# Defense Spending in the Context of the U.S. Economy: 1987 – 2003

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During most of the 1980s, several industries, regions, and types of workers in the U.S. economy benefited particularly from a boom in federal defense spending. From 1987 to the present, and especially after the Persian Gulf conflict, these same industries, regions and workers have been buffeted by a decline in spending almost as rapid as the previous buildup. This paper uses the INFORUM interindustry modeling system of the U.S. economy to determine industry level impacts on output and employment resulting from the decline in defense spending from 1987 to 1997. It also examines projected changes until 2003 using calculations from DEPPS, the Defense Employment and Purchases Projection System, of the Department of Defense, of which INFORUM is a contributor.[1] Throughout the paper, the historical and projected impacts arising from defense will be put in context with impacts on these industries and occupational groups from the patterns of expenditures in the economy as a whole.[2]

## Recent Spending Patterns

Although the Reagan administration is given the credit for the 1980s defense buildup, it actually began in 1978, during the Carter administration. By 1987, the extent of the increasing spending was clear. Real expenditures by that year were actually higher than in 1969, which was the year of peak spending on the Vietnam War. Table 1 shows that in constant chain-weighted 1992 dollars, total defense spending in 1987 was $360.2 billion, compared to $339.5 billion in 1969.[3] From its low point in 1977 of $229.9 billion, total spending had increase by $130.3 billion, an increase of over 50%.

However, table 1 makes it evident that the increase in spending in the 1980s was quite unlike the Vietnam spending, both in its character and composition. Although total spending on goods and services was certainly high in the Vietnam peak, the composition of expenditures was tilted towards compensation of employees. This was of course a function of the high manpower requirements during that period. Total Department of Defense employment in 1968 reached almost 4.9 million, whereas in the peak years of the 1980s it never climbed above 3.4 million. In contrast, spending on goods, especially those now treated as defense "investment" goods, increased dramatically in the 1980s.[4] Total spending on defense consumption and investment had increased by 1987 to $205.1 billion, from $92.2 billion in 1977, an increase of over 200%. Investment goods alone increased from $26.7 billion to $67.5, an increase of over 250%.

Since 1987, expenditures on goods and services as well as compensation have declined. The decline was slow at first, but after the end of the Persian Gulf conflict in 1991, spending fell sharply. The reduction in expenditures was especially significant in defense investment, which was only $35.7 billion in 1997, a little over half its 1987 peak. This amounts to an average annual decline of about 6.4%. However, DoD employment has fallen to a postwar low of only about 2.3 million, an average annual decline of almost 4% since 1987. Real compensation has not fallen by quite as much, but has declined at about 3.2% per year.

The administration projection used for this study implies a continued sharp decline in defense outlays in 1998, with a more gradual decline until 2001. Spending is actually projected to increase from 2001 to 2003. The NIPA figures and the outlays used in DEPPS are not directly comparable. However, if the NIPA numbers are moved forward using DEPPS growth rates, then total spending will fall to $240.1 billion by 2001, and then rise to $245.2 billion by 2003, on the NIPA basis, as indicated in table 1.

Another difference between the 1987 and 1969 expenditure peaks is that by 1987 the U.S. economy had grown from $3.4 trillion to $5.6 trillion in real GDP, so that the share of defense spending was only 6.4%, as opposed to 10.0% during the peak Vietnam year. By 1997 the defense spending share is only 3.6%, and is projected to decline further.

In terms of the overall economy, a rough assessment of the impact of declining defense expenditures can be obtained by performing the following crude thought experiment. Assume that defense expenditures had been maintained until 1997 at the 1987 level, but that all other components of GDP were as they actually were in 1997. This would raise GDP by the difference between 1997 and 1987 defense expenditures ($101.6 billion), resulting in a GDP for 1997 of $7291.2. This change would bring the average growth rate of GDP over the 1987 to 1997 period up from 2.4% to 2.6%. Assuming a constant GDP/employment ratio at the margin, this would result in an increase in total employment of 1.8 million, resulting in an unemployment rate of about 3.6%.

The experiment described above is unrealistic because such a low unemployment could most likely not have been attained. Maintaining the high level of defense spending probably would have crowded out consumption, investment or exports, since the economy in 1997 was already very tight. The experiment is also crude because it only looks at the economy as a whole. The impacts on output and employment of particular industries or occupational groups are usually more severe than the estimated impacts on the overall economy. However, such a thought experiment is still valuable in understanding the relative size of the decline of defense spending in the context of overall GDP. It shows briefly that although the cutbacks in defense spending have been difficult for certain industries, they have allowed for other components of GDP to grow, such as consumption, investment or exports. In some cases, firms have diversified away from the defense market, to rely more on commercial end uses of their products. In other cases, firms have been able to find overseas export markets to cushion the shock of U.S. government reductions in demand for military goods.

**The Composition of Defense Spending**

The composition of goods purchased by the government is a function of the set of defense programs that have budget authority that actually results in total obligational authority (TOA). The outlays occurring in each year depend as well on the "spend-out" rate of each of those programs, which reflects the time lag between budgeting funds, signing contracts and placing orders, and receiving goods or services and making payments. Although there are over 200 detailed defense programs in the budget, they are usually summarized in several major categories. DEPPS analyzes the impacts of defense outlays at the level of the 10 major defense programs shown in table 2.[5]

This analysis begins in 1987, when defense expenditures reached a peak after climbing for several years. At this point, with the passage of the Gramm-Rudman act, there existed strong pressures to reduce the defense budget. At about 1990, with the breakup of the Soviet Union, these pressures increased, and there was hope of a "peace dividend" to be obtained from the end of the cold war and reduction of defense expenditures. However, the Persian Gulf war kept expenditures up in 1991, even with the sizeable foreign financial contributions to this effort. After 1991, defense spending decelerated dramatically, so the period 1987 to 1991 presents a logical period for analysis. The second period analyzed is from 1991 to 1997, which is the last year for which annual NIPA data are available. This is also the first year of the DEPPS projections based on the FY 1998 Future Years Defense Plan (FYDP). The final period analyzed is from 1997 to 2003, which is obtained using the FYDP spending assumptions, and detailed calculations made in DEPPS.

In table 2, overall spending does not show a great decline from 1987 to 1991, falling at a rate of only 1.3% annually. However, within this overall falling budget, certain categories actually grew, such as missiles procurement (4.9%), ships and conversions (1.3%) and other procurement (1.6%). Total spending on operations and maintenance also experienced an average annual increase of 1.8%. Total procurement was falling at a rate of 2.5% per year, due to strong declines in aircraft procurement (-9.3%), weapons and tracked vehicles (-11.8%) and ammunition (-5%). Construction experienced the largest average percentage drop (-16.8%). Overall spending on military personnel remained flat during this period.

From 1991 to 1997, spending cuts were more rapid, with significant reductions in personnel, base closings, and strong cutbacks in the major procurement programs. The combination of these factors led to annual average declines of 4.7% in total spending. Spending on military personnel declined from $101.9 billion to $74.9 billion, at an average rate of -5.1%. Total procurement declined from $99 billion to $58.5 billion, an average rate of –8.8%. Procurement expenditures, which had been larger than personnel expenditures in 1987, by 1997 were only about three fourths as large. Three categories of procurement declined by at least 15% per year: missiles (-16.5%), weapons and tracked vehicles (-17.1%) and ammunition (-15.0%). Aircraft and ships procurement also fell significantly. The overall fall in the defense budget would have been much larger if it had not been for slightly rising expenditures on research, development, test and evaluation (RDT&E) and relatively slowly declining expenditures on operations and maintenance. The changes in percentage distribution among 5 major categories between 1987 and 1997 (treating procurement as a whole) are summarized in chart 1. The most obvious point revealed by this chart is that the procurement share has fallen, while the shares of Operations and maintenance and RDT&E have risen.

The DEPPS projected spending assumptions foretell declining expenditures until 2001, with a slight upward trend until 2003, especially in procurement. The net result is that real expenditures are projected to decline at only a –0.2% annual rate during this period.[6] All procurement categories are expected to show increases, and total procurement will grow at an average rate of 3.3%. However, expenditures on military personnel and operations and maintenance will probably continue to fall gradually.

The changing distribution of expenditures among the various defense programs will determine the impact of defense spending on industry output and employment. In particular, as the relative size of the non-pay portions of the budget have declined since 1987, this means that a reduced allocation of expenditures to the industry sectors that support the military. The next section shows the results of using the input-output model within DEPPS to analyze the effects of the historical and projected changes in defense spending on industry output.

