DEFENSE/SPACE EXPENDITURES AND THE DOMESTIC ECONOMY

by

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INTRODUCTION

The objective of this report is to explain the importance of defense and space programs to the American economy. It is intended to be a survey of the "state-of-the-art" of our knowledge of space and defense economic impacts.

This working paper is a draft of a chapter for a volume on Defense Management, edited by Stephen Enke, to be published by Prentice Hall.

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Introduction

National security expenditures--primarily the outlays of the Department of Defense (DOD) and the National Aeronautics and Space Administration (NASA)--exercise a limited but often catalytic role in the American economy. Using general or aggregate types of comparisons as a first approximation, it appears that defense and space spending is of marginal importance in the national economy--such spending accounts for less than one-tenth of the Gross National Product and for a slightly smaller portion of the labor force. From a geographic point of view, most regions, states, and major metropolitan areas are but slightly affected by the economic impacts of these national security programs; only a handful of such localities depend on these programs for as much as a third of their employment.

A similar situation prevails in the industrial economy. Most large industry groupings--food, clothing, textiles, lumber, furniture, automobiles, mining, construction, machinery, retail and wholesale trade, and service establishments, among many others--find the military market to be a relatively small one for them. Even among the biggest defense contractors--the companies receiving the largest amounts of contract awards from DOD and NASA--the majority look to civilian markets for the bulk of their sales.

Nevertheless, because of the unusual nature of the economic resources devoted to defense and space programs, they affect the American economy in several important ways. The following is a sampling of these impacts:

1. Defense/space programs utilize a major share of the scientific and engineering talent in the United States; this tremendous demand may have created more than a little of its own supply, and that for the rest of the economy as well.

2. Defense/space programs receive the great bulk of all the goods and services purchased by the Federal Government; in creating this vast market for private industry, these programs have also served as the instrument for the expansion of the direct role of the Federal Government in the American economy as a purchaser and consumer of goods and services.

3. Because of the specialized nature of defense/space purchases--primarily high-technology weapon and space systems--a relatively few durable goods industries provide most of these needs. In turn, these industries have become the leading growth industries in the Nation and the regions in which they cluster among the fastest growing areas.

4. The expansion of defense/space programs also signifies that an increasing share of the national economy is independent of the level, or of changes in the level, of private consumption and investment; these governmental programs are independent of forces producing fluctuations in the private sector of the economy because they respond to a different set of demands.

Some statistical perspectives may be helpful in understanding the nature of the role that defense and space programs play in the national economy.

Some Aggregate Comparisons

Until comparatively recently, expenditures for national security were a very minor factor in total economic activity. In the half century prior to 1930, such outlays normally equaled less than one percent of the Gross National Product(GNP), except for the World War I period. From 1931 to 1939 military outlays averaged 1.3 percent of GNP. World War II, of course, raised security programs to what appears to be a relatively permanent high level in the American economy. Presently, purchases by the Department of

Defense and NASA are $57 billion or 9.7 percent of the total output of the Nation. The proportion was even higher during World War II (peak of 48 percent) and the Korean War (peak of 12 percent).

An alternative measure of the economic impact of defense/space activity is the portion of the work force devoted to defense activities. Figures for 1963 reveal that 6.7 million workers were in defense-related employment, representing 9.4 percent of total United States employment. A little over half were employed directly by the Federal Government, either in the Armed Forces or in defense-related work in Federal agencies. The remainder were in defense-related employment in private industry, working for prime defense contractors, subcontractors or firms providing materials and services to contractors.

The current level of military demand reflects an extended period of Cold War, interspersed by incidents leading to limited conflicts, such as Korea and Viet Nam, and temporary thaws and defense cutbacks, such as in 1957-58 and in 1963-64. An abrupt change in the nature of the external environment, and in the country's reaction to it, would cause another major shift from the present proportion of a little less than one-tenth of the Nation's resources being devoted to armaments and related security programs. (See Table 1) Clearly, the level and composition of national security demands are relatively independent of influences in the private economy. Defense and space spending does not regularly act as a stabilizer to counter swings in private consumption or investment, but neither does it necessarily move in parallel to accentuate such destabilizing swings in the private economy.

The impact of defense and space spending on the economy depends on many factors other than the level and rate of change of such spending.

