, while more favorable than for steel, does not point to a return to extremely tight supply conditions. Aluminum benefits from stronger ties to expanding defense production and less competition from abroad. But the market for aluminum is currently glutted, and prices are generally insufficient to cover costs. 9/ The projected improvement in capacity utilization--from about 65 percent in 1982 to about 85 percent in 1985--should, therefore, allow some improvement in prices (see Figure 1). But 85 percent is still below the historical average capacity utilization rate of 90 percent for aluminum. Capacity pressures and accelerating price increases, therefore, seem unlikely during the next few years, unless there is an unexpectedly strong resurgence in the commercial aircraft market in addition to rebounds in construction and motor vehicles.

Production capacity for the other large volume nonferrous metals (copper, lead, zinc, and magnesium) should be more than adequate through 1985, unless large-scale shutdowns occurred, followed by unexpected surges in demands, which is unlikely. (See Figure A-1 in Appendix A for an overview of nonferrous metals production and capacity.) Operations currently are severely depressed--with production generally down to about 70 percent of capacity--largely because of the moribund construction and automobile markets. Primary producers have faced shrinking or only

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9. The U.S. market price of aluminum has averaged between 40 and 50 cents per pound throughout most of 1982, while, according to industry analysts, the cost of production for U.S. producers has stood near 60 cents per pound. "Kaiser Aluminum in Squeeze," **The New York Times,** December 3, 1982, pp. D1, D4.

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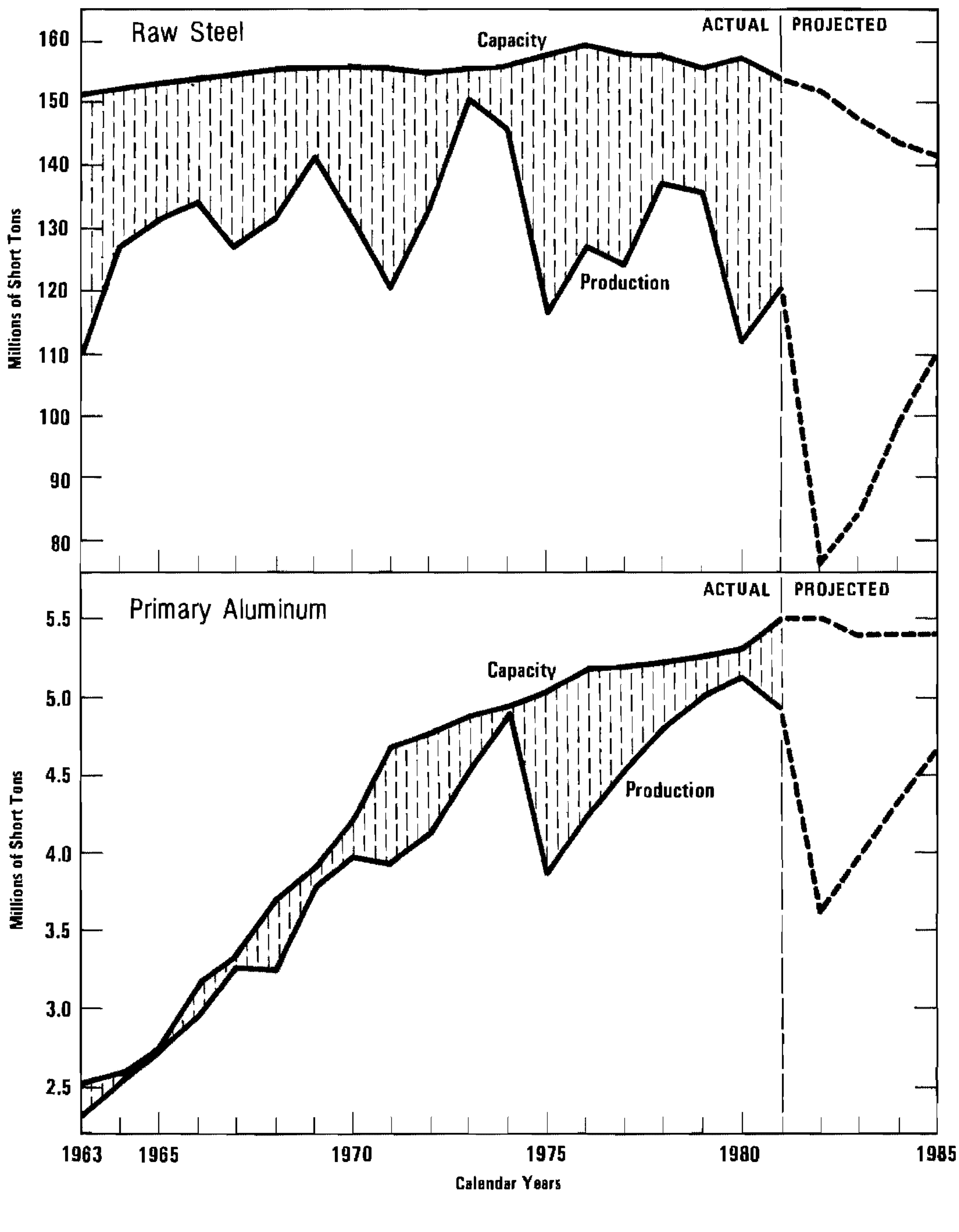
Figure 1.
U.S. Raw Steel and Primary Aluminum Production and Capacity



slowly growing markets for years, due to rising supplies of both imports and secondary (recycled) metal. These nonferrous metals are more influenced by world market conditions than is aluminum. Even from a worldwide perspective, however, there is little reason to expect robust demand and sharply increased prices during the next few years, since the economic outlook abroad is not substantially better than in the United States. 10/

The risks of shortages may be greatest for titanium sponge, a key material used in aircraft forgings and other high-technology defense and nondefense applications. 11/ A recurrence of the severe shortages of 1979-1980 appears unlikely, however, since they reflected a number of special circumstances. The production of commercial transport aircraft unexpectedly more than doubled between 1977 and 1980. The Soviet Union, furthermore, withdrew as a supplier in the world market, apparently because of its own growing defense requirements for the metal. Since 1980, commercial aircraft orders have dropped sharply and titanium sponge production is once again well within capacity. Additional capacity is coming on stream, and commercial aircraft orders are not expected to rise near the 1979-1980 level before 1985. (See Figure A-1 in Appendix A for data on titanium sponge.)

Castings and Forgings. 12/ Despite shortages and selected large price increases in 1979-1980, supplies of castings and forgings should be adequate through 1985 and price pressures should remain moderate. Beyond 1985, the outlook is more uncertain. Long-term projections show demand continuing to grow, rising above recent production trends. It is unclear whether producers currently have sufficient capacity--with the requisite qualities--to provide for that continuing growth in demand.

Castings and forgings produced to stringent military specifications were extremely scarce in 1979-1980. Lead times for such items increased by two- to threefold from the end of 1977 to the end of 1979 (see Table A-1 in Appendix A). Prices rose faster than the general inflation rate.

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10. See OECD, **OECD Economic Outlook.**

11. Titanium sponge is the initial metallic form of titanium obtained in the process of extracting titanium metal from the ore. Titanium has anti-corrosive and strength-to-weight properties that are useful in commercial aircraft and several weapons systems.

12. Casting is the formation of metal shapes by solidification of molten metal within a mold. Forging is a form of hot working of metal, done by hammering or pressing, usually with a die for controlling shape.

Shortages for nonmilitary uses were not nearly as pronounced, in part because of slumping automobile demand. Although order backlogs grew and lead times lengthened, they showed that the scarcity of civilian products was not nearly as acute as for military-quality items (see Tables A-2 and A-3 in Appendix A). Production at some plants was and has remained below maximum capacity.

The existence of surplus capacity at some plants does not necessarily imply that industry production could expand to satisfy demand fully in a period similar to 1979-1980. Producers specialize and plant capacity is not fungible. It is unlikely, therefore, that industry production could reach the "rated" industry capacity, which is the total estimated tonnage capacity of all plants in the industry. Tonnage shipments in 1978-1979, when order backlogs grew and lead times lengthened, provide a more realistic estimate of industry production limits.

Compared with forecasts of production, these estimates indicate that the current capacities of the castings and forgings industries are sufficient to satisfy demand through 1985 (see Figures 2 and 3). To satisfy demand beyond 1985, additional capacity to produce steel castings and nonferrous castings and forgings may be needed. (Note, however, that some analysts contend that raw materials constrained production in 1978-1979, and that realistic capacity is closer to the higher 1973-1974 shipments levels.)

<u>Shipbuilding</u>. Sharp increases in shipbuilding prices appear unlikely, because the shipbuilding industry will have abundant plant capacity for the foreseeable future and abundant manpower for the near term. Commercial shipbuilding is depressed worldwide and is not expected to recover soon, because of the collapse of the large-tanker market. At present, the slump in the construction market has cut competition for some of the skilled workers needed in shipyards. Together, these trends have freed large amounts of shipbuilding capacity and manpower for use in building conventionally powered vessels, though problems may still remain for some nuclear-powered naval vessels. (See Table A-4 in Appendix A for data on capacity of U.S. shipyards.)

There is concern, however, that much of the available shipbuilding capacity in this country is obsolete. For many years, the domestic industry has been uncompetitive in world markets. It owes its tenuous existence mainly to laws requiring that U.S. naval vessels be built domestically and to government subsidies and laws favoring commercial construction in U.S. yards.

These considerations suggest that the United States pays more for ships than it would if it made greater use of foreign shipyards. They do not

Figure 2.
U.S. Shipments of Castings for Iron, Steel, and Aluminum

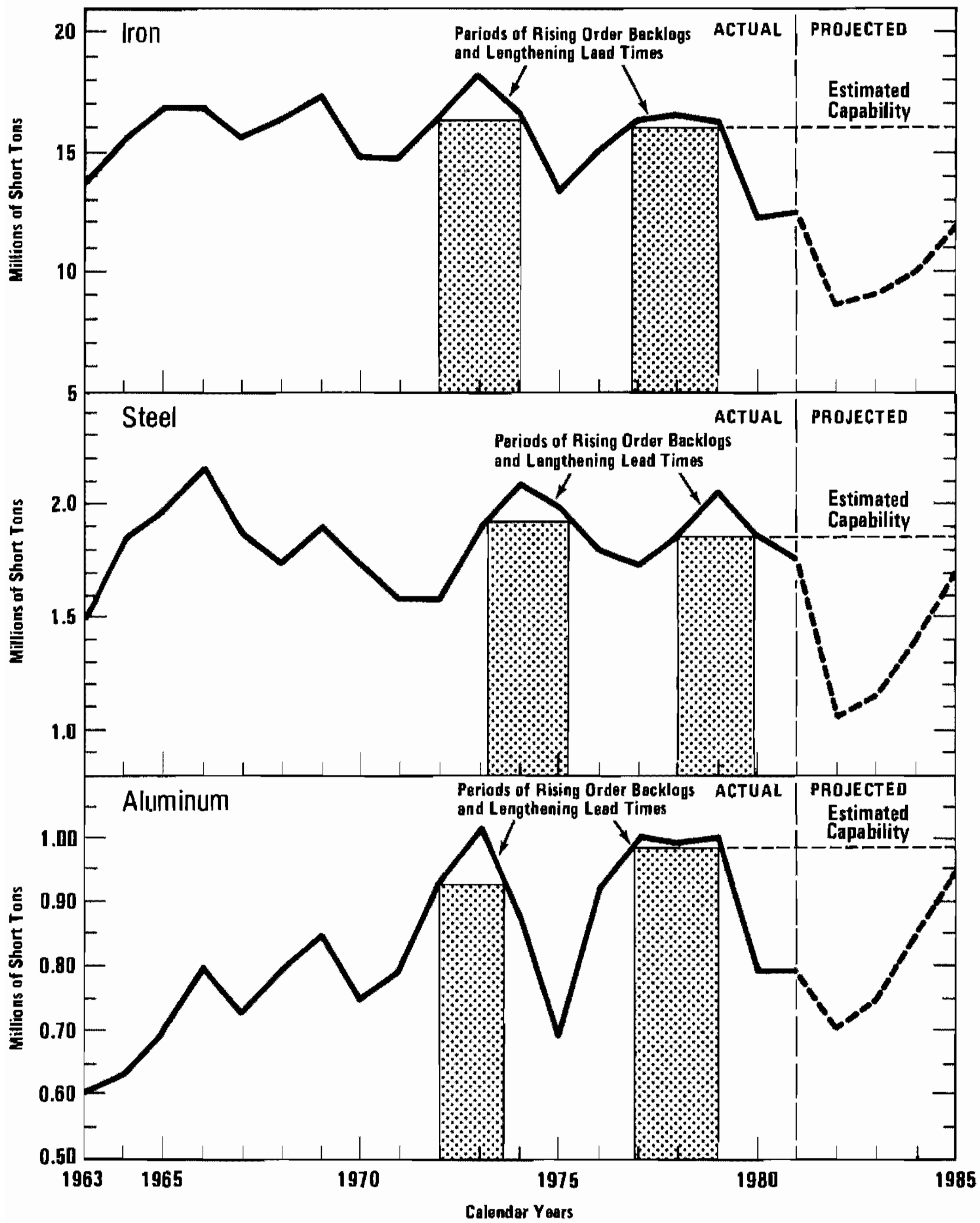
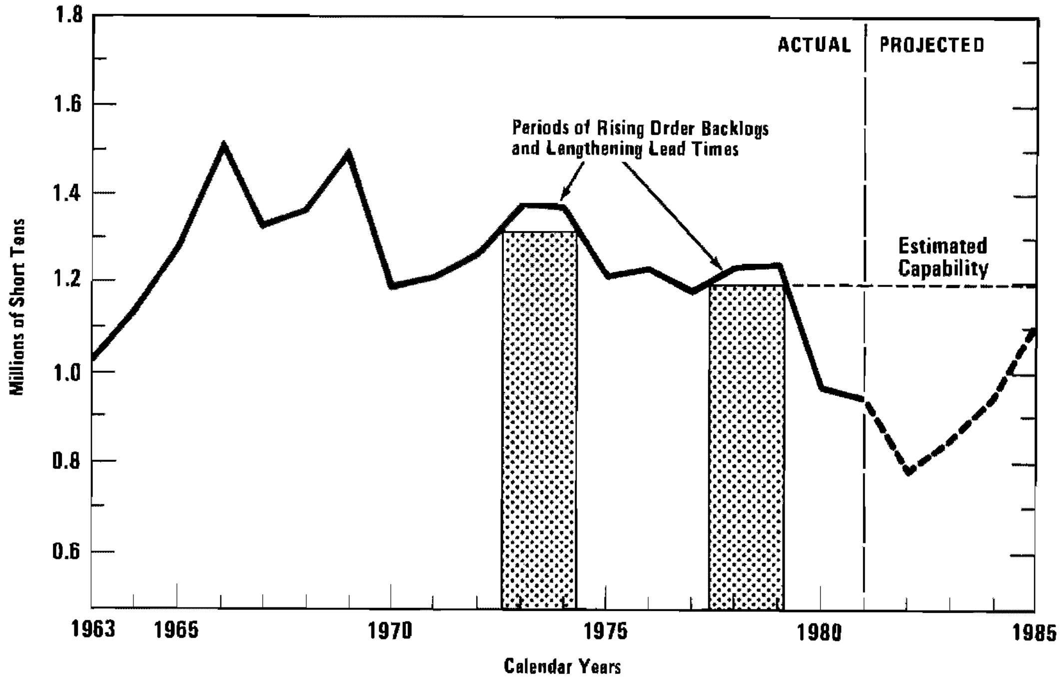


Figure 3.
U.S. Shipments of Custom Impression Die Forgings



imply that shipbuilding costs will escalate as a consequence of growing naval orders. In most cases, expanding naval orders will merely compensate for shrinking commercial demand. Thus, there is little evidence that less efficient marginal capacity will be used.