**Output Effects of the Defense Spending Declines**

The input-output model used within DEPPS is the INFORUM detailed model of the U.S., named *Iliad*.[7] This model forecasts detailed changes in 10 final demand categories, including federal defense spending, at the 320 industry level. From these projections of domestic final demands, *Iliad* calculates total requirements needed to satisfy those final demands, how much of those requirements will be imported and how much will be produced domestically for each industry. Total requirements projections are based on input-output tables that change over time, to reflect changing input patterns that can be estimated econometrically. The share of total domestic demand for each industry that will be satisfied by imports is also an estimated equation.

Given the forecast of domestic output by industry, the model calculates employment by industry. The model can perform a similar calculation of the requirements for defense spending alone.

This calculation yields a projection of total requirements and total domestic output due to defense spending, as well as a projection of total defense-related employment in the economy. Defense-related employment includes the employment necessary to produce both direct and indirect defense requirements.

Before examining the changing importance of defense spending at the industry level, turn to table 3, which summarizes both the relative shares of four major segments of the economy in defense spending, as well as the importance of defense spending within the total economy at this aggregate level. The first conclusion we can draw from studying this table is that the composition of defense spending is quite different from that of the economy as a whole. In the entire economy, the service sector is by far the most important of these four sectors, taking between 64% and 67% of total final demand (GDP) and between 57% and 69% of total output, over the periods examined. Durable manufacturing, in contrast, is the most important sector in direct defense purchases, especially in 1987, when the level of procurement was high. As a proportion of total requirements, durable manufacturing is larger than services in 1987, but smaller by 1997, when procurement is a lower share of total spending. The bottom third of table 3 highlights the changing importance of defense as a share of the overall economy. In 1987, defense spending accounted for 6.5% of total final demand, and 6.4% of total output. Within the durable manufacturing sector, defense spending accounted for almost a quarter (23.3%) of total final demand in that year, and 16.3% of total output. By 1997, the share in total final demand had decrease to only 2.8%, and the share in durables, while still significant, had declined to 8.1%. The projection to 2003 shows a slight further decline in the share of defense, but not nearly as steep as the average decline from 1987 to 1997.

At the industry level, the differences in the impacts of defense spending are even more dramatic, both across industries and over time. Table 4 shows the industries for which defense spending is most important, ranked by the defense share of total output in 1987[8]. Defense shares of total output are shown for 1987, 1991, 1997 and projected shares for 2003. The next two sections to the right show the average growth rates of defense output and of total output for each industry. The far right hand column shows the ratio of the change in defense output to the change in total output for each industry.

In 1987, 57 of 320 industries produced 10% or more of their output for defense. The top 40 are shown in the table. By 1997, the number of industries satisfying this criterion had fallen to only 19. For the top industries in this list, not only was defense-related output declining significantly, but total output was declining. Of the top 20 industries in this list, only 5 had overall positive output growth during the period from 1987 to 1997, and the two fastest growing were service sectors: Engineering and architectural services (295) and Research laboratories and management consulting (290).

Several of the industries near the top of the list make products predominantly for military use. The fortunes of these industries have risen or fallen with defense spending, for the most part, except where they have been able to diversify into military exports. In 1987, four industries had defense-related output of 80% or more: Ammunition, except small arms; Shipbuilding and repairing; Tanks and tank components; and Guided missiles and space vehicles.

Several other industries produce a large segment of their output for defense, but may have some other important markets, such as other government, exports or investment. Five industries produced between 50% and 75% of their output for defense in 1987: Other ordnance and accessories; Small arms ammunition; Aircraft and missile parts; Aircraft and missile engines; and Aircraft. Six other industries produced between 25% and 50% of their output for defense in 1987.

Purchases of ammunition declined at an annual rate of 15% from 1991 to 1997, with total output falling at 14.2% per year. The output decline was cushioned slightly by a small increase in exports. This industry is projected to show positive growth in output (1.7%) from 1997 to 2003.

The Shipbuilding and repairing industry was moving ahead full steam in 1987 to try to satisfy the Reagan administration's stated goal of a 600-ship fleet. Defense purchases of ships, and total output actually continued to increase until 1991. However, after this point, the purchases of ships by the defense department sunk rapidly. The decline in total production was not as great as the decline in production for defense, as there was some increase in exports and sales as domestic equipment investment. For this industry, the ratio in the right hand column of table 4 is 1.37. This column shows the change in defense output divided by the change in total output, from the period 1987 to 1997. Since this number is positive for ships, it means that both defense output and total output moved in the same direction. It is greater than one because defense output declined more than total output, by almost 40%. This is also reflected in the first section of columns, which show that the defense share of output fell from 90% in 1987 to 64.5% in 1997.

Tanks and tank components were already being cut between 1987 and 1991, but after 1991 the cutbacks in spending resulted in output declines at the phenomenal rate of –20.3%, partly because the Army completed its purchasing program of the M1A1 Abrams Tank in that year.[9] Total output did not decline quite as much, again because of a rise in net exports.

Defense output of Guided missiles and space vehicles grew at 0.2% from 1987 to 1991, as total output in that industry remained relatively flat. From 1991 to 1997, defense output has declined significantly, at a rate of 13.3% annually. Output did not decline as severely as it would have since exports and federal nondefense purchases grew slightly. Federal nondefense purchases are mostly from NASA.

Other ordnance and accessories is yet another industry where declines in total output were not as severe as declines in defense output, due to a stable demand from net exports. Defense output in this industry, which fell at 14.7% from 1987 to 1991, and 10.1% from 1991 to 1997, is projected to continue fall, but only at 1.1% per year. Due to expected export growth, total output is projected to grow at 1.8%.

Small arms ammunition is in the unique position of being an industry that is primarily military in nature, yet satisfying the criterion of "dual use", in that a significant share of output is purchased by consumers. In fact, from 1987 to 1997, this source of demand was the fastest growing component of final demand for this industry. While defense purchases were falling from 7% to 8% per year, purchases by consumers were *growing* at almost 7% per year! While total output growth was still negative over this period, this industry did not experience such fast declines in growth as some of the other important defense industries. In 1997, the U.S. may have been one of the only countries in the world where consumer purchases of ammunition appeared ready to surpass military purchases. However, defense purchases are projected to grow more quickly than consumer purchases from 1997 to 2003, so this may not come to pass.

There are three industries in DEPPS that comprise a large share of the components required to satisfy the many detailed defense programs falling under the major headings of aircraft procurement and missiles procurement. These are aircraft and missile parts, aircraft and missile engines, and aircraft. The latter industry consists mostly of the airframes, since engines, electronics and computer systems, warheads, bombs and guns are purchased directly by the defense department. Table 2 showed that total outlays on aircraft procurement from 1987 to 1997 fell an average of 9% to 10% annually. Procurement of missiles increased at about 5% from 1987 to 1991, but then declined at 16.5% from 1991 to 1997. All three of these industries showed declines in defense output throughout the period 1987 to 1997, with aircraft declining the fastest.

However, total output growth of the aircraft industry was positive (3.2%) from 1987 to 1991, with domestic equipment investment in aircraft growing at 9%, and exports at 20% annually.

I leave you to peruse the rest of table 4, but a few summary comments may help. If you look at the far right column, it is striking that beyond the top 10 industries, almost all of the rest of the industries show a negative number for the ratio of defense output growth to total output growth. Since defense output was invariably declining for these industries over that period, this means that total output still grew. In other words, these industries managed to find other markets to substitute for the declining U.S. federal defense market. Defense shares of output in these industries therefore were significantly lower by 1997. On the other hand, simple correlations of the growth rates of defense output and total output for these industries beyond the top 10 were .4 from 1987 to 1991, .5 from 1991 to 1997, and .2 from 1997 to 2003. This correlation suggests that the pattern of growth in defense output probably affected the pattern of growth in total output across industries.

**Changes in Defense Related Employment**

Employment related to defense spending can be viewed at three levels:

1. *DoD employment* - civilians employed directly by the Department of Defense.
2. *Defense Direct Employment* – Dod employment plus those employed in producing direct defense purchases.
3. *Defense Related Employment* – Direct employment plus those employed in producing indirect defense purchases.

In addition to these workers are military personnel, which are not included in the civilian labor force, and therefore do not figure in the published employment and unemployment statistics.

Historical data and projections of DoD employment are furnished in the *National Defense Budget Estimates*, or "Green Book".[10] In 1997, total military employment was 1452 thousand for the four major armed forces, and civilian employment was 799 thousand. This source also publishes a figure labeled "Defense Related Employment in Industry", which was 2180 in 1997. Table 5 summarizes these defense employment data and total civilian employment. Defense direct employment and defense related employment are calculated in DEPPS. The method used is to assume that the jobs to output ratio, or inverse labor productivity, is the same for defense related output as for total output. In the projections, total economy jobs are forecast using industry level labor productivity equations, which capture trends and cyclical movements of productivity in each industry.[11] The INFORUM/DEPPS estimate of defense related employment in industry for 1997 is 1964 thousand, significantly lower than the published Green Book number.