Table 1

MEASURES OF THE ECONOMIC IMPACT OF DEFENSE/SPACE PROGRAMS
DATA FOR 1963

GNP Comparisons (dollar amounts in billions)	
Gross National Product	$585.1
Purchases of goods and services for National Defense	$ 56.7
National Defense as percent of GNP	9.7%
Employment Comparisons (in millions)	
Total U.S. employment	71.5
Estimated defense-related employment	6.7
Defense employment as percent of total	9.4%

Source: U.S. Departments of Commerce and Labor.

Heavy reliance on deficit financing during World War II, in contrast to the tax financing of the Korean War, produced different results on consumer income and spending and, hence, different economic stabilization problems. Variations in tax structures to finance any given level of expenditures are likely to influence the impact of defense and space outlays. Also, consumer and business expectations may differ from one period to another. Finally, the availability of resources also affects the timing and extent of the impact on prices, production, and economic growth. /1

Budgetary Implications

Military and space spending dominates the Federal Budget. From the point of view of economic activity, these programs account for over 85 percent of all Federal Government purchases of goods and services. In real terms (when the dollar figures are adjusted to eliminate changes resulting from inflation) virtually all of the increase in the absolute amount of Federal purchases during the past two decades has been accounted for by defense and space programs. In the aggregate, purchases of all other Federal Government agencies are at about the same level as in 1940. The large increases in Federal Government spending for civilian purposes have been transfer payments and grants, which do not show up directly in GNP. Hence, the rise in the Federal share of GNP from 6.2 percent in 1940 to 10.3 percent in 1964 has been accounted for entirely by defense/space expenditures. On this basis, it can be seen that these security-related expenditures have served, intentionally or otherwise, as the means for the expansion of the position of the Federal Government as a purchaser and consumer of goods and services.

The rather unique composition of military and space requirements affords useful insights into the nature of the resources required to meet these

needs and of the resultant geographical and industrial distribution of these resources. As can be seen in Table 2, capital outlays--which roughly correspond to plant and equipment expenditures in the private economy--receive 47 percent of the funds. This is in striking contrast to other sectors of the economy, such as consumer purchases of goods and services. Consumer spending on durables (including residential housing) accounts for only 21 percent of total personal consumption expenditures plus housing. Such hard goods or capital items produced for DOD and NASA are currently almost half as large as the total production of new plant and equipment for the private sector of the economy.

Within the capital outlays segment, the concentration on research and development (R&D)--38 percent of capital outlays--is noteworthy. These R&D disbursements of the Department of Defense and NASA, in turn, finance about three-fifths of all the R&D performed in the United States. They also represent the major element in the rising trend of R&D in the United States in recent years, far surpassing in dollar significance the increase in R&D funds supplied by all other sources, including private industry, colleges and universities, and other nonprofit institutions.

Reflecting the tremendous input of science and technology, the composition of the capital goods acquired by defense and space programs has changed significantly and frequently in the period since World War II. As shown in Figure 1, aircraft has gone through a cycle of decline and now expansion, as well as a shift in emphasis from strategic bombers to tactical fighters and transports. With the advent of the ICBM, missile procurement rose sharply. With the completion of much of the second generation of this type of weapon (such as Minuteman and Polaris), a decline has set in. Space systems--although still in the research stage--have expanded greatly, the great bulk being