Aerospace. The outlook for the aerospace industry is, as always, highly uncertain. Weak commercial demand should keep capacity utilization low for the next one to two years. Improving commercial demand coupled with continued increases in military procurement could well lift capacity utilization in 1985 to near its 1979 peak. Most analysts believe, however, that if the 1983-1985 commercial upturn is gradual, as now anticipated, aerospace industry capacity will be adequate over that period. One indication of this is that aerospace employment in late 1982 was about 25 percent below its 1968 peak (see Table A-5 in Appendix A). Assuming a gradual upturn in commercial orders, it will take more than three years for employment to reach that earlier level. In addition, data collected by the

Department of Defense indicate that military airframe and jet engine manufacturing facilities have ample capacity to handle likely demand during the next few years. 13/ The Navy, for example, reports that the prime contractor for each of its major aircraft has a maximum production capacity at least twice current shipments.

The outlook toward the end of 1985 and beyond is more problematical. Projections show military production continuing to rise. A surge in commercial aircraft demand also is possible starting in the mid-1980s. Many commercial carriers have plans to modernize their fleets with the new generation of quieter, fuel-efficient transport aircraft that are designed for effective operation over a series of short to medium hauls, as required in today's market. The airlines have deferred these plans, following the decline in commercial traffic that has precipitated a severe squeeze on earnings. Improved economic conditions over the next three years could well unleash those pent-up demands. If this occurs, the aircraft industry would be severely tested in the latter 1980s. Forecasts assuming a continued increase in military production and a strong rebound in commercial orders show not only a strong recovery between 1982 and 1985, but also sustained double-digit increases in production into the latter 1980s (see Table 7 on p. 30).

Electronic Components and Products and Scientific Instruments. Tightness could develop within a few years in markets for many electronic components and products. This outlook reflects both the explosive growth in private-sector applications of digital technology, as well as the increasingly pervasive use of electronics in weapons systems. These factors, combined with cyclical influences, yield forecasts for communications equipment and, to a lesser extent, for electronic components that show production requirements rising above trend by the mid-1980s (see Figure 4). Lead times of components, however, have been falling throughout the last year and one-half and now are only about half as high as in 1979 when markets were tight (see Table A-6 in Appendix A). This suggests that producers could comfortably accommodate some of the prospective growth in demand.

It is hard to foresee extended problems in such dynamic sectors in which production has often grown rapidly. In the case of electronic components, growth averaged 11.5 percent annually between 1963 and 1980. Prices, nevertheless, have generally increased moderately, and have

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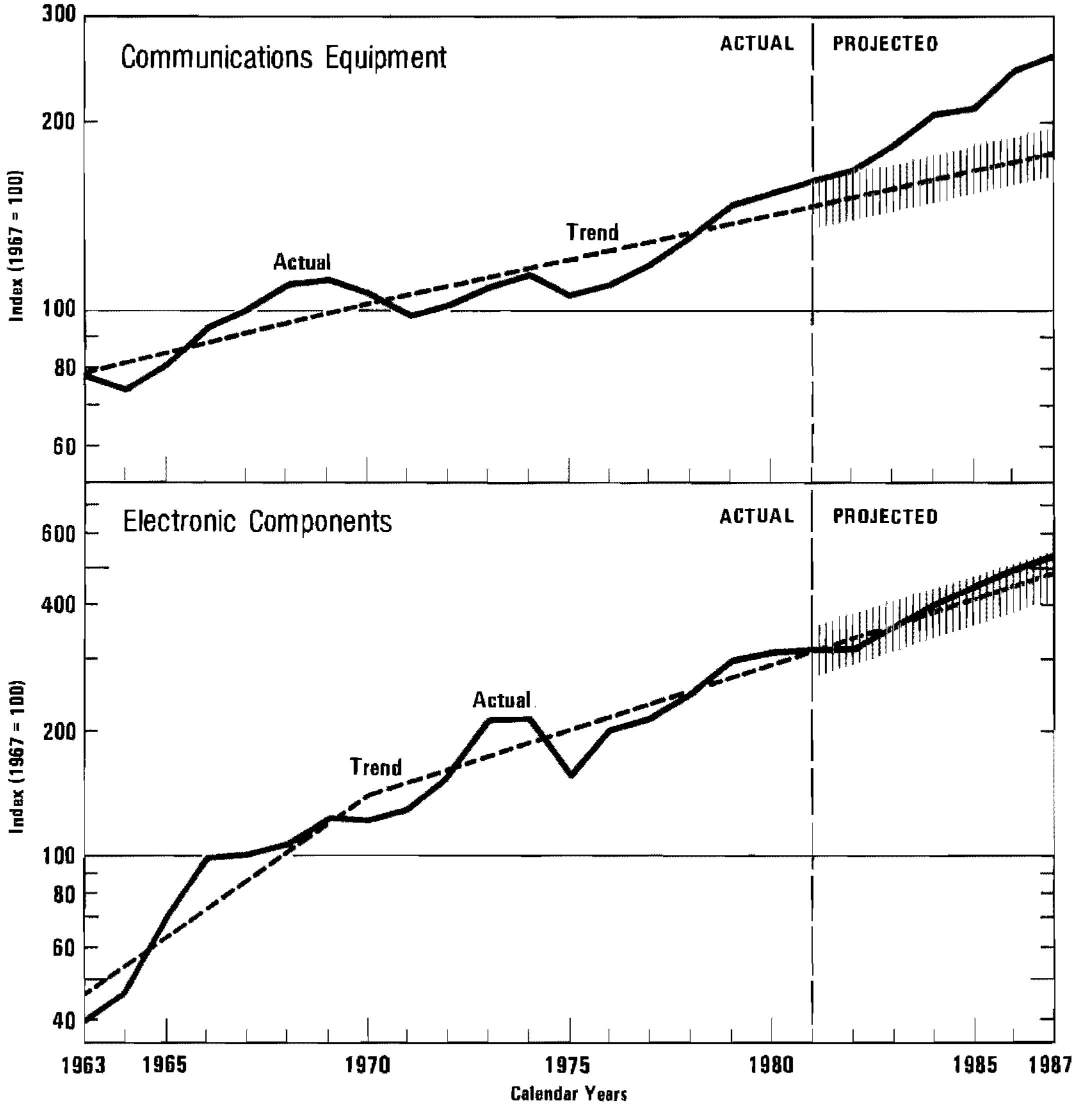
13. Based on confidential reports by defense contractors.

Figure 4.
U.S. Actual and Trend Production of Communications Equipment and Electronic Components



NOTE: The shaded areas in this figure show "one standard-deviation band" about the trend lines. A standard deviation indicates how far from its average (here a trend line) a statistical series can be expected to be. Projections that are more than one standard-deviation above trend may be regarded as unexpectedly high. Projections well within the range determined by the band may be regarded as close to normal. One standard-deviation is calculated as the square root of the average squared difference between actual annual production and trend production over the 1965-1980 period.

actually fallen substantially for state-of-the-art components. 14/ Surges in demand have occasionally caused sharp price increases in exotic raw materials, such as tantalum and gold, forcing up component prices. Such episodes have typically been short-lived, however, as innovations abound and can be directed towards cost avoidance. The fast pace of production growth and innovation implies that capacity can be expanded and modernized extremely rapidly. This is further reflected in fast turnover of capital--approaching five years in some branches of electronics.

Growing availability of imports is another factor contributing to an elastic supply of electronic components. In 1978, the United States ran its first trade deficit with Japan in integrated circuits ($3.7 million). By 1980, the deficit had reached $183 million. The penalties for inadequate capacity can be stiff, moreover. Some analysts believe that Japan achieved its dominant position in the market for state-of-the-art computer memory (the 64K RAM chip market), because U.S. chip manufacturers were not aggressive enough in establishing new capacity. 15/

The outlook for scientific and related instruments is similar in many respects to that for the electronics industry. Production requirements will likely rise above trend by the mid-1980s (see Table 7). Other developments, however, probably will counter any price pressures that might otherwise be stimulated by growing demand. New, improved products appear frequently. Advances in electronics will continue to facilitate low-cost improvements in the more sophisticated scientific instruments. Increasing competition from abroad should discipline pricing of many simpler devices. In the case of engineering and scientific instruments, the market share of imports has increased more than threefold over the last decade. 16/

Defense Spending and Labor-Market Conditions

Even if plant and equipment facilities can accommodate growing demand, the defense buildup could contribute to bottlenecks and to wage-

14. Bureau of Labor Statistics' producer price indexes for various integrated circuits fell between 33 and 46 percent from 1975 to 1981, despite growing demand.

15. See Masayoshi Kanabayashi, "Japanese to Make 64k RAM Chips at Plant in US," **The Wall Street Journal**, March 2, 1982, p. 35.

16. U.S. Department of Commerce, **U.S. Industrial Outlook 1982** (1982), p. 221.

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price pressures by exacerbating shortages of skilled workers. Although there appear to be few, if any, skill shortages in today's slack economy, some analysts foresee future shortages of some types of engineers, computer specialists, and skilled craftsmen such as machinists and tool and die makers. Defense spending is an important determinant of employment in each of these occupational categories (see Table 6).

Recent trends in job vacancies and employment testify to the potential for shortages in these occupational categories once the economy recovers. Technical job vacancies, measured by an index of help-wanted ads, reached a 10-year high in 1979. 17/ Although it has dropped since 1980, the vacancy index remains above the levels that prevailed in the early 1970s. Employment prospects for engineers, particularly for aerospace engineers, improved during the late 1970s, following several years of no growth (see Table A-7 in Appendix A). In 1979, for example, at the height of the recent commercial aircraft boom, the Current Population Survey found virtually no unemployed aerospace engineers. Employment of computer specialists has also grown rapidly for years and unemployment rates have remained low. Growth in the employment of skilled craft workers, on the other hand, has generally been slow and unemployment rates have trended upwards, with variations paralleling the business cycle (see Table A-8 in Appendix A). Demand for skilled machinists and tool-and-die makers, however, improved markedly in the latter 1970s with accompanying jumps in wage rates.

The supply of these skilled workers, however, may be responding dramatically to growing demand. The National Center for Educational Statistics projects that, in contrast to overall declining college enrollments, the number of students graduating with degrees in engineering will increase by nearly 40 percent between 1979 and 1985. The number with bachelor's degrees in computer and information science expanded by 67 percent between 1972 and 1980. Past shortfalls of skilled machinists and tool-and-die makers have spawned innovative changes in work patterns, with sophisticated "smart" machines, operated by less skilled workers, being substituted for scarce journeymen. There is some evidence, therefore, to suggest that recent worker shortages and rising wages in these occupations are not a cause for alarm, but rather part of a properly functioning, free-market mechanism.

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17. Deutsch, Shea, and Evans, "High Technology Recruitment Index, Year-End Review and Forecast," (New York: Deutsch, Shea, and Evans, Inc., 1982).

TABLE 6. 1981 CIVILIAN EMPLOYMENT FOR DEPARTMENT OF DEFENSE AND DEFENSE-RELATED INDUSTRIES, BY OCCUPATION

Occupation a/	Number Employed (in thousands)	Percent of Occupation's Total
Teachers, Vocational Education	17	61.0
Mathematical Specialists, N.E.C.	3	60.4
Aero-Astronautic Engineers	31	47.0
Mathematicians	4	30.3
Life and Physical Scientists, N.E.C.	7	24.7
Physicists	5	24.4
Engineers, N.E.C.	40	21.5
Electrical Engineers	60	18.3
Industrial Technicians	5	15.8
Social Scientists, N.E.C.	5	15.8
Mechanical Technicians	8	15.7
Lawyers	11	14.2
Technicians, N.E.C.	23	13.1
Mechanical Engineers	26	12.2
Computer Programmers	26	11.3
Electrical and Electronic Technicians	38	10.9
Painters, Manufactured Articles	17	10.3
Industrial Engineers	11	9.7
Civil Engineering Technicians	3	9.6
Metalworking Crafts Workers	84	9.3
Metalworking Operatives	141	8.6
Assemblers	140	8.5
Metallurgical Engineers	1	8.4
Engineering and Science Technicians, N.E.C.	33	8.2
Civil Engineers	12	7.7

NOTE: N.E.C. denotes not elsewhere classified.

a/ Ranked by percentage of employment devoted to defense work.