Although military employees are not counted in the civilian labor force, changes in military employment are significant for understanding civilian labor force issues. From 1987 to 1997, the defense department shed 400 thousand active duty military. Even though many of these were surely retirees, the fact remains that this reduction adds roughly that many people to the civilian labor force, since if the department had maintained its force level, there would have been 400 thousand less able bodied workers available for private sector jobs. During the same period, the defense department civilian workforce was reduced by 333 thousand, which was an even larger proportion of the total. From 1997 to 2003, total DoD employment is expected to decline. The workforce will be reduced by 30 thousand military and 83 thousand civilian employees.

Defense related employment in industry has declined at an even faster rate. The average annual decline over the 1991 to 1997 period was 8.8%. The total decline in jobs between 1987 and 1997 was 1601 thousand. This has occurred primarily because of the sharp cuts in defense programs

discussed above. But increasing labor productivity in manufacturing over this period has also played a role. Certain industries important to defense, such as semiconductors, computers and communication equipment, have experienced some of the highest rates of productivity increase in the economy.

Combined DoD employment and defense related employment stood at a ratio of 5.6% of total civilian employment in 1987. By 1997 this ratio had fallen to 3.1%, and is expected to fall by 2003 to 2.7%, as the economy continues to grow, and defense related employment declines somewhat more. During the period 1991 to 1997, when defense employment had its greatest decline, civilian employment was growing on average 1.9%, an average of almost 2.5 million jobs per year. The unemployment rate, which stood at 6.8% in 1991, had fallen by 1997 to only 4.9%. The economy apparently had little trouble generating more than enough jobs to compensate for the jobs lost through reduced defense spending. From this perspective, it would appear that the shrinking defense budget has caused little pain, and has probably yielded great benefits in freeing up resources for production of more consumption, investment and export goods. However, evidence suggests that certain regions and occupations did feel the pinch from these spending declines.[12] The discussion of regional impacts of the spending declines is beyond the scope of this paper. Next we turn to the discussion of the impact of falling defense spending on employment by occupational group.

**Occupations Significantly Affected by Declining Defense Spending**

Estimates of occupational employment by industry can be obtained by multiplying the employment estimates discussed above by occupational distribution matrices. Indeed, this is the main function of LDEPPS, the skilled labor component of DEPPS.[13] The Office of Economic Projections at the Bureau of Labor Statistics (BLS) provides these matrices, which show the distribution of employment by occupation for each industry. In each industry, we assume that the occupational distribution of defense employment is the same as total employment for that industry.

Table 6 shows the total defense employment by 10 major occupational groups, which are formed as an aggregate of the 100 occupational categories used in LDEPPS. Each element in this table represents the sum of employment for that major occupational group over all industries. Changes over time are the product of two factors: the changing distribution of defense employment across industries; and changes in the occupational distribution matrix over time.[14] The columns on the right show annual growth rates for the time periods examined in this study. In almost all categories and in all periods, the average growth for defense employment was negative, a reflection of both declining defense output and rising labor productivity. The largest declines in the 1987 to 1997 period were the Precision production, craft and repair group and the group entitled Operators, fabricators, laborers. These are both occupational groups which figure prominently in the production of procurement, which fell most sharply during this period.

The bottom half of table 6 shows the percent distribution of the major occupations in total defense related employment. Comparing this with the same section in table 7, several observations stand out. The share of Scientists and engineers in the total defense related employment varies between 10% and 12% as opposed to between 2.3% and 2.6% for the economy as a whole. Workers in this group are generally highly specialized, and have accumulated significant academic and on-the-job training. Although 200 thousand defense related jobs were lost between 1987 and 1997, the overall economy added over 500 thousand jobs in science and engineering fields. From 1991 to 1997, these jobs were being added at the rate of 2.5% per year, despite the large cuts in defense spending. Another highly educated group, Other professional specialties, is much more sparsely represented in defense employment (4.3% to 5.2%) than in the overall economy (10.6% to

12.4%). This group includes such occupations as architects, doctors, lawyers and economists. Marketing and sales occupations also have a relatively low representation in defense employment compared to the economy at large.

Table 8 shows the share of defense related employment within each major occupational group. These shares have been on the decline in every category. In 1987, 18.6% of scientists and engineers were employed either directly or indirectly to produce goods and services for defense. By 1997 that share had dropped to 9.4%, and is projected to drop to 7.6% by 2003. The second highest share of defense related workers is in the group called Precision production, craft and repair. In that group, 6.2% of employment was due to defense in 1987, but only 3.1% by 1997. The share of Operators, fabricators and laborers fell by more than half during that same period.

If one examines occupations at a greater level of detail, the importance of defense spending for certain occupations is striking. Table 9 shows the results of ranking the occupations by the share of defense employment in 1987, and picking the top 30. The top two occupations on this list are also the most highly specialized. Shipfitters are employed in both the shipbuilding industry and by federal defense, and almost nowhere else[15]. Aircraft assemblers are employed only in the aerospace industry. Aeronautical and astronautical engineers are employed by dozens of industries, but over 95% of their employment is either in the aerospace industry or federal defense. Aircraft mechanics have an alternate source of employment in the air transport industry, and their decline in employment hasn't been as severe as the previous categories in the 1987 to 1997 period.

Beyond these top four, few of these occupational groups failed to increase employment over 1987 to 1997. Up to 1991, there was a decline in employment in many occupations as the economy was slowing down simultaneously with defense spending declines. However, in 1991 to 1997, strong economic growth in the overall economy more than compensated for the defense cuts. Within defense related employment, operations researchers are employed largely by the defense department directly, with some employment generated indirectly in aerospace and business services. However, in the overall economy, those two industries employ the bulk of operations researchers. Their employment in these industries has seen strong growth, and is expected to continue to do so. In contrast, total economy employment of electrical and electronics engineers grew at a rate of only 0.8% from 1991 to 1997, when total economy employment was growing at 1.9%. In addition to significant cuts in defense related employment for these workers, they are employed in industries such as computers, communication equipment and instruments, where there is strong productivity growth. Skipping down to computer systems analysts, we see that this group enjoyed 5.2% annual growth in total employment from 1991 to 1997, despite declining defense related employment. This is due to the fact that they are employed in just about every industry and more than a third of them are employed in business services, which is one of the fastest growing industries in terms of employment.

**Conclusions**

We have reviewed the pattern of U.S. defense spending over the recent historical period, and the budget projections for the coming years. The U.S. increased purchases of planes, missiles, ships, tanks and guns frantically during the Reagan administration, only to cut back purchases almost as quickly after the Gulf War. A well considered defense strategy would probably have resulted in a smoother pattern of defense spending over this period, but sadly, much of this spending is determined by politics, not with an eye to the optimal force structure. In spite of this, the behavior of the overall economy has dovetailed quite well with this pattern of spending. During the 1991-92 mini-recession defense spending had not yet begun its steepest decline. The recession was certainly not helped by the ongoing defense cuts at that time, but it could have been

worse. The steepest cuts occurred during the 1991 to 1997 period. After 1992, the U.S. economy enjoyed strong economic growth, and a reduction in unemployment by 1997 to a level not seen since 1973. Many companies whose defense markets were drying up found that the market for investment goods domestically and internationally was quite healthy. Also, many companies producing purely military goods were somewhat successful in promoting military exports.

The period of steepest decline in military and civilian DoD employment and private defense related employment was also a period of strong employment growth for the U.S. economy. With this tight economy, more spending would only have crowded out growth of other components of GDP.

Nevertheless, since we do find a correlation across industries between growth rates in defense related output and in total output, the defense spending declines have certainly affected the industrial pattern of growth across the economy.

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**NOTES**

[1] This modeling system replaces the former system known as DEIMS. The system is described in Meade (1995).

[2] This paper borrows from an earlier analysis by David Henry and Richard Oliver, which appeared in the August 1987 *Monthly Labor Review*.

[3] The source of this data is the most recent National Income and Product Accounts (NIPA). In order to facilitate comparison with results from DEPPS, I have omitted capital consumption allowances from the totals.

[4] In the last several years, the NIPA have divided government purchases of goods and services into two categories. Consumption includes goods used up in the current production of government activities, whereas investment goods are durable, and last over several periods. Thus, a ship or a plane is treated as investment, but the fuel that runs the ship or plane is consumption. Spare parts are treated as consumption, even though they may go to maintain an investment good.