Table 2

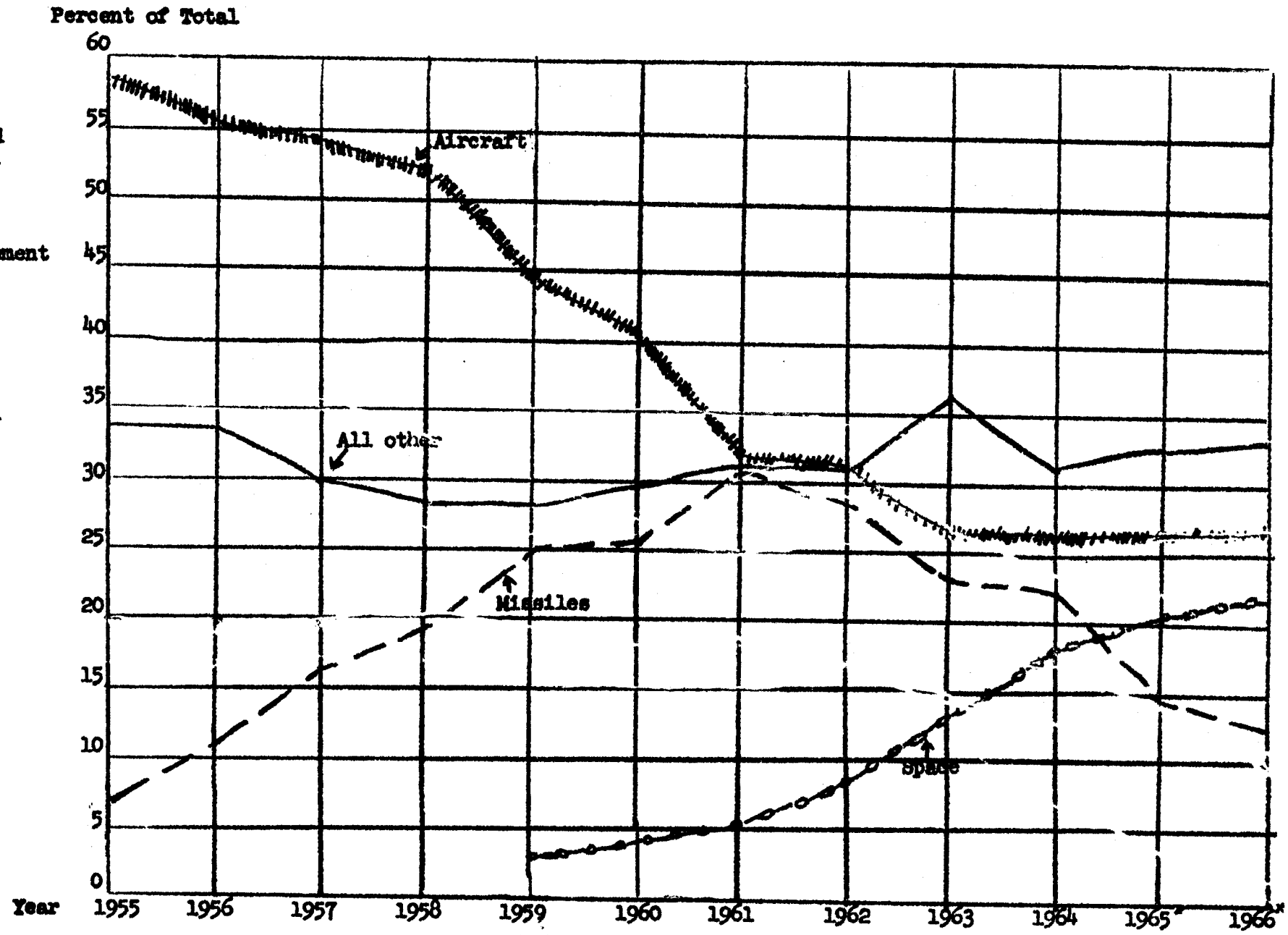
COMPOSITION OF DEFENSE/SPACE EXPENDITURES, FISCAL YEAR 1964

Capital Outlays	Billions of Dollars	Percent
Procurement of Weapon Systems:		
Department of Defense	15.4	26.4
Research and Development:		
Department of Defense	7.0	
NASA	3.3	
Subtotal	10.3	17.7
Construction:		
Department of Defense	1.3	
NASA	.4	
Subtotal	1.7	2.9
Total Capital Outlays	27.4	(47.0)
Operating Expenses		
Department of Defense	30.5	
NASA	.5	
Total Operating Expenses	31.0	53.0
Grand Total	58.4	100.0

Source: The Budget in Brief Fiscal Year 1966.

Figure 1

CHANGING COMPOSITION OF DEFENSE/SPACE PROCUREMENT AND R&D
FISCAL YEARS 1955-66



Source: Department of Defense and NASA
*Estimate

accounted for by Project Apollo and other NASA programs. It should be recognized that the civilian space exploration program, although it uses much of the same types of resources, results from a different set of national requirements. An expansion in defense outlays resulting from a limited war might have a neutral or even adverse effect on NASA funding; a cutback in military outlays resulting from arms control or disarmament agreements might lead to expanding NASA activities.

The Industrial Base

The composition of the firms and industries supplying goods and services to the Department of Defense and NASA is determined in large measure by the changing nature of the requirements of these agencies. For example, during the period July 1950-June 1953, the time of peak procurement of Army ordnance equipment for the Korean Conflict, General Motors, a major producer of tanks and trucks, was the number one military contractor based on size of orders received. It had fallen to 19 by the fiscal year 1964. Aerospace companies, such as Lockheed, Boeing, and North American, provide the bulk of the aircraft, missile, and space systems which now dominate DOD and NASA requirements.