In any event, it seems unlikely that shortages of such skilled workers could have a perceptible effect on inflation. The occupational categories in which shortages appear possible during the next few years are exceptions in a generally weak job market. In 1980, the occupational categories discussed above--engineers, scientists, computer specialists, machinists, and tool-and-die makers--accounted for about 3 million people out of a total work force in excess of 105 million. In a well-functioning labor market, shortages in less than 3 percent of the work force should not outweigh slack in most of the remaining 97 percent and trigger general increases in wages. But even if the labor market is so imperfect that shortages of only a few skills could spark widespread wage inflation, it is doubtful that the U.S. government should allow its spending priorities to be determined by the wish to avoid all possible shortages.

KEY RISKS ASSOCIATED WITH THE BUILDUP

The foregoing analysis suggests that, at least through 1985, the Administration's proposed defense buildup would probably not contribute to a rekindling of inflation. The buildup does, however, pose some potentially important risks to the economy. These risks may well grow after 1985, especially if the recovery is more vigorous than now projected by CBO.

Rapid Defense Spending Increases Could Contribute to Higher Weapons Costs

Despite the evidence that capacity generally will be adequate in major manufacturing sectors during the next few years, it is still possible that capacity constraints could arise in several small sectors strongly influenced by defense spending. These could push up weapons costs.

The sheer magnitude of the proposed increases in procurement spending suggests that spot shortages may develop. Already in mid-1982, manufacturers inventories and unfilled orders of defense products were up more than 50 percent from 1980. Additionally, the labor-market data cited above indicate that those workers for which shortages could develop soonest--engineers, scientists, and tool-and-die makers--are many of those with the particular skills demanded in defense production. Unfortunately, the available data on capacity are too unreliable for very detailed analysis. Production forecasts for the most detailed industries now described by U.S. economic data offer some insights, however. 18/

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18. The Standard Industrial Classification (SIC) uses a decimal system to reference industries. The most detailed industry groupings are identified by four numbers--four-digit industries. Four-digit SIC industries were generally used in the trend analysis in Table 7.

Forecasts show demand for several specific defense-intensive industries rising rapidly during the next five years (see Table 7). The median of the projected 1982-1987 growth rates for the top 100 defense-intensive industries is 6.4 percent annually, compared with 3.6 percent for overall GNP in the associated DRI forecast. The growth rates for defense production by these industries is much higher still--a median of 12 percent annually.

These high growth rates do not necessarily foreshadow bottlenecks. Many of the industries are currently operating far below capacity. Capacity, moreover, may expand in response to growing demand. Comparisons of the production forecasts with recent production trends help put these considerations in perspective.

In several cases, the forecast shows output rising well above trend.[19/] Table 7 expresses the 1985 and 1987 output forecasts for each industry as a number of standard deviations from the trend growth path. 20/ A high (positive) value indicates a production level outside the range that firms may have anticipated a few years earlier when laying the groundwork for capacity in 1985 and 1987. A high value may, therefore, indicate an emerging bottleneck.

The specific industries for which bottlenecks appear likely, by this measure, account for an extremely small share of GNP. Consider, for example, those defense-intensive industries whose output is projected to rise significantly (more than one standard deviation) above trend by 1987. The projections indicate that output will rise this high for 36 of the 100 defense-intensive industries listed in Table 7. Value added for total production by such industries accounted for less than 4 percent of GNP in

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19. Trends were calculated by least-squares regressions over the period 1963-1980, with an allowance for different growth rates in the 1960s and 1970s.

20. One standard deviation, a statistical measure of dispersion, indicates how far from its average (here a trend line) a statistical series can be expected to be. Projections that are more than one standard-deviation above trend may be regarded as unexpectedly high. Projections well within the range determined by the band may be regarded as close to normal. One standard-deviation is calculated as the square root of the average squared difference between actual annual production and trend production over the 1963-1980 period.

TABLE 7. OUTPUT IN DEFENSE-INTENSIVE INDUSTRIES

Industry a/	1982-1987 Output Growth b/ Total Industry	Defense Production	Industry Output Relative to Trend c/ 1985	1987
New Military Facilities	13.6	13.9	5.8	7.8
Ammunition Except Small Arms N.E.C.	15.0	15.1	2.4	3.0
Other Ordnance and Accessories	11.0	11.1	3.8	4.4
Tank and Tank Components	11.4	12.7	2.6	2.8
Complete Guided Missiles	8.6	11.9	3.4	4.3
Shipbuilding and Repairing	6.4	7.5	-1.1	-0.4
Radio and Television Communication Equipment	9.3	12.8	2.3	2.8
Aircraft Engines and Engine Parts	10.1	11.7	2.5	3.4
Aircraft Parts and Equipment N.E.C.	8.9	11.0	1.4	2.2
Small Arms Ammunition	10.1	16.8	1.9	2.6
Engineering and Scientific Instruments	7.8	9.9	2.2	3.4
Aircraft	12.1	15.2	2.4	3.3
Nonferrous Forgings	8.1	12.3	0.6	1.1
Electronic Components N.E.C.	10.4	14.8	0.5	1.2
Explosives	9.8	13.9	2.7	4.1
Industrial Trucks and Tractors	7.9	15.6	-0.5	0.3
Nonferrous Castings N.E.C.	6.5	10.4	0.9	1.3
Small Arms	9.0	20.7	0.8	1.5
Plating and Polishing	8.6	13.7	-0.6	-0.3
Semiconductors	12.3	17.9	-3.2	-4.5
Primary Metal Products N.E.C.	6.7	13.2	-2.2	-2.7
Truck and Bus Bodies	17.4	61.6	-1.2	-0.1
Steam Engines and Turbines	3.2	10.2	-1.8	-1.1
Aluminum Castings	6.9	12.5	0.4	1.2
Nonmetallic Mineral Products N.E.C.	6.4	10.0	-2.6	-3.0
Nonferrous Rolling and Drawing N.E.C.	7.4	12.7	2.2	3.4
Metal Heat Treating	6.5	11.7	-1.2	-1.1
Miscellaneous Machinery	5.5	11.6	-0.7	-0.4
Electron Tubes	6.5	12.9	1.2	1.8
Wooden Containers	4.2	12.0	2.1	2.7
Iron and Steel Forgings	6.0	11.5	0.7	1.6
Electric Measuring Instruments	8.1	12.5	-1.6	-1.6
Screw Machine Products	4.7	9.9	0.2	0.7
Aluminum Rolling and Drawing	6.9	14.7	-1.3	-1.1
Metal Coating and Allied Services	7.4	14.0	-3.2	-3.8

(Continued)

TABLE 7. (Continued)

Industry a/	1982-1987 Output Growth b/ Total Industry	Defense Production	Industry Output Relative to Trend c/ 1985	1987
Secondary Nonferrous Metals	6.5	12.2	-1.3	-1.0
Machine Tools, Metal Cutting	7.7	14.5	-0.3	0.1
Primary Aluminum	5.9	13.3	-3.3	-3.3
Special Dies, Tool, Accessories	7.7	13.4	0.2	1.2
Water Transportation and Related Services	2.0	2.7	-2.6	-3.1
Watches and Clocks	4.1	8.7	-2.5	-2.4
Industrial Patterns	5.6	10.1	-0.5	0.2
Ball and Roller Bearings	6.3	11.8	-0.4	0.5
Primary Zinc	5.5	11.3	1.3	1.5
Social Services N.E.C.	3.0	4.8	1.6	2.9
Telephone and Telegraph Equipment	10.6	15.2	2.5	3.6
Primary Nonferrous Metals N.E.C.	5.5	12.7	1.7	2.2
Brass, Bronze, Copper Castings	6.3	11.1	0.0	0.9
Metalworking Machinery N.E.C.	7.4	16.1	0.5	0.8
Power Transmission Equipment	5.5	11.5	-2.2	-1.6
Copper Rolling and Drawing	6.3	13.5	-0.2	0.5
Optical Instruments and Lenses	6.8	14.1	-4.8	-6.5
Machine Tools, Metal Forming	7.4	16.5	-1.0	0.1
Steel Pipe and Tubes	2.6	8.4	-0.5	-0.3
Electrometallurgical Products	6.4	11.2	1.3	1.5
Surgical Appliances and Supplies	6.4	7.5	1.0	1.6
Hotels and Lodging Places	3.3	9.3	-0.8	0.3
Manifold Business Forms	4.2	10.5	-0.3	-0.4
Writing Devices	6.0	12.7	0.7	1.6
Fabric Textile Products N.E.C.	5.1	7.4	-0.9	-0.5
Blast Furnaces and Steel Mills	6.6	11.4	-1.5	-1.1
Primary Lead	5.1	11.7	-1.6	-1.1
Measuring and Control Instruments	7.8	13.1	2.1	3.9
Iron and Ferroalloy Ores Mining	6.4	11.4	0.9	0.7
Miscellaneous Business Services	5.9	11.8	0.0	-0.2
Carbon and Graphite Products	5.1	11.6	-0.5	-0.1
Fabricated Metal Products N.E.C.	5.9	12.0	1.0	1.4
Electronic Computing Equipment	12.5	17.4	-2.7	-3.4
Wood Pallets and Skids	5.6	12.7	-3.9	-4.7
Truck Trailers	6.8	19.4	-1.2	-0.9
Copper Ore Mining	5.2	12.8	-0.4	0.1

(Continued)

TABLE 7. (Continued)

Industry a/	1982-1987 Output Growth b/ Total Industry	Defense Production	Industry Output Relative to Trend c/ 1985	1987
Transportation Services N.E.C.	3.9	6.7	-1.0	-0.5
Industrial Controls	7.4	13.5	-0.3	0.4
Motors and Generators	5.5	13.4	-0.8	-0.2
Iron and Steel Foundries	4.1	10.5	-2.1	-1.6
Cold Finishing, Steel Shapes	7.6	11.8	0.5	1.1
Metal Ores Mining N.E.C.	3.7	11.6	-4.1	-3.5
Blowers and Fans	4.8	11.0	-1.9	-0.8
Motor Freight	4.9	7.1	0.0	0.9
Hoists, Cranes, and Monorails	5.1	19.1	-0.6	0.9
Welding Apparatus	6.9	10.3	0.0	0.9
Nonferrous Wire Drawing and Insulating	6.0	13.2	-0.7	-0.3
Primary Copper	4.7	12.4	-1.3	-1.4
Petroleum Refining and Related Products	0.8	5.4	-5.0	-5.5
Metal Office Furniture	3.8	3.7	-0.1	0.4
Envelopes	4.1	7.0	-0.7	-0.7
Abrasive Products	5.7	12.2	-0.3	-0.1
Engine Electrical Equipment	7.1	13.3	-0.2	0.5
Narrow Fabric Mills	4.4	7.1	1.5	2.1
Crude Petroleum and Natural Gas	-0.3	5.0	1.1	1.1
Miscellaneous Fabricated Wire Products	5.5	12.1	1.6	2.5
Pipelines, Except Natural Gas	3.0	0.0	-0.9	-0.8
Metal Stampings	6.7	13.7	0.3	1.0
Photographic Equipment and Supplies	5.7	12.4	-3.7	-3.9
Air Carriers and Related Services	5.0	10.0	-1.6	-1.1
Architectural Metal Work	4.5	12.2	-0.3	0.6
Hand Saws and Saw Blades	5.7	10.8	-2.0	-2.0
Maintenance and Repair, Other	2.9	10.2	-0.9	1.6
Paints and Allied Products	4.9	10.5	-1.9	-1.1
Fabricated Plate Work	2.8	8.1	-3.4	-2.9

SOURCE: Data Resources, Inc.

a. Ranked in terms of the share of output accounted for by defense production.

b. Annual rates of growth.

c. Forecast output expressed as a number of standard deviations from trend.

1980. Moreover, production in some of these industries, notably tanks, complete guided missiles, and ordnance and accessories, does not compete closely with nondefense production for specialized resources. For these reasons, it appears unlikely that shortages in these industries will contribute much to overall inflation.

The effect on weapons-systems' costs could be much more substantial, however. Consider again the defense-intensive industries in which output is projected to rise more than one standard deviation above trend. Value added from defense production in these industries represents a substantial share of total defense purchases from the private sector--about 37 percent in 1980--and most defense purchases embody some production by these industries. Furthermore, since defense production may require specialized facilities within some industries (at the 4-digit SIC level), the prospects for defense-specific bottlenecks and cost growth may be understated by these results. The forecast for almost every one of these industries shows defense production rising far beyond its own trend by 1985. 21/

Although data on projected defense production indicate probable spot shortages of specialized defense components, other factors may offset increased costs from shortages caused by higher spending on weapons. Because weapons systems are usually produced in small quantities, overhead often comprises a large share of unit costs. As higher spending allows higher production rates, overhead can be spread over more units, thus reducing unit costs. At least a portion of such unit cost savings should reduce procurement costs.

The effects of spot shortages on weapons costs may, in any event, be dwarfed by cost problems largely unrelated to limitations in industry capacity. Contractors anxious to secure work on new weapons may present unrealistically low bids, with subsequent increases in prices. "Technological uncertainty," or the gaps in knowledge that exist at the beginning of a complex new endeavor, virtually guarantees that unforeseen problems and expensive redirection of efforts will occur. Limitations on annual funding can stretch out weapons purchases, causing inefficient production rates. Low rewards for cost containment can result in inattentiveness to cost control by the contractors and DoD. The lack of competition among weapons producers can increase costs. Although a broad discussion of weapons cost growth is beyond the scope of this study, it is clear that such

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21. The tooling to assemble finished defense products such as complete guided missiles is generally reported to be available to support the projected high growth rates. What is less clear is whether adequate capacity exists among the specialized sub-contractors who provide the components required for assembly.

cost growth is pervasive, extremely variable, yet basically unpredictable. 22/

Inflationary Pressures Much More Likely if Private Spending Recovers Rapidly

The analysis thus far assumes that nondefense spending will recover slowly over the next few years, as projected by CBO. If private spending increased more rapidly, the risks of inflation would rise.