[5] Table 2 was derived from NIPA table 3.10. The mapping used between that table and the 10 major defense programs treated here is as follows. *Military personnel*, line 16; *Aircraft procurement*, lines 4, 30; *Missiles procurement*, lines 5, 31; *Weapons and tracked vehicles*, lines 7, 33; *Ammunition procurement*, line 12; *Ships and conversions*, lines 6, 32; *Other procurement*, lines 8, 9, 11, 13, 34, 35; *Research, development test and evaluation*, line 20; *Military construction and family housing*, line 28. The lines from the NIPA table not included in the above totals are 17 (Civilian compensation), 18 (Consumption of fixed capital), and 36 (Residual).

[6] The NIPA data and the DEPPS detail are not strictly comparable. The DEPPS projections are all done in constant 1998 dollars, while the NIPA constant price series are chained 1992 dollars. Since the two sets of data are obtained from somewhat different sources, using different aggregation rules, the relative shares of the major categories are different. Therefore, while the growth rates of the individual categories in table 2 are correct, the total spending figure in DEPPS declined at an average rate of 0.7%, instead of 0.2%, due to different weights of the major defense programs.

[7] This model is described in Meade (1996).

[8] There are a number of important caveats in the interpretation and analysis of table 4. First, it should be stressed that these figures are *estimates*, made using an input-output model in conjunction with a defense translator, or defense bridge, which converts expenditures by major program category to final demand expenditures by industry. Since the DEPPS project is oriented towards making projections based on the

FYDP, a consistent historical series of translators is not available, and therefore a fixed bridge was used in the historical period of 1987 to 1997. This surely introduces some error into the estimates, and the size of this error is unknown. The interpretation of "defense share" should also be made carefully. A defense share of 50% does not mean that the average company in that industry produces only half of its output as military goods. Part of this nondefense share may be military exports, which are taking a larger share of the output of the important defense industries. Although imports of defense goods are generally small, declining imports can also lead to total output rising faster than defense output, and the table will show a declining defense share. Growth rates of other categories of final demand are discussed in the text, but not shown in this paper. Detailed "matrix listings", showing the share of total output used by each final demand category and by intermediate demand, can be obtained from the author on request.

[9] Korb (1990) contains a critical discussion of changes in the budget around the period of 1991.

[10] Table 7-5, pp. 168-69, in the FY 1998 edition. I haven't yet found the methodology for the calculation of Defense Related Employment in Industry from this source.

[11] See Meade (1997) for a discussion of the INFORUM labor productivity equations.

[12] The presentation of the regional impacts of defense spending from 1987 to 2003 is an important and interesting topic. Unfortunately, it lies beyond the scope of this paper. DEPPS includes a component that models the direct and indirect impacts of spending by major program by state. However, a consistent historical database is not available for this analysis.

[13] LDEPPS is based on the occupational employment matrix constructed by BLS. LDEPPS uses a 90 sector aggregation of industries, which is based on the INFORUM LIFT 85 sector private sector classification. In addition to the 85 LIFT sectors, there is one for domestic household employment, post office and federal government enterprises, state and local government, federal nondefense, and federal defense. Paul Dickens calculated the occupational distribution for federal defense civilian employment. The occupational categories in the BLS matrix have been combined to 100, and more detail has been maintained for occupational categories particularly important to defense. Silvestri (1997) presents the latest occupational employment projections. The BLS *Handbook of Methods* tells in more detail how these matrices are compiled.

[14] We are currently using the 1994 occupational matrix, with a projection to 2004, and interpolating the matrices for the intervening years. For the years before 1994, the 1994 distribution was used.

[15] In the discussion that follows, I report results from detailed tables available from LDEPPS. Space constraints do not permit including these tables in this paper.

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**Table 1. GDP, Federal Expenditures, Defense Expenditures, Employment**
**Expenditures are in chain weighted 1992$, employment in thousands**

| | 1969 | 1977 | 1987 | 1997 | 69-77 | 77-87 | 87-97 |
|---|---|---|---|---|---|---|---|
| GDP | 3393.6 | 4273.6 | 5649.5 | 7189.6 | 2.9 | 2.8 | 2.4 |
| Total federal spending, excluding CCA | 398.9 | 321.6 | 478.5 | 395.3 | -2.7 | 4.0 | -1.9 |
| Total defense spending, excluding CCA | 339.5 | 229.9 | 360.2 | 258.6 | -4.9 | 4.5 | -3.3 |
| Compensation | 194.5 | 137.7 | 155.1 | 112.9 | -4.3 | 1.2 | -3.2 |
| Defense consumption, excluding compensation | 115.6 | 65.5 | 137.6 | 110.0 | -7.1 | 7.4 | -2.2 |
| Defense gross investment | 29.4 | 26.7 | 67.5 | 35.7 | -1.2 | 9.3 | -6.4 |
| Defense share of GDP (%) | 10.0 | 5.4 | 6.4 | 3.6 | -7.8 | 1.7 | -5.7 |
| Share of federal C & I spending (%) | 85.1 | 71.5 | 75.3 | 65.4 | -2.2 | 0.5 | -1.4 |
| | | | | | | | |
| Total DoD employment (thousands) | 4849 | 3096 | 3376 | 2316 | -5.6 | 0.9 | -3.8 |
| Total military | 3460 | 2074 | 2243 | 1517 | -6.4 | 0.8 | -3.9 |
| Total civilian | 1390 | 1022 | 1133 | 799 | -3.8 | 1.0 | -3.5 |
| Defense related employment in industry | 2916 | 1730 | 3665 | 2180 | -6.5 | 7.5 | -5.2 |
| Total U.S. employment | 78958 | 91247 | 113413 | 129300 | 1.8 | 2.2 | 1.3 |
| Total labor force | 82357 | 97684 | 121088 | 136500 | 2.1 | 2.1 | 1.2 |
| Unemployment | 3399 | 6437 | 7675 | 7200 | 8.0 | 1.8 | -0.6 |
| Unemployment rate | 3.5% | 7.0% | 6.2% | 4.5% | | | |

NOTE: Capital consumption allowances have not been included in the spending totals to make them more easily comparable to Department of Defense data.
SOURCES: National Income and Product Accounts (BEA) and National Defense Budget Estimates (DoD)