The Industries Involved

Table 3 shows the current industrial distribution of the firms holding the largest value of military and space prime contracts. It is apparent that only a relatively few hard goods producing industries account for the bulk of these contracts: aircraft, electronics, motor vehicles, petroleum refining, chemicals, rubber, and construction, in that order. A far greater variety of companies and industries, of course, participate at the sub-

Table 3

DEFENSE CONTRACT AWARDS BY INDUSTRY, FISCAL YEAR 1963
(in millions of dollars)

Industry /1	SIC Code	Dept. of Defense	NASA	Total	Cumulative Percent
Aircraft and Parts	372	$ 9192.1	$1477.0	$10,669.1	50.4
Electronics	481, 482 361, 365 366	5065.1	257.5	5,322.6	75.5
Motor Vehicle and Equipment	371	1101.5	85.6	1,187.1	81.1
Petroleum Refining	291	716.7	-	716.7	84.5
Chemicals	281,289	556.8	12.7	569.5	87.2
Rubber	301	497.3	-	497.3	89.6
Construction	15,16	406.0	34.8	440.8	91.6
Education and Non-Profit Institutions	822,892	288.8	102.2	391.0	93.5
Ship and Boat Building	373	284.9	-	284.9	94.8
Machinery	352,354 355,356 358	238.8	13.3	252.1	96.0
Instruments	381,383	206.8	10.7	217.5	97.0
Air Transportation	451,458	213.1	-	213.1	98.0
Engines and Turbines	351	97.2	-	97.2	98.5
Business Services	739	43.9	33.8	77.7	98.9
Primary Metal Industries	331,333	68.4	2.7	71.1	99.2
Toys, Amusement and Sporting Goods	394	57.1	1.6	58.7	99.5
Deep Sea Transportation	441	26.7	-	26.7	99.6
Combined Utility Systems	493	-	1.3	1.3	99.6
Paper and Allied Products	262	-	1.2	1.2	99.6
Railroad Equipment	374	-	1.2	1.2	99.6
Miscellaneous	991 and Misc.	31.4	46.7	78.1	100.0
TOTAL		$19,092.6	$2082.3	$21,174.9	

/1 Companies are classified according to their primary area of business. This may not coincide with the categories in which they do the bulk of their defense/space work.

Sources: Listings of SIC codes were taken from S.E.C., Directory of Listed Companies, 1963, Dun and Bradstreet, Million Dollar Directory, and Aerospace Industry Assn. reports. Data on Defense contracts were obtained from Joint Economic Committee, Background Material on Economic Aspects of Military Procurement and Supply--1964; for NASA contractors from NASA Annual Procurement Report, Fiscal Year 1963.

contractor and supplier level. The funds for materials and parts reach many other industries in the form of subcontracts. This subcontracting does much to modify the concentration. Major Department of Defense prime contractors subcontract approximately half of all the contracts they receive; about 40 percent of this amount going to small business firms. Data on NASA's subcontracts for 1964 show that of the 1923 different subcontractors, 76 percent were small business firms; they received 24 percent of the subcontract dollars.

The extent of dependence on defense and space work varies widely among industries. It is estimated that 98 percent of ordnance production is consumed by defense, 90 percent of aerospace, 60 percent of ship building and 35 percent of electrical equipment. In contrast, the proportion is less than 5 percent for many important industries, including food, apparel, leather, lumber and wood, wholesale and retail trade, services, finance, and construction.

A relatively few large corporations receive the bulk of the defense contract awards. In fiscal 1964, the one hundred companies receiving the largest dollar volume of military prime contracts accounted for 73 percent of the Department of Defense's total. The top 100 companies accounted for 91 percent of the National Aeronautics and Space Administration's prime contracts.

It should be noted, by way of perspective, that concentration of economic activity is a long-standing and pervasive attribute of the American economy. For example, the 139 largest manufacturing corporations accounted for 46.5 percent of the assets of all manufacturing corporations in 1931. Likewise, the eight largest firms in 1954 accounted for a third or more of

the total shipments in 108 of 164 manufacturing industries for which census data were available.

The award of defense contracts has been concentrated in a relatively few companies for some time. In World War II the 100 largest contractors ranked by dollar volume of contract awards accounted for 67 percent of the value of all military contracts and among these the top 25 companies had 46 percent. In their study of the weapons acquisition process, Peck and Scherer concluded that "...the weapons business is apparently less concentrated than the most highly concentrated of American industries such as automobiles and aluminum. It is still, however, competition among the few."[12]

The extent of dependence on defense work varies widely among major contractors. Of the 35 largest such contractors in 1964, defense-space sales represented over 75 percent of the total company sales in the case of 9 of these firms, from 50 to 74 percent in 7 firms, and less than half in the case of 19 of the 35.