Suppose, for example, that military spending increased as proposed and that each major nondefense component of GNP grew at the average rate achieved during cyclical recoveries since the Korean conflict. In late 1985, under this scenario, real GNP would be 4 to 5 percent greater than currently forecast by CBO and the unemployment rate would approach the 6 percent full-employment threshold. Capacity utilization in manufacturing as a whole would be about 86 percent in 1985, well above the historical average of 83 and the 81 percent rate consistent with the current CBO forecast (see Table A-9 in Appendix A for details). Capacity utilization in defense-intensive, high-technology industries would edge up, and tightness would even spread to basic industries. In primary metals industries, for example, 1985 utilization rates would cluster near 90 percent, close to levels associated with inflationary pressures in the past.

Much of this increased tightness would reflect higher spending on business fixed investment and motor vehicles. The outlook for business investment in equipment is particularly critical to the high-technology industries. Each additional 1 percent of equipment investment implies about an additional one-half percent of demand for electronics equipment, instruments, and aircraft. 23/

If nondefense final demand recovers rapidly, rather than sluggishly as now forecast, the inflationary pressures that could develop by 1985 would not be greatly offset even by large reductions in the growth of defense spending. The estimates just discussed assumed an average cyclical recovery coupled with increases in defense budget authority of about 9percent a year in fiscal years 1983-1985, after adjustment for inflation. This caused capacity utilization to rise to about 86 percent in all

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22. Congressional Budget Office, **Cost Growth in Weapons Systems: Recent Experience and Possible Remedies** (October 1982).

23. Data Resources Inc., **U.S./Macro Model** (December 1977), p. 155.

manufacturing industries. With an $18 billion cut in 1983 defense budget authority and further cuts in 1984 and 1985 to hold real defense growth in those years to 5 percent--as some in the Congress have suggested--capacity utilization in 1985 would be about 85.5 percent. Only if growth in defense spending were eliminated altogether would capacity utilization fall below the 85 percent threshold historically associated with full employment--to about 84.5 percent. The effects on defense-intensive industries within manufacturing--for example, aerospace--would, of course, be more pronounced.

These results indicate that nondefense spending, rather than defense spending, is the key factor in determining capacity problems and inflationary pressures. This is not surprising, since even by fiscal year 1987 the defense share of GNP would still be only about 7.7 percent.

Longer-Term Outlook Hinges on Overall Budgetary and Monetary Policies

Almost all the analysis in this chapter has focused on economic developments through 1985. The defense buildup could pose important risks to the economy in the longer run, however.

Analysts generally agree that there is no necessary connection between sustained increases in defense spending and inflation. 24/ But if the Congress chose to continue increased defense spending as the economy approached full employment of resources, offsetting cuts in nondefense spending or increases in taxes would become critical to avoid inflation. Without such fiscal offsets, or counterbalancing restrictive monetary policy, the combined defense and nondefense demands for resources would exceed full-employment supply, thereby stimulating higher inflation.

Results of several recent macroeconomic projections support this analysis. In 1980, for example, the Department of Defense asked five major macroeconomic forecasting firms to estimate the effects of an annual 10 percent real increase in defense expenditures from fiscal years 1980 through 1986. The forecasters agreed that a defense buildup of even this magnitude would have a negligible to small effect on aggregate prices if the Congress enacted compensating tax increases or nondefense spending cuts. Estimates of additional annual inflation ranged from zero to only 0.2 percent. If, however, the buildup was not compensated but instead was

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24. See Charles Schultze, "Economic Effects of the Defense Budget," **The Brookings Bulletin** (Fall 1981), vol. 18, no. 2.

financed by larger deficits, the forecasts predicted that it could have increasingly inflationary effects in 1985 and 1986, when unemployment was projected to be low. Estimates of added annual inflation in this case ranged from 0.1 to 1.8 percent.

There are several reasons why it is important now to consider changes in budget policy that may be required to help sustain a noninflationary high-employment economy in the latter 1980s. For one thing, projections of federal deficits under current law remain high in fiscal years 1983-1988, even though the economy is gradually recovering. CBO forecasts that annual deficits will remain around $200 billion through 1985 and increase to nearly $270 billion by 1988. Even if measured at high-employment levels to eliminate the portion of the deficit that may provide desirable stimulus during periods of high unemployment, the deficit is projected to increase from about $90 billion in 1984 to $130 billion in 1985 and to more than $200 billion in 1988.

The nature of the projected defense buildup also contributes to the importance of early consideration of longer-run problems. Defense spending, especially for procurement which is a large part of the Administration's plan, "spends out" very slowly. On average, $1 appropriated for defense procurement produces only about 12 cents of actual outlays in the first year. Outlays grow to 37 cents in the second year, 30 cents in the third year, and then tail off. Some currently authorized defense procurement programs (for example, shipbuilding) will result in significant outlays beyond 1985, when a stimulative fiscal policy may entail high inflationary risks.

These observations suggest that, if the defense buildup is to continue, further offsetting cuts in nondefense spending or increases in taxes will be necessary. Without them, higher inflation would, in time, be likely. If inflation were instead controlled by restrictive monetary policy, the result probably would be high interest rates and sluggish economic growth.

If, on the other hand, the Congress chose to slow the defense buildup, then the nature of the defense spending cuts would be critical in determining effects on the economy. Cuts that predominately affected outlays in 1985 and beyond would be more effective in countering inflation than reductions affecting near-term outlays. This suggests that the Congress should review carefully the plans for procurement and other defense spending that commits the United States to outlays over many years. It is especially important, from the economy's standpoint, to be cautious about near-term cuts that might necessitate higher compensating outlays in the latter 1980s. Such cuts could push outlay increases into a period when there is more risk of rekindling inflation.

CHAPTER III. DEFENSE SPENDING, PRODUCTIVITY, AND EMPLOYMENT

Defense spending, like any other spending, necessitates sacrifices. Resources that could otherwise be employed are used in producing goods and services for the national defense. Some analysts further believe that defense spending not only absorbs resources but also diminishes overall economic activity. They make two specific claims: some believe that the use of resources for defense depletes productivity growth in the private economy; others contend that defense spending reduces employment. Both issues concern the particular pattern of resource demand that derives from defense spending.

DEFENSE SPENDING AND PRODUCTIVITY

Defense spending potentially has both adverse and beneficial effects on private-sector productivity. Defense production employs much of the nation's scarce scientific and engineering talent and considerable capital that could otherwise contribute to productivity growth in the civilian sector. By competing for these resources, defense spending could well restrict private-sector efforts to improve productivity. On the other hand, research and development (R&D) efforts sponsored by the DoD occasionally yield knowledge that proves valuable in civilian production. The computer is probably the most striking example of a development fostered by military R&D that has contributed enormously to private-sector productivity.

Assessing the net effect of these opposing influences is extremely difficult. It requires determining how costly it is to expand national research efforts and understanding how those efforts translate into higher productivity. Existing knowledge of these processes, however, is sketchy. Analysts generally agree that capital formation, R&D spending, and labor training contribute to labor productivity. But estimates of the importance of each of these items vary widely. 1/ Furthermore, direct statistical evidence relating defense spending and productivity growth is inconclusive.

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1. Edward Denison, for example, identifies "advances in knowledge and not elsewhere classified"--a residual category--as the most important source of productivity growth. He asserts that little of this

Defense Spending and Long-Term Trends in Productivity

Elementary statistical tabulations provide mixed evidence on the relationship between defense spending and trends in productivity growth. International comparisons seem to support the notion that high defense

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component appears to reflect measured R&D expenditures. See Edward Denison, **Accounting for Slower Economic Growth,** (Washington: The Brookings Institution, 1979). John W. Kendrick, however, attributes much more influence to measured R&D and almost all of total productivity gains to measured factors. See John W. Kendrick, "Total Investment and Productivity Developments," **American Economic Review** (New York, Papers and Proceedings, 1977). For comments on the difficulties involved in estimating the effects of presumed causal factors, see Zvi Griliches, "R&D and the Productivity Slowdown," **American Economic Review** (New York, Papers and Proceedings, 1980).

The uncertain results of studies on producitivity evidently reflect the complexity of the processes leading to productivity improvement and the limitations of available data on production relations. Some pertinent evidence may be found in a recent study by Griliches and Mairesse. See Zvi Griliches and Jacques Mairesse, "Productivity and R&D at the Firm Level," Harvard Institute of Economic Research Discussion Paper No. 891H, (Cambridge: Harvard University, 1982). Using pooled cross-section, time-series data on production and inputs (including R&D spending) of individual firms, the authors obtained highly significant estimates of production elasticities for physical capital and R&D capital in the cross-section sample, but unstable and sometimes insignificant estimates in the time dimension. Such results seem both to confirm that high levels of physical and research and development capital contribute to high productivity and to demonstrate that the timing of productivity gains is inherently unpredictable. Alternatively, the cross-section results may merely reflect unmeasured firm-specific effects that, in the sample, were correlated with the physical and R&D capital stocks.

The ambiguous results are not altogether surprising. Spillover effects from military R&D and replication of technologies developed by others are sources of productivity growth largely unrelated to a firm's inputs of R&D. Such arguably important effects make it extremely difficult to trace all sources of productivity growth on the basis of measurable factors.

spending retards productivity growth. Advanced industrial nations that have experienced relatively high productivity growth since 1950, such as Japan and Germany, have devoted a smaller share of their output to defense than have nations that have experienced relatively slow rates of productivity growth, such as the United States and the United Kingdom (see Table 8). Time series data on productivity, however, do not support this hypothesis. Productivity growth in the United States and other industrialized countries has slowed while defense has commanded a shrinking share of resources.

These data alone could hardly establish a causal link between the level of defense spending and productivity gains. They do not isolate effects of defense spending from those of other important factors, such as the accumulation of capital and the training of labor. There are, moreover, more plausible explanations for the observed differences in productivity growth rates among free-world countries. High growth rates, for example, may be partly explained by a country's stage of development. Less advanced--or rebuilding--countries may progress faster by replicating technologies developed over the years by more advanced countries. The inverse relationship between productivity growth and the defense share of GNP (or GDP) may, therefore, merely reflect this catch-up phenomenon and that the United States--the country with the highest per capita income--chooses to spend more of its income on defense.

Defense Spending and Productivity Over the Current Business Cycle

Although the evidence supports no general conclusion on the long-run relationship between defense spending and productivity, the proposed defense buildup could nevertheless adversely affect private-sector productivity over the current business cycle. This would occur if the buildup contributed to overheating markets for the specific resources essential to productivity growth.

Defense Investment Could Compete with Private Investment. The proposed large increases in defense investment spending could contribute to higher prices for nondefense capital goods, thereby diminishing private investment and productivity. The risks of such "crowding out" of private investment are probably small over the next few years. As shown in the preceding chapter, near-term capacity should be adequate in major sectors supplying capital goods, and materials, components, and labor used in producing capital goods. This outlook reflects, in part, projected sluggish private demand for capital goods during the next two to three years. Together, the Data Resources, Inc. (DRI) forecast of private capital expenditures and the Administration's projections of defense capital

TABLE 8. DEFENSE SPENDING AND PRODUCTIVITY GROWTH--COMPARISONS OVER TIME AND ACROSS COUNTRIES

Country	1950-1960	1960-1970	1970-1979
United States			
Productivity growth	2.3	2.1	1.1
Defense share of GDP	10.3	8.7	6.1
Japan			
Productivity growth	-- a/	9.7	4.5
Defense share of GDP	1.0	0.9	0.9
Germany			
Productivity growth	-- a/	4.6	3.4
Defense share of GDP	3.9	4.2	3.9
France			
Productivity growth	-- a/	4.8	3.4
Defense share of GDP	7.2	5.4	3.9
United Kingdom			
Productivity growth	-- a/	2.8	2.0
Defense share of GDP	7.9	5.8	4.9
Canada			
Productivity growth	3.0	2.4	1.3
Defense share of GDP	5.6	3.3	2.0

SOURCES: Data Resources, Inc.; NATO Facts and Figures (Brussels: NATO Information Service, 1976); Stockholm International Peace Research Institute, World Armaments and Disarmament SIPRI Year Book 1981 (London: Taylor and Francis, Ltd., 1981).

a. Not available.

expenditures, will rise to about 18 percent of potential GNP in 1985. This share of potential GNP is below the 18.4 percent reached in 1979, the 18.6 percent during 1966 to 1969, and the 20 percent in 1953.

As with inflation, the risks are more substantial beyond 1985. The combination of rising pent-up demands, continuing economic recovery, and investment incentives embodied in the current tax laws could eventually yield a sharp rise in private demand for capital goods, coinciding with the increase in defense capital spending. The resulting imbalances could dramatically increase costs of capital formation and undermine the continuance of the expansion, with associated adverse effects on productivity. 2/

Growing Defense R&D Spending Competes for Research Scientists and Engineers. In recent years, the DoD has funded about 25 percent of U.S. research and development; in doing so, DoD directly and indirectly employs many of the nation's top scientists and engineers. The Administration proposes more than a 40 percent real increase in defense R&D spending between 1982 and 1987. With the tight demand in many markets for scientists and engineers in 1979-1980, there is concern that the increased DoD research and development spending could draw critical human resources out of private sector R&D, at least until supply has expanded to meet overall demand.

Such substitution of defense for private- sector R&D is not evident in data describing past R&D spending. Instead, past increases in DoD spending on R&D have been paralleled by increases in private spending on R&D (see Table A-10 in Appendix A). R&D spending surged in the late 1950s and early 1960s in response to the space race. During this period both DoD, other federal agencies, particularly NASA, and industry massively increased R&D funding (at about a 10 percent annual rate). Similar changes apparently occurred in real (inflation adjusted) R&D activity. Employment of scientists and engineers, patent activity, and publications in scientific journals also went up substantially during that period.