**Figure 1. Total federal defense expenditures: 1960 - 2003**

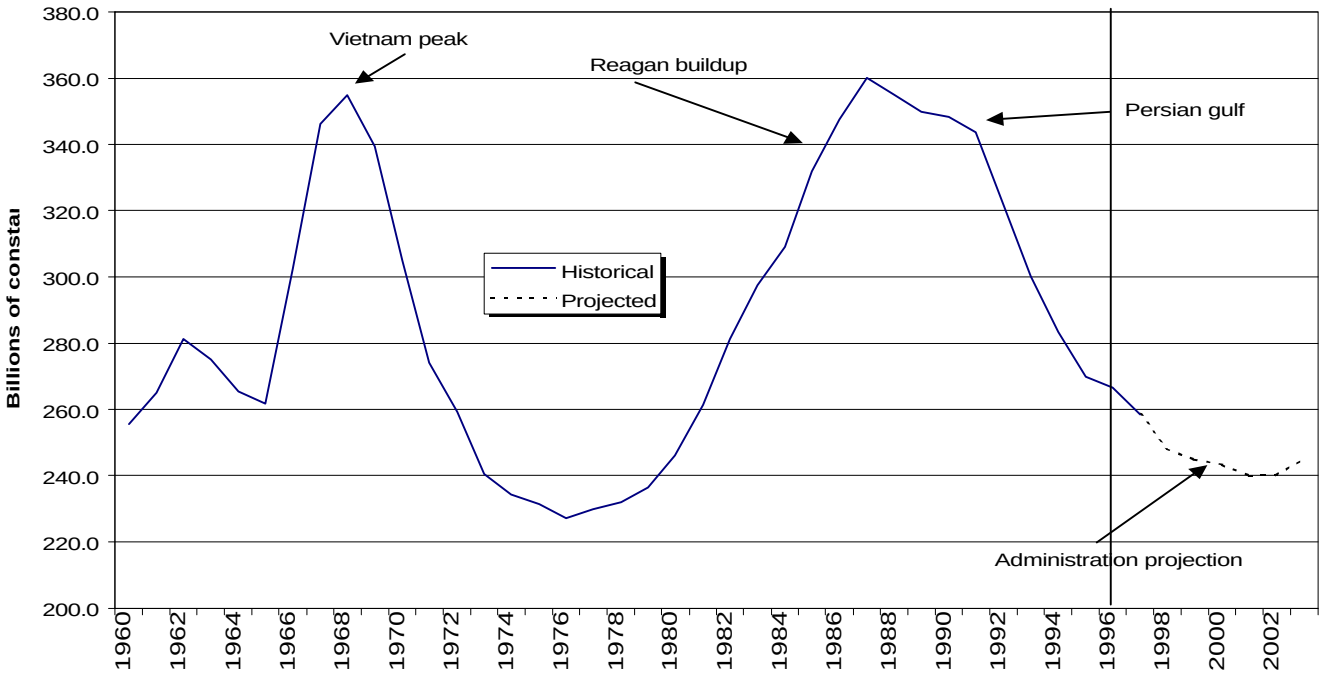



**Figure 2. Defense Expenditures as a Percentage of GDP**
**Calculated in constant 1992 dollars**

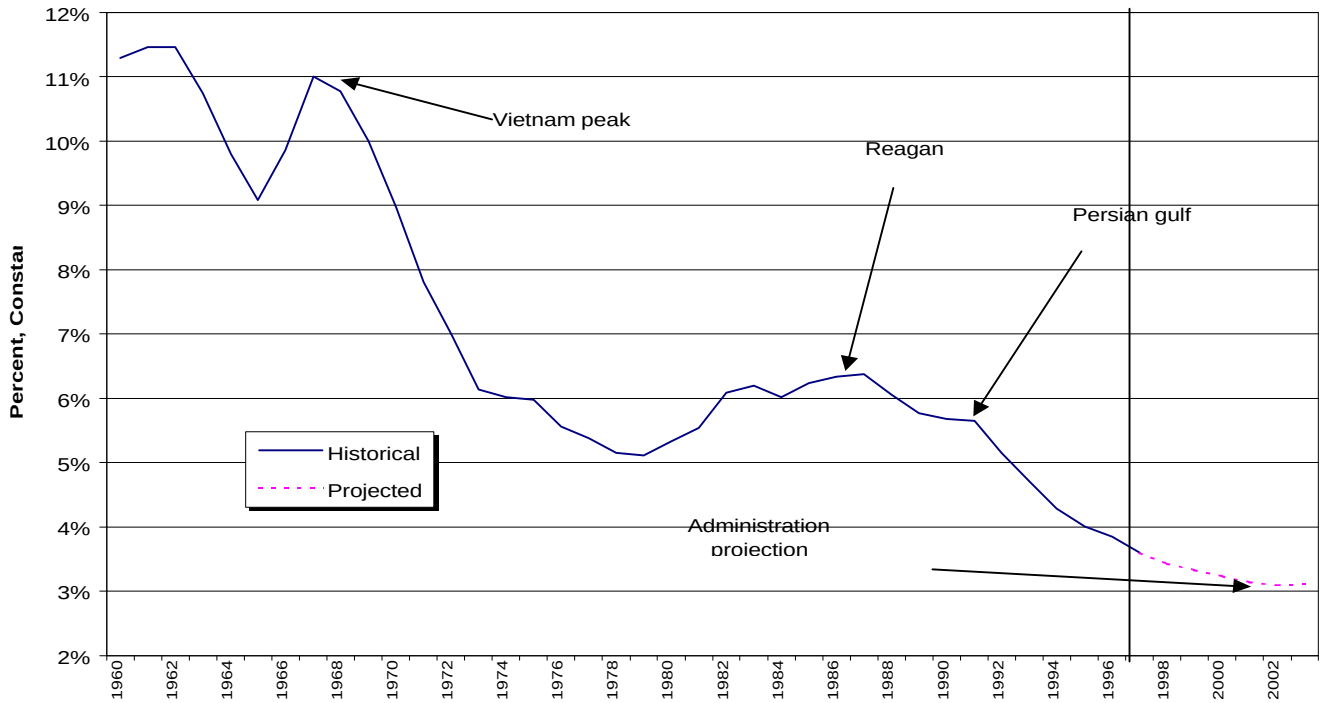


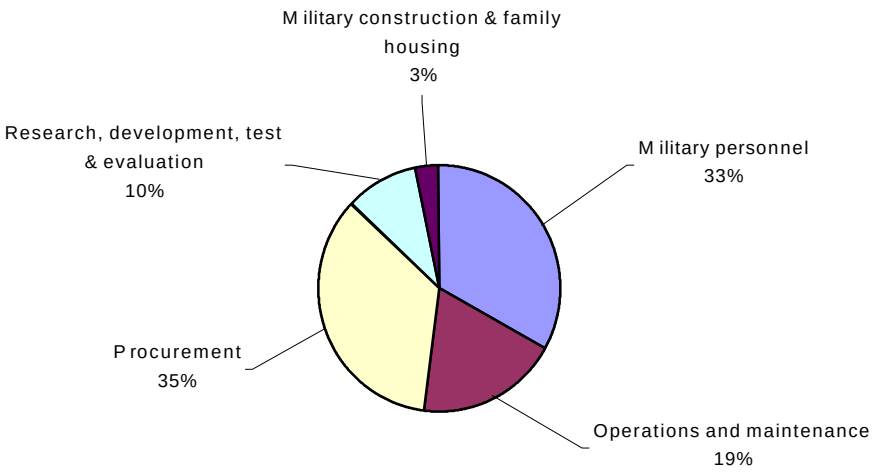
**Table 2. Defense Budget Outlays by Major Program, 1987 - 2003**
**[Billions of Chained 1992 Dollars]**

| Major Defense Program | Spending in Chained 1992 Dollars | | | | Percent Change | | |
|---|---|---|---|---|---|---|---|
| | 1987 | 1991 | 1997 | 2003 | 87-91 | 91-97 | 97-03 |
| 1. Military personnel | 101.9 | 101.9 | 74.9 | 70.2 | 0.0 | -5.1 | -1.1 |
| 2. Operations and maintenance | 58.1 | 62.4 | 56.2 | 51.7 | 1.8 | -1.7 | -1.4 |
| Total procurement | **109.3** | **99.0** | **58.5** | **71.3** | **-2.5** | **-8.8** | **3.3** |
| 3. Aircraft procurement | 39.1 | 26.9 | 14.3 | 17.7 | -9.3 | -10.5 | 3.6 |
| 4. Missiles procurement | 13.5 | 16.4 | 6.1 | 7.8 | 4.9 | -16.5 | 4.1 |
| 5. Weapons & tracked vehicles | 8.5 | 5.3 | 1.9 | 1.9 | -11.8 | -17.1 | 0.0 |
| 6. Ammunition procurement | 3.3 | 2.7 | 1.1 | 1.2 | -5.0 | -15.0 | 1.5 |
| 7. Ships & conversions | 11.6 | 12.2 | 6.1 | 6.9 | 1.3 | -11.6 | 2.1 |
| 8. Other procurement | 33.3 | 35.5 | 29.0 | 35.8 | 1.6 | -3.4 | 3.5 |
| 9. Research, development, test & evaluation | 30.3 | 25.7 | 27.0 | 23.3 | -4.1 | 0.8 | -2.5 |
| 10. Military construction & family housing | 9.2 | 4.7 | 5.0 | 3.2 | -16.8 | 1.0 | -7.7 |
| Total spending | 308.8 | 293.7 | 221.6 | 219.6 | -1.3 | -4.7 | -0.2 |

SOURCE: NIPA table 3.10 for 1987 to 1997 data. Data for 2003 was estimated by moving NIPA data forward by the rate of change in the DEPPS projections.
NOTE: Detail on the individual procurement categories was not available in the last DEPPS projections. Neither capital consumption allowances nor civilian compensation have been included in the defense spending total shown here. See the footnote on this table for details on the aggregation of the NIPA table 3.10 to these 10 major programs.

# Chart 1

1987




1997

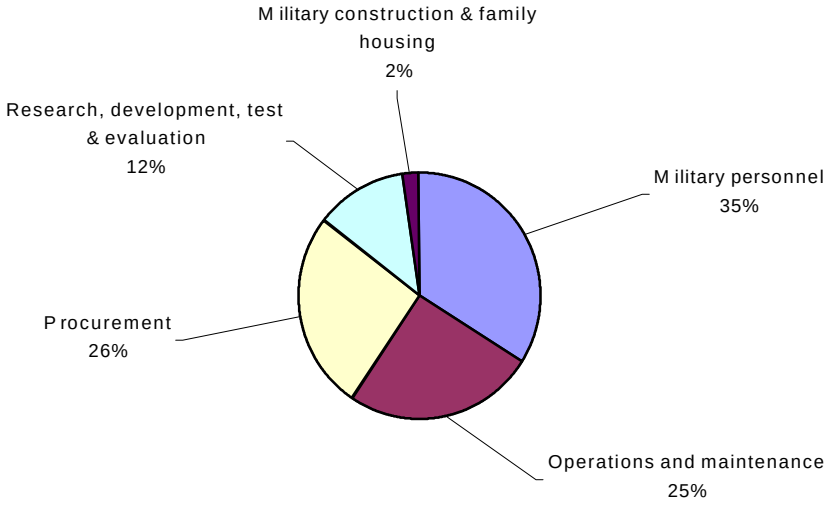


**Table 3. Comparison of the composition of defense and total economy final demand and output**

| | Defense Direct Demand Distribution in percent | | | Defense Output Distribution in percent | | | Growth Rate of Total Requirements | |
|---|---|---|---|---|---|---|---|---|
| | *1987* | *1997* | *2003* | *1987* | *1997* | *2003* | *87-97* | *97-03* |
| Agriculture, Mining, Construction | 3.6 | 5.5 | 5.0 | 5.4 | 5.7 | 5.3 | -4.6 | -1.5 |
| Durable Manufacturing | 62.2 | 47.6 | 50.4 | 44.0 | 30.4 | 31.6 | -8.9 | 0.6 |
| Nondurable Manufacturing | 7.4 | 7.4 | 6.6 | 10.4 | 9.4 | 8.6 | -6.2 | -1.6 |
| Services | 26.8 | 39.5 | 38.0 | 40.2 | 54.4 | 54.5 | -2.2 | 0.0 |