Specialized Resources

Another aspect of the industrial impact of defense and space programs is the very specialized nature of the resources used by the supplying companies. In contrast with the situation during World War II, and even with that during the Korean conflict, a far greater share of the work currently is performed in highly specialized facilities which have been specifically built for the purpose, often at the initiative of DOD or NASA which still may retain title to the factories and the equipment in them. In 1941, less than one-half of the total material needs of warfare consisted of special-purpose equipment. Most of this was material that could be produced by con-

verting ordinary peacetime facilities. Currently, the great bulk of the material needs of defense and space programs consists of specialized equipment which is produced in special facilities built for the purpose.

Moreover, many of the companies involved in the aerospace and electronics industries were set up for, and so much of their experience is limited to, the design and production of military weapon systems and related aerospace vehicles. As a consequence of the technical requirements of defense and space work, these companies have tremendous numbers of scientists and engineers, compared to the more commercially-oriented industries. The typical company or division of a company specializing in defense and space work hires four or five times the number of scientists and engineers than the most technically-oriented commercial company to support the same volume of sales. For a typical company producing aerospace systems, engineers and related technical personnel no longer constitute merely a single important but limited department. They may exceed in actual numbers the total of factory or "blue collar" employment. In large measure, these companies have become primarily large aggregations of R&D resources.

Aircraft and missile companies alone employ more scientists and engineers on research and development work than the combined total of the chemical, drug, petroleum, motor vehicle, rubber, and machinery industries. It has been estimated that about 52 percent of all the scientists and engineers doing R&D work in American industry are engaged on projects funded either by DOD or NASA.

Another striking relationship found between defense/space procurement trends and the American economy is the close correspondence between "growth" industries and the industry groupings that comprise the major DOD and NASA

suppliers, notably aerospace and electronics.[3] A study of the earlier postwar period concluded that fluctuations in these security-related purchases also were a major source of the shift in industrial output patterns.[4]

Changing Manpower Requirements

As a result of the change in product mix, there has also been a change in the occupational distribution of defense/space employment in private industry. The change is characterized by a high proportion of workers in professional and technical occupations and a below average proportion at the lower levels of skills. Scientists and engineers are, of all occupational groups, the ones most involved in the defense and space programs. About one out of every four in the country were on work connected with these programs in 1963.

In 1958, production workers represented 64 percent of the work force in the five major defense-related industries as compared to 75 percent in manufacturing as a whole. By 1963, the proportion of workers in production jobs had fallen to 57 percent in the defense industries, whereas in total manufacturing it had declined only 1 percent to 74 percent. At the same time, the proportion of defense workers in professional and technical occupations was two-thirds higher than the corresponding figure for workers in all manufacturing. At the other end of the occupational ladder, only 27 percent of the employees in defense plants were in semi-skilled or unskilled jobs, while 63 percent of the workers in civilian plants were in these occupational categories.

The defense and space programs, however, acted as more than sources of demand for scientists, engineers, and other technical employees. Both

directly and indirectly, they served to increase the supply of such personnel. The direct means included university fellowships, aid to research funding, and training programs. The more indirect influence on the supply of scientists and engineers was in creating a favorable labor market for them, via increasing pay rates and employment opportunities.

In addition, there has been a significant movement from military employment, both those with government agencies and those with defense contractors, to the private economy. Numerous veterans of the Armed Forces are now using skills, such as those in the field of electronics, which were acquired in the military service (over 16 percent of enlisted personnel separations from the Armed Services during the period 1957-63 were trained in electronic skills, either as operators of equipment or as maintenance technicians). An example of the movement of defense industry personnel to civilian work occurred as the result of the Dyna-Soar cancellation; two-thirds of the laid-off employees found jobs in nondefense fields.[5]

Regional Impacts

The concentration of military and space production in certain industries and companies has been accompanied by a rather high degree of geographic concentration. The tendency for individual regions of the country to specialize in supplying different types of military equipment is shown in Table 4. Firms in the East North Central states supplied over 73 percent of the tanks and related automotive equipment ordered by the DOD in 1964; the Pacific Coast states supplied 51 percent of missile and space systems, and the Middle Atlantic states 35 percent of electronics and communication equipment.