These observations suggest that R&D activity can expand readily in response to higher demand. Other evidence, however, suggests that the

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2. Forecasts based on the DRI long-term model illustrate how wide swings in economic activity can diminish expected capital formation and productivity. Forecasts assuming steady growth indicate higher capital formation than do forecasts assuming periodic cyclical fluctuations.

favorable experience of the late 1950s-early 1960s may not recur without changes in present policies. For one thing, in 1982 the United States will start from a higher base since it now devotes about 2.5 percent of its resources to R&D, compared with the 1.5 percent it devoted at the beginning of the earlier R&D expansion in the mid-1950s. Attempts to expand R&D even more may encounter diminishing returns as less talented people are drawn into the effort. In addition, in the late 1950s and 1960s the United States benefited from the availability of scientific talent from abroad. The rebuilding of economies abroad has now increased worldwide competition for technically trained labor. For these reasons, Lester Thurow has recommended that the U.S. government consider directing more of its resources to the training of scientific and other technical labor. 3/

DEFENSE SPENDING AND EMPLOYMENT

Some analysts have claimed that the defense buildup will actually reduce the number of jobs in the economy, if the added defense spending

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3. See Lester C. Thurow, "Rising Armament Expenditures: Effects on the Civilian Economy," **Commentary** (Summer 1982). The case for government subsidization of labor training rests on the observation that private firms face serious obstacles in obtaining full compensation for any training they provide. Firms cannot retain ownership of the skills acquired by an individual, because they do not own the individual. Firms additionally may have difficulty collecting compensation from individuals who quit shortly after receiving valuable on-the-job training, because they may not be able to separate the value of the training from the value of the work accomplished by the individual trainee. These considerations suggest that government subsidization of private-sector training may enhance economic efficiency. But clearly an ill-designed program would be counterproductive. Great care would have to be exercised so that any subsidy program would provide for productive jobs rather than continued dependency. In the abstract, the objective would be to facilitate people's transition to new jobs by diminishing the risks that private firms bear in undertaking job training. To be cost effective, a policy designed to advance this objective would have to be unencumbered by conditions relating to other objectives. Such issues concerning the government's proper role in promoting job training involve considerations well beyond the scope of this paper. It remains worth noting that the defense buildup adds a degree of urgency to this issue.

comes at least partly at the expense of nondefense spending. 4/ CBO analysis indicates, however, that additional spending on defense and on nondefense purchases of goods and services appear to have roughly equal expansionary effects on employment in the short run. Econometric model simulations suggest that an additional $10 billion in defense spending in the current fiscal year could create up to 250,000 additional jobs; the same $10 billion spent on nondefense purchases in the public and private sector could also create almost 250,000 jobs. 5/ This result assumes the $10 billion is spent on all types of defense work; thus almost half would go to pay salaries and benefits of the Department of Defense's military and civilian employees. The difference in employment effects is larger if one focuses on defense purchases from industry, which is the emphasis in the proposed buildup. Spending $10 billion exclusively on additional defense purchases from industry would create about 210,000 jobs.

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4. Defense spending here refers to purchases of goods and services, including services of military and civilian personnel that are accounted for by compensation payments. Nondefense spending on goods and services includes all other spending, excluding transfer payments.

   For one study claiming that defense spending diminishes employment, see Marion Anderson, **The Empty Pork Barrel** (Report) (Lansing, Michigan: Employment Research Associates, 1982). This study assumes that, because a higher share of GNP spent on defense is associated with a lower share spent on other things, higher real defense spending will necessarily lead to lower real spending elsewhere. Such a conclusion follows only if the economy is at full employment, which is hardly an accurate description of today's U.S. economy. Furthermore, the study uses outdated and inconsistent estimates of direct-employment effects of defense and nondefense spending and neglects the multiplier effects that tend to make the overall effects similar.

5. These figures derive from (1) DRI-model input-output estimates of direct and indirect employment effects of federal defense and total (federal plus nonfederal) nondefense spending, excluding multiplier effects; (2) an assumed first-year multiplier of 1.6 yielding an induced employment effect of 0.6 times the direct plus the indirect employment effect of nondefense spending (taken to be a proxy for "average" spending); and (3) the assumption that half of the employment stimulus calculated in (1) and (2) translates into increased labor productivity rather than increased employment, in accordance with Okun's Law.

These results are the sum of:

- Direct employment effects--that is, hiring by the final customer (government, consumers, business investors) or by businesses supplying finished goods directly to that customer;

- Indirect employment effects--that is, hiring by businesses supplying intermediate goods and services used at some point in production leading to finished goods demanded by the final customer; and

- Induced or multiplier employment effects--that is, jobs created to fulfill the demand for consumer goods by those employed directly or indirectly or the demand for capital goods by businesses benefiting directly or indirectly from the final customer's spending.

These results also reflect Okun's law, which implies that changes in employment over the business cycle are less than proportional to changes in production. The change in employment is proportionately smaller, because some of the change in production shows up as higher or lower labor hours and productivity.

The employment effects of defense purchases are smaller than for nondefense, partly because wage and salary levels in defense industries average about 7 percent higher than in nondefense (see Table A-11 in Appendix A). These higher salaries reflect the highly skilled personnel, such as engineers, required for defense production. In addition, incremental spending solely on nongovernment activity--for example, defense purchases from industry--tend to have smaller employment effects since some of the additional spending goes into higher profits. Spending on government activity--for example, services performed by military personnel--goes wholly into compensation and employment.

These results are subject to important caveats. Results show short-run employment effects. In the long run in a free-market economy, any initial differences in overall employment should vanish as wages adjust to clear all markets. Even in the short run, employment differences between defense and nondefense spending could be offset by other fiscal or monetary policies.

Some analysts might also argue that the estimates in this section overstate the number of jobs that would be created by spending for defense or nondefense purposes. Such spending would add to the federal deficit, which could lead to higher interest rates. This could choke off investment in equipment, housing purchases, or other areas and offset some of the gains in jobs. The estimates provided above assume that such offsets occur, but that each additional dollar of spending still causes GNP to expand by about 1.6 dollars. In today's economy, the offsets may be unusually large, causing fiscal multipliers to be less than 1.6. This problem may be especially important for defense. If price increases are much greater in defense than in nondefense, then a given increase in real spending directed to defense would cost more in current dollars, increase the deficit more, and thus would face larger offsets than the same amount of real spending directed to nondefense. 6/

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6. Suppose that inflation is running at an annual rate of 10 percent in defense and 5 percent in nondefense. Compared with a baseline of no changes in real spending on defense or nondefense, a $10 billion increase in constant prior-year-dollar defense spending would cost $11 billion (equals 10 x 1.10) in current-year dollars; the same constant-dollar increase in nondefense spending would cost 10.5 billion (equals 10 x 1.05) in current-year dollars. The additional $500 million associated with defense spending would contribute to a higher deficit and larger offsetting effects on interest-sensitive expenditures.

APPENDIXES

APPENDIX A. SUPPORTING DATA FOR CHAPTERS II AND III

This appendix contains supplementary data for industrial and economic issues discussed in Chapters II and III. The figure and tables present detailed information on the production, capacity, lead times and shipments of resources vital to the proposed defense buildup. Appendix A also includes data on defense-intensive employment and research and development funding that can affect overall economic productivity.

Figure A-1.
U.S. Production and Capacity for Large-Volume Nonferrous Metals (Other than Aluminum)

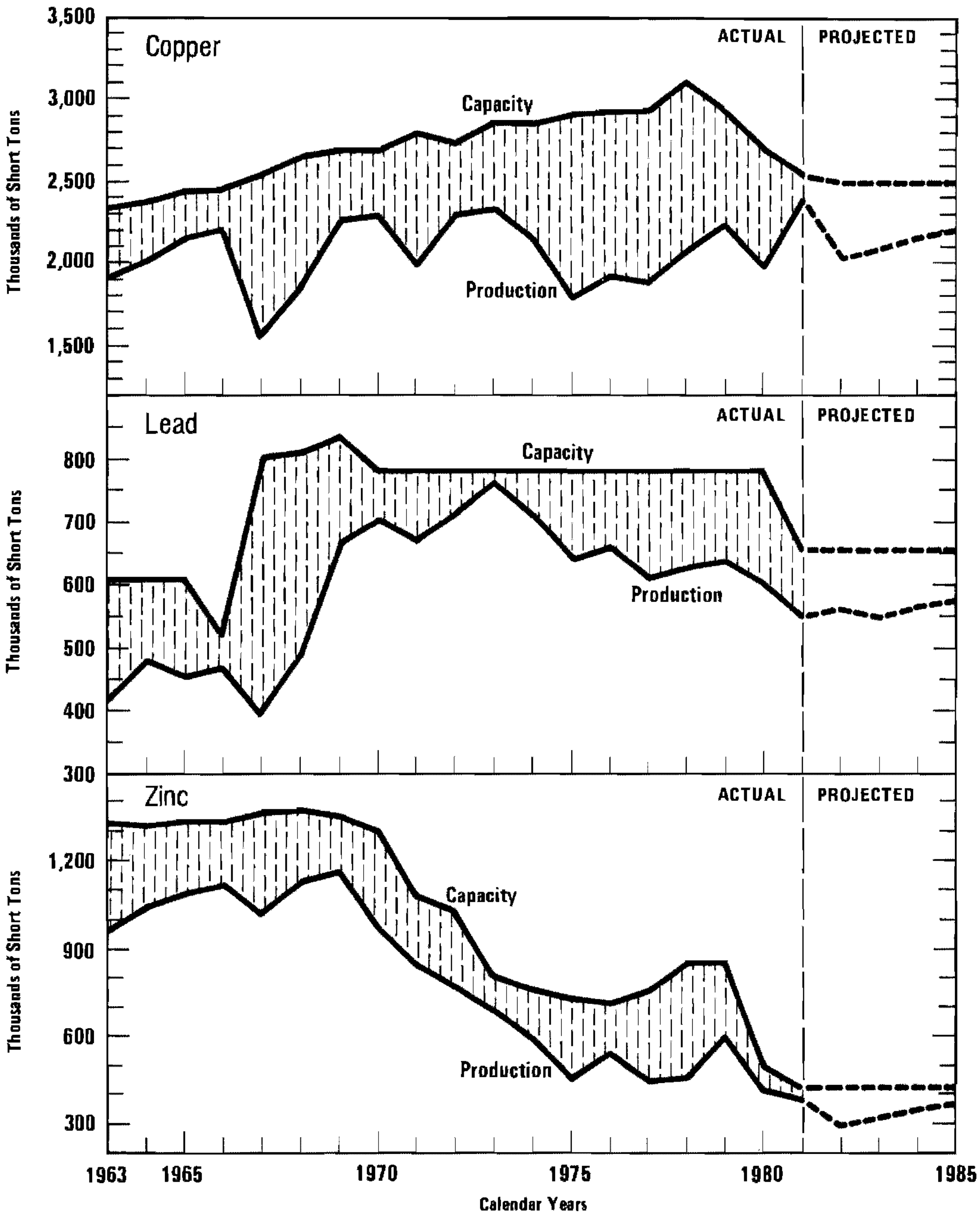

Figure A-1. (Continued)

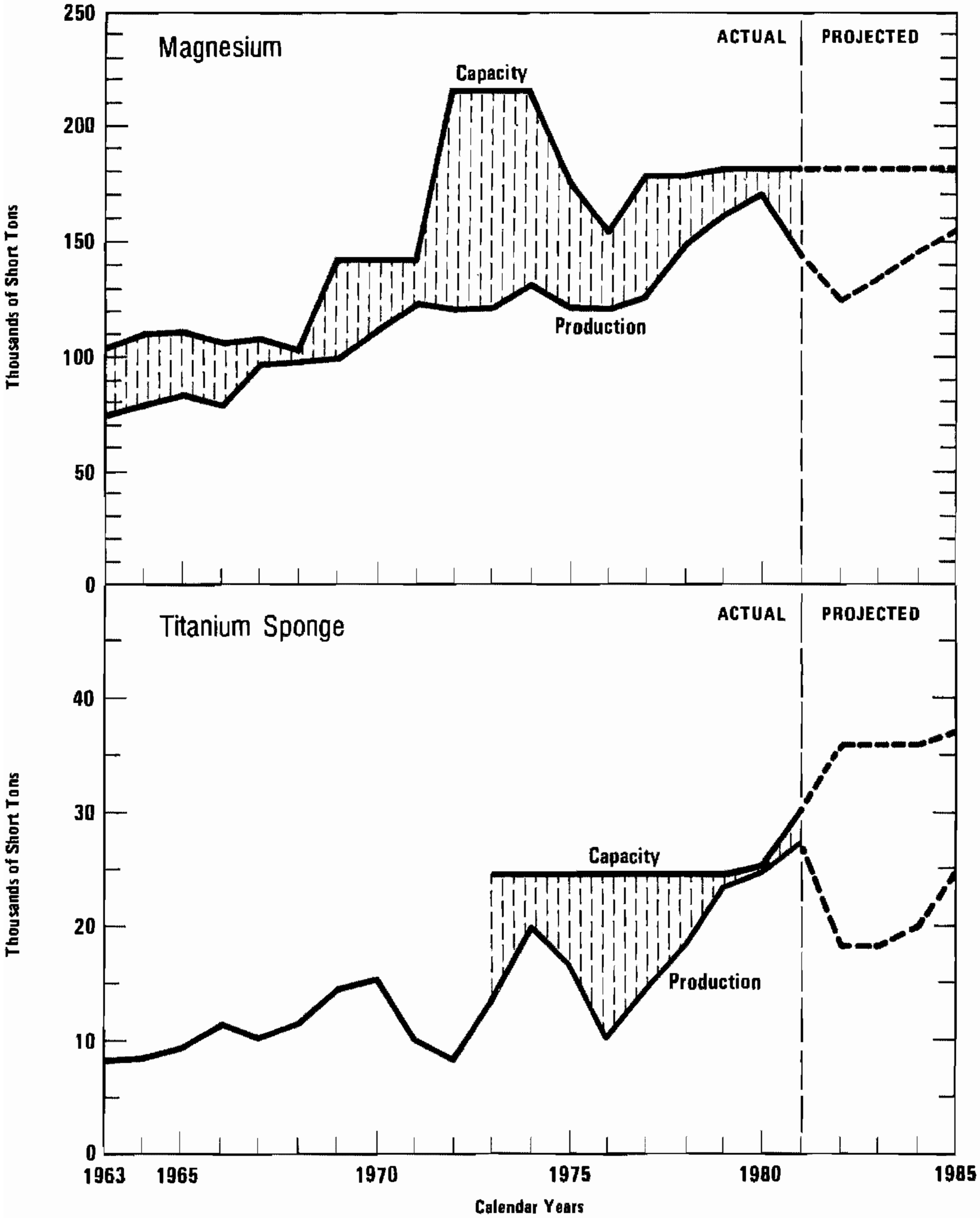

TABLE A-1. LEAD TIMES FOR SELECTED MILITARY AEROSPACE CASTINGS AND FORGINGS (In weeks)

Metal	Feb. 1976	Dec. 1977	Dec. 1978	Nov. 1979	Jan. 1981	Dec. 1981	Apr. 1982	Oct. 1982
Aluminum								
Casting	16	29	35	49	50	40	35	31
Forging (small)	24	32	48	79	73	60	44	32
Forging (large)	24	38	50	90	81	70	49	40
Steel								
Casting	19	29	35	47	47	40	33	30
Forging (small)	21	28	43	78	66	50	37	31
Forging (large)	21	36	51	93	70	60	39	37
Titanium								
Casting	--	--	31	64	72	66	49	45
Forging (small)	32	33	68	108	109	92	54	42
Forging (large)	32	38	74	108	116	98	60	48

SOURCE: Department of Defense.