| | Total Economy Final Demand | | | Total Economy Output | | | Growth Rate of Total Output | |
|---|---|---|---|---|---|---|---|---|
| | *1987* | *1997* | *2003* | *1987* | *1997* | *2003* | *87-97* | *97-03* |
| Agriculture, Mining, Construction | 6.0 | 4.8 | 4.6 | 8.9 | 7.7 | 7.3 | 1.3 | 1.3 |
| Durable Manufacturing | 17.3 | 16.6 | 16.9 | 17.3 | 17.0 | 17.3 | 2.6 | 2.4 |
| Nondurable Manufacturing | 12.1 | 11.3 | 11.5 | 16.3 | 15.4 | 15.3 | 2.2 | 2.1 |
| Services | 64.6 | 67.2 | 67.0 | 57.5 | 59.9 | 60.1 | 3.2 | 2.2 |

| | Defense Share of Final Demand | | | Defense Share of Output | | |
|---|---|---|---|---|---|---|
| | *1987* | *1997* | *2003* | *1987* | *1997* | *2003* |
| Agriculture, Mining, Construction | 3.8 | 3.2 | 2.7 | 3.9 | 2.1 | 1.8 |
| Durable Manufacturing | 23.3 | 8.1 | 7.3 | 16.3 | 5.1 | 4.6 |
| Nondurable Manufacturing | 3.9 | 1.8 | 1.4 | 4.1 | 1.8 | 1.4 |
| Services | 2.7 | 1.7 | 1.4 | 4.5 | 2.6 | 2.3 |
| Total | 6.5 | 2.8 | 2.4 | 6.4 | 2.9 | 2.5 |

Source: Calculations made by the author from the industry component of DEPPS and the INFORUM *Iliad* model

**Table 4. Changes in defense related output compared with changes in total output for selected industries.**

| Industry | Defense Share of Output in Percent | | | | Defense Output, Annual Percent Change | | | Total Output, Annual Percent Change | | | Change in Defense Output / Change in Total Output |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 87 | 91 | 97 | 03 | 87-91 | 91-97 | 97-03 | 87-91 | 91-97 | 97-03 | 1987-1997 |
| 22 Ammunition, except small arms | 98.9 | 97.9 | 93.3 | 92.3 | -4.5 | -15.0 | 1.5 | -4.3 | -14.2 | 1.7 | 1.02 |
| 238 Ship building and repairing | 90.0 | 85.2 | 64.5 | 60.8 | 1.5 | -13.8 | 0.9 | 2.9 | -9.1 | 1.8 | 1.37 |
| 23 Tanks and tank components | 89.7 | 81.3 | 44.2 | 43.3 | -12.8 | -20.3 | 1.4 | -10.4 | -10.1 | 1.7 | 1.15 |
| 21 Guided missiles and space vehicles | 84.0 | 84.7 | 70.5 | 67.2 | 0.2 | -13.3 | -1.6 | 0.0 | -10.3 | -0.8 | 1.00 |
| 26 Other ordnance and accessories | 68.5 | 56.1 | 47.1 | 39.5 | -14.7 | -10.1 | -1.1 | -9.7 | -7.1 | 1.8 | 0.85 |
| 25 Small arms ammunition | 67.9 | 57.2 | 36.5 | 38.1 | -6.7 | -9.1 | 3.1 | -2.4 | -1.6 | 2.4 | 2.17 |
| 237 Aircraft and missile parts | 67.0 | 51.1 | 39.0 | 37.6 | -7.0 | -10.0 | 2.4 | -0.2 | -5.5 | 3.0 | 1.37 |
| 236 Aircraft and missile engines | 59.4 | 40.4 | 25.2 | 22.8 | -9.7 | -11.1 | 2.0 | 0.0 | -3.2 | 3.6 | 2.18 |
| 235 Aircraft | 58.0 | 33.7 | 21.9 | 21.6 | -10.3 | -11.8 | 2.6 | 3.2 | -4.6 | 2.9 | 2.88 |
| 220 Radio and TV broadcasting & comm. equip. | 48.8 | 42.4 | 20.1 | 17.4 | 0.2 | -11.8 | 0.8 | 3.7 | 0.7 | 3.3 | -1.17 |
| 145 Nonferrous castings and forgings | 47.3 | 33.3 | 17.2 | 16.0 | -7.6 | -11.2 | 2.1 | 1.1 | -0.3 | 3.4 | -9.59 |
| 100 Explosives | 41.2 | 32.1 | 12.7 | 11.4 | -9.2 | -17.3 | 0.8 | -3.0 | -1.9 | 2.5 | 1.51 |
| 246 Search and navigation equipment | 37.0 | 42.0 | 26.1 | 23.2 | -5.2 | -10.0 | 0.0 | -8.4 | -2.1 | 1.9 | 0.55 |
| 295 Engineering and architectural services | 30.3 | 25.1 | 17.1 | 13.7 | -3.4 | -3.5 | -1.3 | 1.3 | 3.0 | 2.3 | -0.34 |
| 290 Research labs and management consulting | 26.8 | 21.9 | 16.3 | 13.7 | -3.0 | -0.2 | -0.5 | 2.1 | 4.6 | 2.5 | -0.08 |
| 192 Mechanical power transmission equipment | 23.4 | 17.0 | 5.7 | 5.5 | -5.3 | -16.1 | 1.3 | 2.6 | 2.0 | 2.0 | -0.63 |
| 111 Fuel oil | 22.4 | 23.6 | 11.3 | 9.3 | 2.3 | -12.4 | -3.4 | 1.0 | -0.2 | -0.1 | -3.79 |
| 230 Electrical mach., equip. and suppl, nec. | 20.7 | 21.2 | 10.9 | 9.0 | 0.0 | -12.1 | -0.2 | -0.6 | -1.1 | 3.1 | 1.27 |
| 248 Measuring devices and environmental contrc | 19.8 | 13.2 | 5.6 | 5.1 | -7.2 | -12.5 | 1.1 | 2.8 | 1.7 | 2.6 | -0.53 |
| 135 Iron and steel forgings | 19.2 | 12.5 | 4.9 | 4.6 | -8.5 | -13.3 | -0.1 | 2.2 | 2.2 | 1.0 | -0.53 |
| 253 Laboratory and optical instruments | 18.9 | 13.8 | 5.4 | 4.5 | -4.7 | -12.4 | -0.7 | 3.1 | 3.2 | 2.5 | -0.31 |
| 195 Fluid power equipment | 18.6 | 13.7 | 5.7 | 5.9 | -5.5 | -12.8 | 2.7 | 2.2 | 1.8 | 2.0 | -0.53 |
| 223 Electronic components, n.e.c. | 17.6 | 11.1 | 4.3 | 4.6 | -5.2 | -8.7 | 1.5 | 6.3 | 7.3 | 0.0 | -0.09 |
| 221 Electron tubes | 17.4 | 11.3 | 4.1 | 4.6 | -3.4 | -12.1 | 3.7 | 7.4 | 4.8 | 1.8 | -0.13 |
| 164 Fabricated metal products, n.e.c. | 15.6 | 12.9 | 5.2 | 4.5 | -4.2 | -13.6 | -0.9 | 0.5 | 1.7 | 1.4 | -0.73 |
| 249 Surgical and medical instruments | 15.5 | 14.4 | 7.8 | 6.1 | 4.3 | -5.6 | -1.6 | 6.1 | 4.6 | 2.7 | -0.03 |
| 151 Fabricated plate work (boiler shops) | 14.7 | 15.7 | 8.3 | 6.5 | 6.6 | -6.5 | -1.2 | 4.8 | 4.1 | 2.9 | -0.03 |
| 24 Small arms | 14.3 | 15.6 | 7.7 | 8.9 | 1.9 | -6.8 | 4.6 | -0.1 | 5.1 | 2.1 | -0.11 |
| 189 Blowers and exhaust and ventilation fans | 14.1 | 10.9 | 4.1 | 3.7 | -0.4 | -13.6 | 1.7 | 6.0 | 2.7 | 3.2 | -0.16 |
| 142 Oth nonferrous rolling & drawing | 13.9 | 10.2 | 4.6 | 4.1 | -6.9 | -10.8 | 0.3 | 0.7 | 2.4 | 2.5 | -0.45 |
| 153 Screw machine products,bolts and nuts | 13.8 | 10.3 | 4.2 | 4.0 | -5.9 | -12.2 | 0.9 | 1.4 | 3.0 | 1.6 | -0.33 |
| 180 Metalworking machinery, n.e.c. | 13.5 | 15.0 | 7.2 | 4.1 | 5.4 | -5.2 | -6.0 | 2.9 | 7.1 | 3.2 | -0.02 |
| 225 Primary batteries, dry and wet | 13.5 | 12.2 | 6.0 | 6.9 | -6.3 | -6.0 | 4.8 | -3.7 | 5.8 | 2.5 | -0.28 |
| 165 Steam, gas and hydraulic turbines | 13.4 | 10.3 | 5.3 | 5.2 | 1.6 | -6.5 | 1.9 | 8.2 | 4.5 | 2.2 | -0.05 |
| 159 Metal plating, polishing and coating | 13.3 | 10.0 | 4.1 | 4.1 | -3.8 | -9.1 | 1.9 | 3.3 | 5.7 | 2.0 | -0.11 |
| 143 Aluminum foundries and castings | 13.2 | 9.6 | 3.6 | 3.4 | -8.3 | -13.4 | -0.1 | -0.3 | 2.8 | 0.9 | -0.54 |
| 141 Aluminum rolling and drawing | 13.1 | 9.4 | 3.8 | 3.6 | -8.2 | -13.8 | -0.4 | 0.2 | 1.0 | 0.9 | -1.25 |
| 211 Relays and industrial controls | 12.9 | 10.7 | 4.6 | 4.6 | -1.8 | -9.4 | 1.3 | 2.8 | 4.7 | 1.3 | -0.12 |
| 198 Electronic computers | 12.8 | 12.1 | 3.0 | 1.9 | 0.8 | -18.6 | -7.6 | 2.2 | 4.4 | 0.4 | -0.20 |