TABLE A-2. CASTINGS FOR SELECTED METALS (By calendar year, in millions of short tons)

Year	Iron				Steel			
	Shipments	Estimated Capacity a/ (end of year)	Unfilled Orders (end of year)	Lead Times (weeks) b/	Shipments	Estimated Capacity a/ (end of year)	Unfilled Orders (end of year)	Lead Times (weeks) b/
1964	15.32	--	0.97	--	1.84	--	0.34	--
1965	16.85	18	1.53	--	1.96	--	0.44	--
1966	16.85	--	1.14	--	2.16	--	0.59	--
1967	15.37	--	1.03	--	1.86	--	0.29	--
1968	16.14	--	1.06	--	1.73	--	0.37	--
1969	17.10	--	1.21	--	1.90	--	0.45	--
1970	14.80	--	0.97	--	1.72	--	0.32	--
1971	14.72	--	0.92	--	1.58	--	0.28	--
1972	16.26	--	1.23	--	1.58	--	0.32	--
1973	18.08	20	1.81	--	1.89	--	0.93	--
1974	16.57	--	1.55	22	2.09	--	1.53	25
1975	13.14	--	1.06	10	1.97	2.25	0.75	10
1976	15.02	--	0.89	9	1.80	--	0.43	12
1977	16.15	--	1.00	10	1.72	--	0.45	12
1978	16.40	--	1.03	13	1.85	--	0.80	10
1979	16.15	--	1.03	12	2.04	--	1.04	16
1980	12.05	17 c/	0.98	9	1.85	2.26	0.61	13
1981	12.35	--	0.78	9	1.75	--	0.39	12
1982 d/	8.70	--	0.60	6	1.07	--	0.20	8

(Continued)

SOURCES: Bureau of the Census; Bureau of the Mines; Purchasing Magazine; Arthur D. Little, Inc.

a. Data available only in selected years.

b. Data not available before 1974.

TABLE A-2. (Continued)

Year	Aluminum				Brass/Bronze			
	Shipments	Estimated Capacity a/ (end of year)	Unfilled Orders e/ (end of year)	Lead Times (weeks) b/ (end of year)	Shipments	Estimated Capacity a/ (end of year)	Unfilled Orders e/ (end of year)	Lead Times (weeks) b/ (end of year)
1964	0.63	--	--	--	0.45	--	--	--
1965	0.70	--	--	--	0.44	--	--	--
1966	0.80	--	--	--	0.46	--	--	--
1967	0.73	--	--	--	0.40	--	--	--
1968	0.79	--	--	--	0.40	--	--	--
1969	0.85	--	--	--	0.43	--	--	--
1970	0.75	--	--	--	0.38	--	--	--
1971	0.79	--	--	--	0.35	--	--	--
1972	0.93	--	--	--	0.38	--	--	--
1973	1.01	--	--	--	0.39	--	--	--
1974	0.88	--	--	15	0.33	--	--	14
1975	0.69	--	--	7	0.26	--	--	7
1976	0.92	--	--	9	0.27	--	--	9
1977	1.00	--	--	8	0.29	--	--	9
1978	0.99	--	--	10	0.28	--	--	10
1979	1.00	--	--	11	0.30	--	--	10
1980	0.79	1.2	--	10	0.24	--	--	10
1981	0.79	--	--	9	0.24	--	--	9
1982 d/	0.69	--	--	5	0.21	--	--	6

c. Reflects recent closing of approximately 1 million tons of captive automotive-foundry capacity.

d. Estimated.

e. Data unavailable.

TABLE A-3. CUSTOM FORGINGS FOR SELECTED METALS--SHIPMENTS AND LEAD TIMES (By calendar year)

	Ferrous			Nonferrous				High Temperature Alloys	
	Shipments (in millions short tons)		Lead Time (end of year, in Weeks) b/	Shipments (in millions short tons)		Lead Time (end of year in weeks) c/		Shipments (in millions short tons)	
	Custom Impression Die	Custom Open Die a/		Custom Impression Die	Custom Open Die a/	Aluminum	Bronze	Custom Impression Die	Custom Open Die a/
1961	0.8061	--	--	0.0394	--	--	--	0.0049	--
1962	0.9819	--	--	0.0436	--	--	--	0.0054	--
1963	0.9744	--	--	0.0481	--	--	--	0.0062	--
1964	1.0598	--	--	0.0613	--	--	--	0.0074	--
1965	1.2023	--	--	0.0704	--	--	--	0.0081	--
1966	1.3162	--	--	0.0874	--	--	--	0.0114	--
1967	1.2331	--	--	0.0869	--	--	--	0.0115	--
1968	1.2626	--	--	0.0870	--	--	--	0.0099	--
1969	1,3952	--	--	0.0811	--	--	--	0.0109	--
1970	1.1183	--	--	0.0611	--	--	--	0.0091	--
1971	1.1381	--	--	0.0639	--	--	--	0.0081	--
1972	1.1914	--	--	0.0727	--	--	--	0.0080	--
1973	1,2990	--	--	0.0762	--	--	--	0.0082	--
1974	1.2880	--	21	0.0714	--	21	15	0.0085	--
1975	1.1501	--	11	0.0555	--	8	6	0.0076	--
1976	1.1625	--	12	0.0599	--	10	11	0.0061	--
1977	1.1135	--	11	0.0655	--	9	10	0.0057	--
1978	1.1510	--	15	0.0720	--	11	11	0.0072	--
1979	1.1497	--	19	0.0816	--	--	--	0.0079	--
1980	0.8983	0.3822	14	0.0613	0.0125	--	--	0.0080	0.0024
1981	0.8775	0.4817	12	0.0615	0.0088	--	--	0.0084	0.0019

SOURCES: Forging Industry Association, Purchasing Magazine.

a. Data not available before 1980.

b. Data not available before 1974.

c. Data available only in selected years.

TABLE A-4. RELEVANT SHIPYARDS, BY CATEGORY, WITH 1980 CURRENT AND POTENTIAL EMPLOYMENT LEVELS

Shipyards	Current Employment	Potential Mobilization Employment	Location
Category I. Combatant-Capable (plus amphibious/auxiliary and merchant)			
Bath Iron Works	5,300	12,000	Bath, ME
General Dynamics, Quincy	4,900	34,000 a/	Quincy, MA
General Dynamics, Groton b/	22,300	30,000	Groton, CT
Newport News Shipbuilding and Drydock	22,400	38,000	Newport News, VA
Litton/Ingalls	17,000	21,000 a/	Pascagouia, MS
Avondale, Todd, San Pedro	7,300	18,000	New Orleans, LA
Lockheed	2,900	8,000	San Pedro, CA
Todd, Seattle	3,300	7,200	Seattle, WA
Total	87,700	164,800	
Category II. Amphibious/Auxiliary-Capable (plus merchant)			
Sun Shipbuilding and Drydock	4,000	35,000 c/	Chester, PA
Maryland Shipbuilding and Drydock	1,300	12,000	Baltimore, MD
Bethlehem Steel, Sparrows Point	2,300	15,500 a/	Sparrows Point, MD
National Steel and Shipbuilding	6,400	16,800	San Diego, CA
Marinette Marine d/	800	1,200	Marinette, WI
Total	14,800	80,500	
Category III. Merchant-Capable (only)			
Norfolk Shipbuilding and Drydock	2,000	3,400	Norfolk, VA
Alabama Drydock and Shipbuilding	800	5,400	Mobile, AL
Tampa Ship Repair and Drydock	1,200	1,400	Tampa, FL
Todd, Houston	300	2,300	Houston, TX
Todd, Galveston	800	5,000	Galveston, TX
Levingston	1,500	4,000	Orange, TX
Equitable	800	13,000	New Orleans, LA
Bethlehem Steel, San Francisco	1,000	3,500	San Francisco, CA
American Ship, Lorain	500	3,600	Lorain, OH
Bay Shipbuilding	1,700	1,800	Sturgeon Bay, WI
Peterson Builders e/	700	1,200 a/	Sturgeon Bay, WI
Total	11,300	44,600	
Total, All Categories	113,800	289,900	

SOURCE: Naval Sea Systems Command (NAVSEA) Memorandum.

a. These data may be too low.

b. Combatant-capable only (nuclear submarines).

c. This figure may be too high.

d. Small combatant/auxiliary-capable only.

e. Recent NAVSEA reassessment indicates that Peterson and Tacoma Board (not listed) can build small combatants (like PGM) also.

TABLE A-5. TOTAL EMPLOYMENT IN THE AEROSPACE INDUSTRY (By calendar year, in thousands of employees)

Year	Total Aerospace	Aircraft		Guided Missiles, Space Vehicles, and Parts	Communi- cations and Other Equipment	Other a/
		Total	Propulsion a/			
1961	1,178	606	--	152	160	--
1962	1,270	634	--	165	193	--
1963	1,267	635	--	173	183	--
1964	1,209	601	--	166	171	--
1965	1,175	620	--	155	145	--
1966	1,375	748	--	159	166	--
1967	1,484	828	--	157	179	--
1968	1,502	846	--	150	184	--
1969	1,402	799	--	124	179	--
1970	1,166	664	--	98	152	--
1971	951	525	--	87	129	--
1972	912	495	--	93	132	--
1973	956	525	133	93	116	222
1974	982	539	135	94	121	228
1975	941	514	126	93	116	218
1976	896	487	120	86	115	208
1977	893	482	121	83	121	207
1978	977	527	134	93	129	228
1979	1,109	611	152	102	139	257
1980	1,185	652	163	111	147	275
1981	1,203	649	163	122	153	279
1982 b/	1,165	614	152	127	154	270

SOURCE: Bureau of Labor Statistics.

a. Data not available before 1973.

b. Estimated.

TABLE A-6. ELECTRONIC EQUIPMENT AND COMPONENTS--PRODUCTION AND LEAD TIMES
(By calendar year)

	Production (Index: 1967 = 100)		Lead Times (end of year, in weeks)					
Year	Communication Equipment	Electronic Components	Integrated Circuits a/	Other Semiconductors b/	Resistors b/	Capacitors b/	Printed Circuits c/	Connectors a/
1970	105.8	120.6	--	--	--	--	--	--
1971	97.5	127.2	--	--	--	--	--	--
1972	101.4	158.4	--	--	--	--	--	--
1973	108.8	209.8	--	--	--	--	--	--
1974	114.1	212.9	--	--	--	--	--	--
1975	105.6	154.7	--	--	--	--	--	--
1976	110.1	201.3	--	--	--	--	--	--
1977	118.6	214.0	--	--	--	--	--	--
1978	131.0	246.9		10	8	8	10	--
1979	148.4	295.9	15	10	8	10	10	9
1980	155.0	304.6	10	6	6	7	9	8
1981	161.5	311.7	8	7	5	6	8	8
1982c/	167.2	312.8	7	4	4	4	6	5

SOURCES: Board of Governors of the Federal Reserve System; Purchasing Magazine.

a. Data not available before 1979.

b. Data not available before 1978.

c. Data through first eleven months of the year.

TABLE A-7. EMPLOYMENT AND UNEMPLOYMENT OF COMPUTER SPECIALISTS, SCIENTISTS, AND ENGINEERS (By calendar year)

	Computer Specialists a/			Life and Physical Scientitsts b/		
	Employment	Unemployment		Employment	Unemployment	
	(thousands)	(thousands)	(percent)	(thousands)	(thousands)	(percent)
1964	--	--	--	--	--	--
1965	--	--	--	--	--	--
1966	--	--	--	--	--	--
1967	--	--	--	--	--	--
1968	--	--	--	214	2	0.9
1969	--	--	--	211	1	0.5
1970	--	--	--	210	2	1.0
1971	247	7	2.9	226	7	3.1
1972	276	4	1.4	232	6	2.5
1973	291	3	1.0	263	5	1.9
1974	317	4	1.3	249	3	1.2
1975	370	7	1.9	281	5	1.8
1976	396	6	1.5	287	6	2.1
1977	81	7	1.9	281	7	2.5
1978	439	4	1.0	279	6	2.2
1979	547	6	1.1	287	8	2.7
1980	598	9	1.5	309	7	2.3
1981	627	7	1.1	311	9	2.8
1982	751	12	1.5	320	10	3.1

	Engineers					
	Total			Aerospace		
	Employment	Unemployment		Employment	Unemployment	
Year	(thousands)	(thousands)	(percent)	(thousands)	(thousands)	(percent)
1964	1,059	15	1.4	67	1	1.5
1965	1,055	11	1.0	60	1	1.6
1966	1,117	8	0.7	63	0	0.0
1967	1,157	9	0.8	71	0	0.0
1968	1,193	8	0.7	76	0	0.0
1969	1,220	10	0.8	80	2	2.4
1970	1,219	27	2.2	75	5	6.4
1971	1,204	35	2.8	61	4	6.3
1972	1,111	23	1.0	52	1	1.9
1973	1,107	11	1.0	60	1	1.9
1974	1,184	17	1.4	54	1	1.9
1975	1,170	32	2.7	52	1	1.9
1976	1,214	26	2.1	52	1	1.9
1977	1,295	17	1.3	55	1	1.8
1978	1,297	16	1.2	61	1	1.7
1979	1,421	17	1.2	66	0	0.0
1980	1,472	19	1.3	75	2	2.7
1981	1,537	23	1.5	84	0	0.3
1982	1,574	38	2.4	71	1	2.0

SOURCE: Bureau of Labor Statistics.
a. Data not available before 1971.
b. Data not available before 1968.

TABLE A-8. EMPLOYMENT AND UNEMPLOYMENT OF CRAFT WORKERS, BY TYPE OF WORKER (By calendar year)

	Total			Machinists and Job Setters			Tool and Die Makers		
	Employment	Unemployment		Employment	Unemployment		Employment	Unemployment	
Year	(thousands)	(thousands)	(percent)	(thousands)	(thousands)	(percent)	(thousands)	(thousands)	(percent)
1964	8,979	--	4.4	414	11	2.7	201	3	1.5
1965	9,216	--	3.6	489	8	1.6	185	2	1.1
1966	9,589	--	2.8	459	8	1.7	207	1	0.5
1967	9,845	--	2.5	576	8	1.4	212	2	0.9
1968	10,015	--	2.4	600	8	1.5	201	4	2.0
1969	10,193	--	2.2	601	8	1.3	207	3	1.4
1970	10,397	399	3.8	611	31	4.9	194	7	3.5
1971	10,436	510	4.7	569	31	5.1	185	9	4.6
1972	10,867	488	4.3	473	17	3.5	184	7	3.7
1973	11,371	441	3.7	497	9	1.8	187	3	1.6
1974	11,586	532	4.4	563	29	4.9	177	4	2.2
1975	11,107	1,005	8.3	563	44	7.2	173	15	7.9
1976	11,439	844	6.9	577	37	6.0	187	6	3.1
1977	12,068	723	5.6	584	22	3.7	192	4	2.0
1978	12,599	620	4.6	600	19	3.0	181	4	2.2
1979	13,119	624	4.5	652	18	2.7	183	2	1.1
1980	12,787	905	6.6	669	48	6.7	175	5	2.7
1981	12,662	1,022	7.5	668	45	6.3	175	10	5.6
1982	12,272	1,397	10.2	589	83	12.4	162	9	5.2

SOURCE: Bureau of Labor Statistics.

TABLE A-9. CAPACITY UTILIZATION RATES FOR DEFENSE-INTENSIVE INDUSTRIES, UNDER VARIOUS SCENARIOS (By calendar year)

Industry	CBO Baseline a/						Average Cycle b/			
	1982	1983	1984	1985	1986	1987	1982	1983	1984	1985
Aerospace/Ships	70	71	79	87	91	89	70	74	83	89
Electronics	77	76	82	87	89	89	78	82	87	91
Instruments	75	75	82	87	88	87	76	81	87	91
Fabricated Metals	60	62	69	75	77	79	61	71	80	85
Steel	48	56	69	77	79	82	48	60	76	86
Nonferrous	68	71	80	85	89	90	67	77	87	92
Total Manufacturing	70	72	77	81	83	85	70	79	83	86

a. Based on the Administration's defense spending targets and the CBO February 1983 forecast for the economy for 1982-1988.

b. Based on the Administration's defense spending targets and on average cyclical recoveries in major nondefense components of GNP.

TABLE A-10. SOURCES OF FUNDS USED FOR RESEARCH AND DEVELOPMENT, BY SECTOR (By fiscal year, in millions of dollars)

	Total		Federal Government		Industry		Universities and Colleges		Other Nonprofit Institutions	
Year	Dollars	Percent of GNP	Dollars	Percent of GNP	Dollars	Percent of GNP	Dollars	Percent of GNP	Dollars	Percent of GNP
1953	5,124	1.397	2,753	0.751	2,245	0.612	72	0.020	54	0.015
1954	5,644	1.539	3,132	0.854	2,373	0.647	80	0.022	59	0.016
1955	6,172	2.654	3,502	0.985	2,520	0.630	88	0.022	62	0.015
1956	8,363	1.983	4,852	1.151	3,343	0.793	96	0.023	72	0.017
1957	9,775	2.202	6,110	1.376	3,467	0.781	109	0.025	89	0.020
1958	10,711	2.382	6,779	1.508	3,707	0.825	121	0.027	104	0.023
1959	12,358	2.533	8,046	1.649	4,064	0.833	134	0.027	114	0.023
1960	13,523	3.670	8,738	1.725	4,516	0.892	149	0.029	120	0.024
1961	14,316	2.729	9,250	1.763	4,757	0.907	165	0.031	144	0.027
1962	15,394	2.724	9,911	1.754	5,123	0.907	185	0.033	175	0.031
1963	17,059	2.859	11,204	1.878	5,456	0.914	207	0.035	192	0.032
1964	18,854	2.956	12,537	1.966	5,887	0.923	235	0.037	195	0.031
1965	20,044	2.901	13,012	1.883	6,548	0.948	267	0.039	217	0.031
1966	21,846	2.890	13,968	1.848	7,328	0.969	304	0.040	246	0.033
1967	23,146	2.895	14,395	1.800	8,142	1.018	345	0.043	264	0.033
1968	24,605	2.817	14,928	1.709	9,005	1.031	390	0.045	282	0.032
1969	25,631	2.715	14,895	1.578	10,010	1.060	420	0.044	306	0.032
1970	26,134	2.633	14,892	1.500	10,444	1.052	461	0.046	337	0.034
1971	26,676	2.475	14,964	1.389	10,822	1.004	529	0.049	361	0.033
1972	28,477	2.401	15,808	1.333	11,710	0.987	574	0.048	385	0.032
1973	30,718	2.316	16,399	1.236	13,293	1.002	613	0.046	413	0.031
1974	32,864	2.291	16,850	1.175	14,878	1.037	677	0.047	459	0.032
1975	35,213	2.273	18,109	1.169	15,820	1.021	749	0.048	535	0.035
1976	39,016	2.271	19,914	1.159	17,694	1.030	808	0.047	600	0.035
1977	42,982	2.241	21,727	1.133	19,696	1.027	887	0.046	672	0.035
1978	48,295	2.232	24,003	1.109	22,491	1.039	1,035	0.048	766	0.035
1979	54,994	2.275	26,935	1.114	26,028	1.077	1,194	0.045	837	0.035
1980	62,222	2.363	29,576	1.123	30,400	1.155	1,313	0.050	933	0.035
1981	69,790	2.376	32,910	1.120	34,385	1.170	1,490	0.051	1,005	0.034
1982	77,285	2.519	36,125	1.178	38,500	1.255	1,600	0.052	1,060	0.035

SOURCES: National Science Foundation; U.S. Department of Commerce, Bureau of Economic Analysis.

TABLE A-11. 1981 CIVILIAN EMPLOYMENT, BY OCCUPATION AND SECTOR (In thousands of employees)

Occupation	Median Weekly Earnings (In 1981 dollars)	Total Employ- ment	Department of Defense Employment	Defense Industries Employment	Other Employment
Aero-Astronautic Engineers	614	67	4	27	35
Chemical Engineers	575	54	1	2	51
Civil Engineers	505	159	9	3	146
Electrical Engineers	530	114	2	9	103
Mechanical Engineers	540	210	8	18	185
Metallurgical Engineers	560	15	0	1	14
Mining Engineers	570	6	0	0	6
Petroleum Engineers	580	20	0	1	19
Engineers, N.E.C.	527	187	14	26	147
Agricultural Scientists	462	19	0	0	19
Biological Scientists	423	44	1	0	43
Chemists	467	93	2	3	88
Geologists	480	38	0	1	37
Medical Scientists	474	8	0	0	7
Physicists	500	21	4	1	16
Life and Physical Scientists, N.E.C.	420	27	6	1	20
Actuaries	480	7	0	0	7
Mathematicians	470	13	3	1	9
Statisticians	450	25	0	1	24
Mathematical Specialists, N.E.C.	425	5	3	0	2
Civil Engineering Technicians	360	30	2	1	27
Drafters	343	315	1	16	298
Electrical and Electronic Technicians	387	350	11	27	312
Industrial Technicians	350	32	3	2	27
Mechanical Technicians	350	48	0	8	40
Surveyors	310	59	1	1	57
Engineer and Science Technicians, N.E.C.	344	406	19	14	373
Dentists	723	174	1	1	173
Physicians and Osteopaths	980	506	1	2	503
Medical Workers Except Techinicians, N.E.C.	327	1,597	9	9	1,579
Health Technologists and Technicians	287	1,403	5	9	1,389
Pilots, Comptrollers, Flight Engineers	530	102	1	4	98
Technicians, N.E.C.	349	176	17	6	153
Computer Programmers	422	227	16	10	202
Systems Analysts	519	207	1	9	197
Economists, Financial Analysts	536	46	1	1	44
Psychologists	394	74	1	1	72
Sociologists, Urban/ Regional Planners	440	36	0	0	35
Social Scientists, N.E.C.	437	33	4	1	28

(Continued)

TABLE A-11. (Continued)

Occupation	Median Weekly Earnings (In 1981 dollars)	Total Employ-ment	Department of Defense Employment	Defense Industries Employment	Other Employment
Teachers, Adult Education	394	111	0	2	108
Teachers, College and University	444	608	9	4	604
Teachers, Vocational Education	380	28	16	1	11
Teachers, N.E.C.	312	3,295	0	30	3,265
Writers and Entertainers	350	937	2	25	910
Professional and Technical Workers, N.E.C.	382	4,452	12	109	4,331
Managers, Officials, Proprietors	407	9,185	137	204	8,845
Sales Workers	306	6,573	4	66	6,504
Office Machine Operators	238	893	12	25	856
Secretaries, Stenographers, Typists	227	3,827	76	84	3,667
Clerical Workers, N.E.C.	233	14,054	141	269	13,644
Construction Craft Workers	352	2,990	0	70	2,921
Mechanics, Repairers, Installers	326	3,907	145	87	3,674
Metalworking Crafts Workers	407	911	27	57	826
Printing Trades Crafts Workers	298	397	4	7	387
Crafts Workers, N.E.C.	352	3,724	22	153	3,549
Assemblers	236	1,644	0	140	1,504
Bindery Operatives	300	83	0	1	81
Cleaning Operatives	166	342	10	4	328
Meat Cutters and Butchers	292	71	0	1	71
Metalworking Operatives	331	1,639	22	119	1,498
Mine Operatives, N.E.C.	413	205	0	7	198
Packing and Inspecting Operatives	241	892	11	11	870
Painters, Manufactured Articles	269	163	7	10	146
Sawyers	204	79	9	2	68
Sewers and Stitchers	157	890	0	7	883
Textile Operatives	200	379	2	4	373
Transport Equipment Operatives	303	3,516	28	84	3,403
Operatives, N.E.C.	242	4,256	60	136	4,060
Food Service Workers	162	5,705	11	108	5,586
Janitors and Sextons	219	2,763	4	66	2,694
Health Service Workers	188	1,434	0	8	1,426
Personal Service Workers	191	1,634	15	40	1,580
Protective Service Workers	315	1,658	20	26	1,612
Private Household Workers	107	1,121	0	0	1,121
Service Workers, N.E.C.	178	718	1	14	704
Laborers, Except Farm	238	5,923	8	126	5,788
Farm Laborers	176	2,852	0	18	2,834
Total Employment	--	101,144	975	2,385	97,784
Average Weekly Earnings a/		289.35	323.70	308.92	288.53

NOTE: N.E.C. = Not elsewhere classified.
a/ Weighted average of median weekly earnings of different occupations.

APPENDIX B. DEFENSE AND NONDEFENSE SPENDING MULTIPLIERS

Many economists use the concept of a "fiscal multiplier" to explain how $1 of additional government spending for purchases (not transfer payments) can lead to more than (that is, some multiple of) $1 of additional GNP. 1/ More generally, the additional GNP yielded by an additional dollar of exogenous spending is called an expenditure multiplier. 2/ An expenditure multiplier of 2 implies that $1 of additional spending would add $2 to GNP. The size of the multiplier measures the stimulative effect of the additional spending. By analogy, the added employment created by an additional dollar of exogenous spending is often called an employment multiplier. Money multipliers measure the effects of changes in monetary aggregates. Tax multipliers measure the stimulus from cutting taxes. Real multipliers refer to the effects on real (constant dollar) activity of changes in exogenous economic variables. Fundamentally, multipliers summarize how GNP, employment, and other important indicators of economic activity respond to small changes in economic variables influenced by federal economic policy or by other external events.

The multiplier stimulus of additional exogenous spending will vary, depending on the kind of spending that is being increased, the time that has elapsed since the increase in spending, and the state of the economy at the time the spending is increased. First, different kinds of spending go to different sectors that may respond differently to additional receipts of income. This phenomenon explains why different types of exogenous spending may have different multiplier effects over some period of time.