Source: Calculations made using the INFORUM Iliad model and DEPPS.

**Table 5. Summary of various measures of defense employment in relation to total civilian employment**

| | Employment in Thousands | | | | Annual Growth Rates | | |
|---|---|---|---|---|---|---|---|
| | 1987 | 1991 | 1997 | 2003 | 87-91 | 91-97 | 97-03 |
| Total civilian employment | 116350 | 123100 | 138049 | 146765 | 1.4 | 1.9 | 1.0 |
| DoD civilian employment | 1133 | 1045 | 800 | 717 | -2.0 | -4.5 | -1.8 |
| DoD military employment | 1853 | 1733 | 1452 | 1422 | -1.7 | -2.9 | -0.3 |
| Defense direct employment | 3030 | 2845 | 1862 | 1615 | -1.6 | -7.1 | -2.4 |
| Defense related employment | 4698 | 4367 | 2763 | 2491 | -1.8 | -7.6 | -1.7 |
| Defense related employment in industry | 3565 | 3322 | 1964 | 1774 | -1.8 | -8.8 | -1.7 |
| Defense related plus military employment | 6552 | 6100 | 4215 | 3913 | -1.8 | -6.2 | -1.2 |
| Percent share of total employment | 5.6 | 5.0 | 3.1 | 2.7 | -3.2 | -8.1 | -2.3 |

Sources: Total employment is from the INFORUM LIFT history, and forecast made using DoD defense projections. Historical and projected DoD employment is obtained from the *Budget Estimates* . Direct employment and indirect employment are the result of calculations within the DEPPS labor model.

**Table 6. Estimates of defense related employment for 10 major occupational categories**

| Occupation | Jobs, in thousands | | | | Annual growth rate | | |
|---|---|---|---|---|---|---|---|
| | 1987 | 1991 | 1997 | 2003 | 87-91 | 91-97 | 97-03 |
| Total defense related employment | 4698.4 | 4366.7 | 2763.0 | 2491.0 | -1.8 | -7.6 | -1.7 |
| Executive, Managerial and Administrative | 580.3 | 527.7 | 343.2 | 315.8 | -2.4 | -7.2 | -1.4 |
| Scientists and Engineers | 509.4 | 443.6 | 308.9 | 289.1 | -3.5 | -6.0 | -1.1 |
| Other Professional Specialties | 202.8 | 189.9 | 140.8 | 128.5 | -1.6 | -5.0 | -1.5 |
| Technicians and Support | 192.5 | 171.2 | 110.3 | 100.7 | -2.9 | -7.3 | -1.5 |
| Marketing and Sales | 214.7 | 210.6 | 132.0 | 121.5 | -0.5 | -7.8 | -1.4 |
| Administrative Support | 857.3 | 805.5 | 522.6 | 461.3 | -1.6 | -7.2 | -2.1 |
| Service Occupations | 397.5 | 416.0 | 288.3 | 267.1 | 1.1 | -6.1 | -1.3 |
| Agriculture, Forestry, Fishery | 48.1 | 45.2 | 29.8 | 26.7 | -1.5 | -6.9 | -1.8 |
| Precision Production, Craft and Repair | 880.8 | 795.8 | 486.1 | 433.7 | -2.5 | -8.2 | -1.9 |
| Operators, Fabricators, Laborers | 769.5 | 725.2 | 379.3 | 326.3 | -1.5 | -10.8 | -2.5 |
| | **Percent Distribution** | | | | | | |
| Executive, Managerial and Administrative | 12.3 | 12.1 | 12.4 | 12.7 | | | |
| Scientists and Engineers | 10.8 | 10.2 | 11.2 | 11.6 | | | |
| Other Professional Specialties | 4.3 | 4.3 | 5.1 | 5.2 | | | |
| Technicians and Support | 4.1 | 3.9 | 4.0 | 4.0 | | | |
| Marketing and Sales | 4.6 | 4.8 | 4.8 | 4.9 | | | |
| Administrative Support | 18.2 | 18.4 | 18.9 | 18.5 | | | |
| Service Occupations | 8.5 | 9.5 | 10.4 | 10.7 | | | |
| Agriculture, Forestry, Fishery | 1.0 | 1.0 | 1.1 | 1.1 | | | |
| Precision Production, Craft and Repair | 18.7 | 18.2 | 17.6 | 17.4 | | | |
| Operators, Fabricators, Laborers | 16.4 | 16.6 | 13.7 | 13.1 | | | |

**Table 7. Estimates of total employment for 10 major occupational categories**

| | Jobs, in thousands | | | | Annual growth rate | | |
|---|---|---|---|---|---|---|---|
| | 1987 | 1991 | 1997 | 2003 | 87-91 | 91-97 | 97-03 |
| TOTAL EMPLOYMENT | 116350.4 | 123099.9 | 138048.7 | 146765.5 | 1.4 | 1.9 | 1.0 |
| Executive, Managerial and Administrative | 11548.9 | 12184.4 | 13761.4 | 14878.3 | 1.3 | 2.0 | 1.3 |
| Scientists and Engineers | 2744.3 | 2839.3 | 3298.7 | 3794.4 | 0.9 | 2.5 | 2.3 |
| Other Professional Specialties | 12377.2 | 14158.8 | 16519.0 | 18216.2 | 3.4 | 2.6 | 1.6 |
| Technicians and Support | 3796.6 | 4220.3 | 4924.3 | 5468.9 | 2.6 | 2.6 | 1.7 |
| Marketing and Sales | 12480.0 | 13011.4 | 14490.9 | 15159.4 | 1.0 | 1.8 | 0.8 |
| Administrative Support | 21541.6 | 23079.5 | 24731.1 | 25428.7 | 1.7 | 1.2 | 0.5 |
| Service Occupations | 17586.3 | 19003.7 | 22578.4 | 25007.1 | 1.9 | 2.9 | 1.7 |
| Agriculture, Forestry, Fishery | 3508.4 | 3574.3 | 3605.7 | 3506.6 | 0.5 | 0.1 | -0.5 |
| Precision Production, Craft and Repair | 14143.9 | 14208.6 | 15568.3 | 16208.3 | 0.1 | 1.5 | 0.7 |
| Operators, Fabricators, Laborers | 16493.4 | 16688.4 | 18446.6 | 18965.9 | 0.3 | 1.7 | 0.5 |
| | **Percent Distribution** | | | | | | |
| Executive, Managerial and Administrative | 9.9 | 9.9 | 10.0 | 10.1 | | | |
| Scientists and Engineers | 2.4 | 2.3 | 2.4 | 2.6 | | | |
| Other Professional Specialties | 10.6 | 11.5 | 12.0 | 12.4 | | | |
| Technicians and Support | 3.3 | 3.4 | 3.6 | 3.7 | | | |
| Marketing and Sales | 10.7 | 10.6 | 10.5 | 10.3 | | | |
| Administrative Support | 18.5 | 18.7 | 17.9 | 17.3 | | | |
| Service Occupations | 15.1 | 15.4 | 16.4 | 17.0 | | | |
| Agriculture, Forestry, Fishery | 3.0 | 2.9 | 2.6 | 2.4 | | | |
| Precision Production, Craft and Repair | 12.2 | 11.5 | 11.3 | 11.0 | | | |
| Operators, Fabricators, Laborers | 14.2 | 13.6 | 13.4 | 12.9 | | | |