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1. See John Maynard Keynes, **The General Theory of Employment, Interest, and Prices** (London: Macmilland and Company, Ltd., 1936); and Congressional Budget Office, **The CBO Multipliers Project: A Methodology for Analyzing the Effects of Alternative Economic Policies** (August 1977).

2. "Exogenous spending" is spending other than that which is determined by the state of the economy. It includes discretionary spending by the federal government and any other spending that may change in a manner unrelated to the state of the economy. Spending determined by the state of the economy is called "endogenous spending."

Second, some types of endogenous spending, especially investment spending, may respond with a lag to the initial changes in economic activity brought about by changes in exogenous spending. Such lags cause the stimulative effects of additional exogenous spending to persist through time. Thus, to understand the full effect of changes in policy, it is necessary to examine multiplier effects through time. Finally, multiplier effects depend on how consumers and businesses adjust their behavior in response to changes in income and interest rates. These responses generally depend on overall economic conditions, so that multipliers will vary according to the state of the economy. Real multipliers, in particular, will vary with the availability of resources. Employment multipliers, for example, will be small when the economy is operating near full employment.

This last point suggests an important corollary: multipliers are useful primarily for describing the economy's short-run response to limited changes in government policy. A different approach is more useful to analyze more ambitious changes in policy or longer-run effects. For example, while it may be true that, in today's economy, additional federal spending on goods and services (or perhaps preferably, additional monetary reserves) would stimulate employment, it is by no means true that employment could be increased indefinitely by ever higher federal spending. Limitations in resources would, at some point, stop the expansion in real activity.

DEFENSE AND NONDEFENSE EXPENDITURE MULTIPLIERS

Defense and nondefense expenditure multipliers could conceivably differ over some period of time, as a consequence of differences in the composition of the two types of spending. By the same token, different types of defense (or of nondefense) spending could have different multiplier effects. Added defense spending on tactical fighters, for example, would have unusually large immediate effects on GNP, if the particular recipients of those outlays exhibited unusually large and rapid spending responses to added income.

As a general rule, however, defense spending does not appear to be particularly more or less stimulative than other forms of governmental spending on goods and services. Changes in defense spending may, nonetheless, have greater immediate effect on aggregate demand than changes in transfer payments such as Social Security outlays. This is because transfer payments--in contrast to outlays on goods and services--

do not directly contribute to production. 3/ No stimulus for production occurs until the recipients spend some portion of the transfer payments. But if the recipients save any of the transfers, then that initial stimulus is correspondingly reduced, thereby reducing the overall effect on aggregate demand. This is so, even though the money saved will contribute to lower interest rates and, in time, end up as higher investment. Such additions to investment, however, will typically occur with a lag and thus not immediately fill the spending gap created by savings out of transfers. 4/

Not all analysts agree that spending on the typical mix of defense purchases is about as equally expansionary as spending on the typical nondefense mix of goods and services. One of the more persuasive arguments assumes that (1) defense spending goes disproportionately to labor-intensive industries; and (2) the short-run propensity to spend out of compensation exceeds the short-run propensity to spend out of other income. Together these assumptions imply that defense spending has relatively large short-term multipliers. But, as shown in Table B-1, the labor intensity of production stimulated by defense spending is little different from the labor intensity of production stimulated by other broad categories of government spending. Furthermore, as shown in Table B-2, econometric-model simulations do not indicate that defense spending has an unusually large multiplier.

LIMITATIONS OF MULTIPLIER ANALYSIS

As mentioned earlier, multipliers measure the short-run response of the economy for relatively small changes in policy variables. Except in this context, it makes little sense to distinguish between multiplier values, such as between values of defense and nondefense employment multipliers. Empirical estimates of employment multipliers, for example, usually are based on assumptions that spending patterns and relationships between production and employment in particular industries are fixed. Such assumptions are untenable in longer-run analyses.

Multiplier analysis, for example, has nothing to say on the possibility of raising employment (presumably to more desirable levels) for the

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3. This account neglects transactions costs of making transfers. Such costs may approximate those involved in administering expenditures on goods and services.

4. If the economy moves towards a full-employment equilibrium, regardless of initial conditions, then such differential effects of policies eventually vanish.

TABLE B-1. AVERAGE LABOR INTENSITY OF OUTPUT STIMULATED BY DIFFERENT TYPES OF SPENDING

Spending Type	Share of Production Accounted for by Compensation: Direct	Direct and Indirect
Personal Consumption	0.273	0.480
Federal Government, Defense	0.347	0.643
Federal Government, Nondefense	0.368	0.659
State and Local Government, Education	0.320	0.622
State and Local Government, Other	0.323	0.623
All Government, Nondefense	0.343	0.630

SOURCE: Stephan Martin, **The Impact of Defense Spending on the Private Sector** (Report), (Michigan State University: 1979)

TABLE B-2. NOMINAL MULTIPLIERS FOR DEFENSE AND NONDEFENSE SPENDING ON GOODS AND SERVICES--ALTERNATIVE MODEL ESTIMATES

	DRI Model		Wharton Model	
Year	Defense	Nondefense	Defense	Nondefense
1	1.71	1.61	1.48	1.90
2	2.12	1.94	1.37	1.67
3	1.72	1.67	1.65	2.10
4	1.52	1.61	2.20	2.81
5	1.79	1.85	2.49	3.18

SOURCE: CBO calculations using the respective models.

indefinite future, by means of large shifts in spending towards "labor-intensive" products. Such questions involve considerations of how markets operate over a time frame far longer than that implicit in multiplier analysis. In most longer-run analyses, differential employment effects vanish. Consider, for example, the free-market model, which assumes that all markets eventually clear to eliminate all shortages and surpluses. In such a case, shifts in spending between nondefense and defense may affect relative pay and the distribution of employment among occupations. But they can have no lasting effects on unemployment, because markets eventually clear regardless of the spending mix.

For somewhat more subtle reasons, multiplier comparisons are largely irrelevant to the choice of a given mix of spending between defense and nondefense, or between any other budget categories. This is because, regardless of the selected mix of federal spending, anti-inflation and full-employment objectives can still be addressed through the choice of appropriate levels of overall spending, taxation, and monetary growth. To be sure, abrupt changes in mix may have serious macroeconomic consequences involving bottlenecks and sharp increases in frictional unemployment. Such problems, however, are essentially transitional and should be considered from that perspective.

APPENDIX C. METHOD USED TO FORECAST INDUSTRY CAPACITY

This appendix describes the method used to forecast output capacity of defense-related industries. The description reviews the underlying model of capacity formation, discusses some of the model's limitations, and presents the results of model estimation.

A MODEL OF CAPACITY FORMATION

The basic model of capacity formation used in this report is part of the "neoclassical" model of capital formation. According to that model, the optimal capital stock is obtained by determining the optimal level of capacity and the optimal capital-to-output ratio. In most empirical applications, some composite of a distributed-lag function of output and a distributed-lag function of the ratio of output price to the user cost of capital determines the capital stock. In this framework, the lagged function of output is the estimator of capacity. The lags are generally regarded to reflect both adaptive-expectations and partial-adjustment mechanisms.

For the purposes of this paper, it is only necessary to deal with the capacity equation that may be expressed as

$$C_t^d = \Sigma\, a_i (Q/u)_{t-i}$$

in which C denotes capacity, Q denotes output, u denotes the desired rate of capacity utilization (which is presumed constant and therefore need not be estimated), d denotes a desired level, and t and i index time. Adding an error term, e_t, one obtains

$$C_t = \Sigma\, b_i Q_{t-i} + e_t$$

which is the specification used in the empirical work below.

LIMITATIONS OF THE MODEL

The capacity formation model has some good points--it is tractable and appears to fit the data reasonably well. Unfortunately, it is deficient in a number of ways, which are discussed in this section.

The model obviously excludes variables that might influence the desired level of capacity. The desired rate of capacity utilization, for example, could conceivably be affected by shifts in seasonal production patterns or by changes in the cost of holding inventories relative to the cost of maintaining standby productive capacity. In addition, firms' expectations of future demand could be influenced by more factors than just lagged production. Data on orders, sales by business customers, and prices and costs, could also influence sales forecasts.

Perhaps the most fundamental problem is that, to facilitate estimation, it is necessary to assume a fixed lag structure. This is not very plausible for several reasons. The speed of adjustment from a given level of capacity to the desired level may be quite different when expanding it than when contracting it, reflecting quite different adjustment costs. Furthermore, the particular autoregressive estimator that best estimates future output requirements would change in response to changes in perceptions of the relative magnitude of trend and cyclical and irregular components of the demand series.

One ideally would start with a more general model that allowed both for more variables influencing capacity and for variations in the lag structure. Data limitations make it extremely difficult to estimate a more complex model. From an empirical perspective, the strong autocorrelation in some of the equations' residuals in Table C-1 is evidence of the influence of other excluded factors.

EMPIRICAL ESTIMATES OF CAPACITY GROWTH EQUATIONS

Table C-1 displays the estimated capacity-growth equations. In each case, the lag coefficients were estimated for ten years, subject to the constraint that they corresponded to points on a third-degree polynominal. The second set of equations was estimated using the Cochrane-Orcutt procedure for dealing with autocorrelated residuals. This set was used in deriving the capacity utilization forecasts reported in the text. Further details on the results and data sources are available from the author.

TABLE C-1. ESTIMATED CAPACITY EQUATIONS, REGRESSION COEFFICIENTS AND DESCRIPTIVE STATISTICS

Industry	Lag (In years) 0.5	1.5	2.5	3.5	4.5	5.5	6.5	7.5	8.5	9.5	Sum	RHO	$\bar{R}^2$	$\overline{SE}$	SE	DW
						No Autocorrelation Correction										
Aerospace/	.31	.29	.25	.19	.13	.08	103	.01	.02	.06	1.38	--	.990	.018	.017	0.95
Shipbuilding	(.03)	(.01)	(.01)	(.01)	(.01)	(.01)	(.01)	(.01)	(.03)	(.01)	(.01)	--				
Nonelectrical	.23	.23	.21	.18	.15	.12	.09	.08	.09	.11	1.49	--	.999	.011	.009	0.97
Machinery	(.02)	(.01)	(.01)	(.01)	(.01)	(.01)	(.01)	(.01)	(.01)	(,02)	(.01)	--				
Instruments	.50	.41	.31	.21	.10	.01	-.06	-.10	-.11	-.06	1.22	--	.994	.039	.029	0.40
	(.10)	(.04)	(.06)	(.06)	(.04)	(.05)	(.06)	(.06)	(.04)	(.12)	(.04)					
Electrical																
Equipment/	.19	.36	.41	.37	.16	.13	-.01	-.11	-.16	0.11	1.32	--	.995	.034	.026	0.47
Components	(.05)	(.02)	(.03)	(.03)	(.04)	(.04)	(.04)	(.04)	(.03)	(.09)	(.03)	--				
Fabricated	.21	.22	.20	.17	.13	.09	.07	.07	.11	.18	1.44	--	.997	.018	.014	0.36
Metals	(.05)	(.02)	(.03)	(.03)	(.02)	(.03)	(.03)	(.03)	(.02)	(.06)	(.01)	--				
Nonferrous	.29	.32	.30	.24	.15	.06	-.01	-.06	-.06	-.00	1.23	--	.932	.066	.055	0.24
Metals	(.10)	(.05)	(.06)	(.06)	(.05)	(.07)	(.09)	(.08)	(.05)	(.17)	(.03)	--				
Iron and	.17	.20	.19	.16	.11	.07	.05	.05	.09	.18	1.27	--	.590	.062	.051	0.18
Steel	(.11)	(.04)	(.06)	(.06)	(.04)	(.06)	(.06)	(.04)	(.13)	(.13)	(.02)	--				
						Including Autocorrelation Correction										
Aerospace/	.30	.29	.25	.20	.14	.08	.03	.01	.01	.06	1.38	.52	.992	.016	.015	1.24
Shipbuilding	(.04)	(.01)	(.02)	(.02)	(.01)	(.01)	(.02)	(.02)	(.02)	(.03)	(.01)	(.23)				
Nonelectrical	.22	.22	.21	.19	.16	.13	.10	.09	.08	.10	1.49	.59	.999	.010	.008	1.53
Machinery	(.03)	(.01)	(.01)	(.01)	(.01)	(.02)	(.02)	(.02)	(.03)	(.02)	(.02)	(.24)				
Instruments	.29	.31	.27	.20	.12	.03	-.03	-.05	-.00	.13	1.27	.98	.999	.011	.010	1.06
	(.04)	(.03)	(.03)	(.03)	(.02)	(.02)	(.04)	(.04)	(.04)	(.07)	(.07)	(.03)				
Electrical																
Equipment/	.17	.27	.30	.28	.23	.15	.06	-.01	-.06	-.06	1.34	.96	.999	.020	.015	1.06
Components	(.04)	(.04)	(.04)	(.03)	(.03)	(.04)	(.04)	(.04)	(.05)	(.08)	(.08)	(.06)				
Fabricated	.15	.18	.19	.18	.16	.13	.11	.10	.11	.14	1.45	.96	.999	.010	.007	1.93
Metals	(.03)	(.02)	(.02)	(.02)	(.02)	(.02)	(.03)	(.03)	(.03)	(.02)	(.04)	(.05)				
Nonferrous	.07	.16	.20	.21	.19	.15	.09	.03	-.02	-.06	1.03	1.00	.996	.017	.014	0.56
Metals	(.03)	(.02)	(.02)	(.02)	(.02)	(.02)	(.03)	(.03)	(.02)	(.04)	(.05)	(.03)				
Iron and	.04	.10	.12	.11	.09	.06	.03	.00	.00	.03	.57	1.00	.987	.011	.010	0.84
Steel	(.02)	(.02)	(.02)	(.02)	(.02)	(.02)	(.02)	(.02)	(.02)	(.02)	(.12)	(.00)				