**Table 8. Defense share of total employment for 10 major occupational categories**

| Occupation | Defense Employment % of Total Employment | | | |
|---|---|---|---|---|
| | 1987 | 1991 | 1997 | 2003 |
| Total defense related employment | 4.0 | 3.5 | 2.0 | 1.7 |
| | | | | |
| Executive, Managerial and Administrative | 5.0 | 4.3 | 2.5 | 2.1 |
| Scientists and Engineers | 18.6 | 15.6 | 9.4 | 7.6 |
| Other Professional Specialties | 1.6 | 1.3 | 0.9 | 0.7 |
| Technicians and Support | 5.1 | 4.1 | 2.2 | 1.8 |
| Marketing and Sales | 1.7 | 1.6 | 0.9 | 0.8 |
| Administrative Support | 4.0 | 3.5 | 2.1 | 1.8 |
| Service Occupations | 2.3 | 2.2 | 1.3 | 1.1 |
| Agriculture, Forestry, Fishery | 1.4 | 1.3 | 0.8 | 0.8 |
| Precision Production, Craft and Repair | 6.2 | 5.6 | 3.1 | 2.7 |
| Operators, Fabricators, Laborers | 4.7 | 4.3 | 2.1 | 1.7 |

**Table 9. Changes in defense related employment compared to changes in total employment for the top 30 defense occupations**

| | Share of Defense Employment in Total Employment | | | | Total Employment, % Growth | | | Defense Employment, % Growth | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Occupation | 1987 | 1991 | 1997 | 2003 | 87-91 | 91-97 | 97-03 | 87-91 | 91-97 | 97-03 |
| TOTAL EMPLOYMENT | 4.0 | 3.5 | 2.0 | 1.7 | 1.4 | 1.9 | 1.0 | -1.8 | -7.6 | -1.7 |
| 74 Shipfitters | 65.6 | 65.5 | 49.2 | 46.9 | -0.6 | -3.0 | -1.3 | -0.6 | -7.7 | -2.1 |
| 64 Aircraft assemblers, precision | 57.6 | 41.3 | 26.6 | 25.2 | -1.3 | -5.9 | 1.0 | -9.6 | -13.2 | 0.1 |
| 3 Aeronautical and astronautical engineers | 49.9 | 38.9 | 26.9 | 24.1 | -0.1 | -2.5 | 0.8 | -6.4 | -8.6 | -1.0 |
| 60 Aircraft mechanics and engine specialists | 37.9 | 31.1 | 21.3 | 19.6 | 2.0 | -0.2 | -0.3 | -2.9 | -6.5 | -1.7 |
| 15 Operations research analysts | 26.5 | 22.8 | 14.9 | 11.9 | 1.2 | 2.4 | 2.4 | -2.6 | -4.7 | -1.2 |
| 6 Electrical and electronics engineers | 26.2 | 23.1 | 14.9 | 12.7 | -0.2 | 0.8 | 1.0 | -3.3 | -6.5 | -1.7 |
| 19 All other physical scientists | 26.2 | 22.7 | 15.1 | 12.0 | 1.5 | 2.1 | 2.2 | -2.1 | -4.6 | -1.6 |
| 8 Mechanical engineers | 23.9 | 20.5 | 12.7 | 10.6 | 0.1 | 1.1 | 1.4 | -3.7 | -6.8 | -1.6 |
| 13 Computer systems analysts, engineers, and scientists | 21.2 | 18.2 | 10.1 | 7.5 | 0.9 | 5.2 | 4.3 | -2.9 | -4.7 | -0.5 |
| 5 Civil engineers, including traffic engineers | 20.4 | 17.8 | 12.4 | 10.4 | 1.3 | 1.3 | 1.2 | -2.1 | -4.8 | -1.7 |
| 7 Industrial engineers, except safety engineers | 19.6 | 15.9 | 8.9 | 8.0 | -0.6 | 0.7 | 1.1 | -5.8 | -9.1 | -0.6 |
| 37 Programmers, numerical, tool, and process control | 18.3 | 13.6 | 6.0 | 5.3 | -0.7 | 1.1 | 1.5 | -8.1 | -12.4 | -0.7 |
| 73 Sheet metal workers and duct installers | 17.9 | 16.6 | 10.2 | 8.4 | -0.9 | 1.8 | 1.5 | -2.8 | -6.3 | -1.7 |
| 10 All other engineers | 16.6 | 12.6 | 6.5 | 5.8 | 0.3 | 1.1 | 1.6 | -6.5 | -9.9 | -0.3 |
| 69 All other precision assemblers | 16.4 | 13.7 | 5.9 | 4.9 | -0.9 | 2.1 | 1.0 | -5.5 | -11.9 | -2.0 |
| 80 Numerical control machine tool operators and tenders, metal and plastic | 14.8 | 11.0 | 4.7 | 4.1 | -0.4 | 2.0 | 2.2 | -7.7 | -12.3 | -0.2 |
| 65 Electrical and electronic equipment assemblers, precision | 14.8 | 12.4 | 5.1 | 4.3 | -2.0 | 0.4 | -0.6 | -6.5 | -14.2 | -3.6 |
| 71 Boilermakers | 14.7 | 13.8 | 8.4 | 7.2 | 0.3 | 0.7 | -0.2 | -1.3 | -7.5 | -2.8 |
| 72 Machinists | 14.6 | 12.1 | 6.4 | 5.5 | 0.0 | 0.6 | 0.5 | -4.8 | -9.9 | -2.0 |
| 9 Metallurgists and metallurgical, ceramic, and materials engineers | 14.6 | 11.0 | 5.6 | 4.8 | 0.4 | 1.7 | 2.0 | -6.6 | -9.7 | -0.6 |
| 14 Mathematicians and all other mathematical scientists | 14.5 | 12.4 | 8.5 | 7.4 | 1.4 | 1.0 | 0.6 | -2.5 | -5.3 | -1.7 |
| 66 Electromechanical equipment assemblers, precision | 14.2 | 11.8 | 4.8 | 4.1 | -1.9 | 0.0 | -0.2 | -6.5 | -14.9 | -3.0 |
| 4 Chemical engineers | 12.3 | 10.5 | 6.2 | 5.2 | 0.8 | 1.2 | 1.2 | -3.2 | -7.5 | -1.6 |
| 75 Tool and die makers | 11.5 | 8.9 | 3.8 | 3.2 | -0.5 | 0.5 | 0.1 | -7.0 | -13.5 | -2.8 |
| 16 Chemists | 11.3 | 9.6 | 6.1 | 5.1 | 1.4 | 1.7 | 1.2 | -2.7 | -5.9 | -1.6 |
| 86 Electrical and electronic assemblers | 10.9 | 9.1 | 3.9 | 3.1 | -2.0 | 1.7 | -0.1 | -6.6 | -12.5 | -3.9 |
| 87 Grinders and polishers, hand | 10.8 | 8.8 | 3.8 | 3.3 | -0.7 | 1.4 | 0.9 | -5.8 | -12.5 | -1.5 |
| 18 Physicists and astronomers | 10.8 | 8.6 | 4.9 | 4.2 | 1.6 | -0.2 | -0.6 | -4.0 | -9.7 | -3.0 |
| 68 Machine builders and other precision machine assemblers | 10.2 | 7.8 | 3.1 | 2.7 | -0.6 | 2.0 | 1.5 | -7.2 | -13.4 | -0.6 |
| 81 Combination machine tool setters, set-up operators, operators, and tenders | 10.0 | 7.9 | 3.3 | 2.7 | -0.7 | 2.8 | 2.5 | -6.6 | -11.9 | -0.5 |