Table 4

ALLOCATION OF DEFENSE CONTRACTS BY CATEGORY AND REGION

Fiscal Year 1964

Program and Area	Millions	Percent
AIRCRAFT	$6,167	100.0%
New England	774	12.5
Middle Atlantic	841	13.6
East North Central	765	12.4
West North Central	1,369	22.2
South Atlantic	515	8.4
South Central	736	11.9
Mountain	32	0.5
Pacific	1,132	18.4
Alaska and Hawaii	3	0.1
MISSILE AND SPACE SYSTEMS	$5,807	100.0%
New England	468	8.1
Middle Atlantic	557	9.6
East North Central	205	3.5
West North Central	182	3.1
South Atlantic	593	10.2
South Central	186	3.2
Mountain	650	11.2
Pacific	2,966	51.1
Alaska and Hawaii	*	**
SHIPS	$1,529	100.0%
New England	275	18.0
Middle Atlantic	320	20.9
East North Central	94	6.2
West North Central	2	0.1
South Atlantic	486	31.8
South Central	82	5.3
Mountain	1	0.1
Pacific	269	17.6
Alaska and Hawaii	*	**
TANK-AUTOMOTIVE	$ 779	100.0%
New England	4	0.4
Middle Atlantic	36	4.7
East North Central	573	73.5
West North Central	9	1.2
South Atlantic	55	7.0
South Central	29	3.8
Mountain	1	0.2
Pacific	72	9.2
Alaska and Hawaii	*	**

Table 4 (continued)

ALLOCATION OF DEFENSE CONTRACTS BY CATEGORY AND REGION

Fiscal Year 1964

Program and Area	Millions	Percent
WEAPONS	$ 213	100.0%
New England	44	20.7
Middle Atlantic	71	33.3
East North Central	34	16.0
West North Central	11	5.1
South Atlantic	10	4.9
South Central	9	4.4
Mountain	1	0.3
Pacific	33	15.3
Alaska and Hawaii	0	0.0
AMMUNITION	$ 672	100.0%
New England	67	9.9
Middle Atlantic	86	12.8
East North Central	141	21.0
West North Central	114	17.0
South Atlantic	46	6.9
South Central	104	15.5
Mountain	7	1.0
Pacific	107	15.9
Alaska and Hawaii	0	0.0
ELECTRONICS AND COMMUNICATION EQUIPMENT	$3,012	100.0%
New England	285	9.5
Middle Atlantic	1,065	35.4
East North Central	318	10.5
West North Central	114	3.8
South Atlantic	385	12.8
South Central	140	4.6
Mountain	94	3.1
Pacific	581	19.3
Alaska and Hawaii	30	1.0

* = Less than $500,000

** = Less than one-twentieth of one percent.

Source: U.S. Department of Defense.

Thus certain states and communities, because of their relatively high degree of dependence on specific categories of defense work, are especially affected by shifts in size and types of DOD and NASA programs.

In fiscal year 1964, the ten states receiving the largest dollar volume of prime contracts accounted for 68 percent of total Department of Defense and NASA prime contracts. The top 15 states received 80 percent and the top 25 states received 93 percent of the total.

Subcontracting affects a significant geographic redistribution of the contract dollars. Although Department of Defense subcontract distribution is not available, a look at NASA's subcontracts gives an indication of the effects. A sample of first-tier NASA subcontracts shows that 68 percent were awarded to companies in states other than those in which the prime contractors were located; many of these states do not participate in NASA activities at the prime contract level at all. Of the first tier subcontracts, 15 percent was further redistributed to second tier-subcontracts. Of these, 56 percent was awarded to companies in other states.

Dollar procurement by state fluctuates from year to year. An example of the change from one year to the next can be illustrated in the case of Missouri whose military contract dollars increased 53 percent from fiscal year 1963 to 1964, and moved the state from the tenth highest state to the third. At the same time Ohio fell back to eighth from third, with a 28 percent decrease in dollar volume.

Three key factors underlie the geographic shift and concentration or dispersion of defense procurement: the product mix or the kind of product being purchased, the upward or downward trend of a few large individual projects, and the kind of industries located within the boundaries of each state and their ability to compete for the military business available.

However, in some states, relatively large amounts of defense/space work represent comparatively small portions of total employment and payrolls because of the state's broad industrial base. This factor cushions the impact of defense/space programs. Certain states and communities, because of their relatively high degree of dependence on defense and space work, are especially affected by shifts in the types of these programs. One indication of the magnitude of this dependence is the portion of the state's personal income derived from direct military payrolls and from wages and salaries of defense workers in private industry. As shown in Figure 2, six states depend on defense and space work for at least 10 percent of personal income--Virginia, Utah, Washington, California, Alaska, and Hawaii. For all other states, the proportion is less than 10 percent.

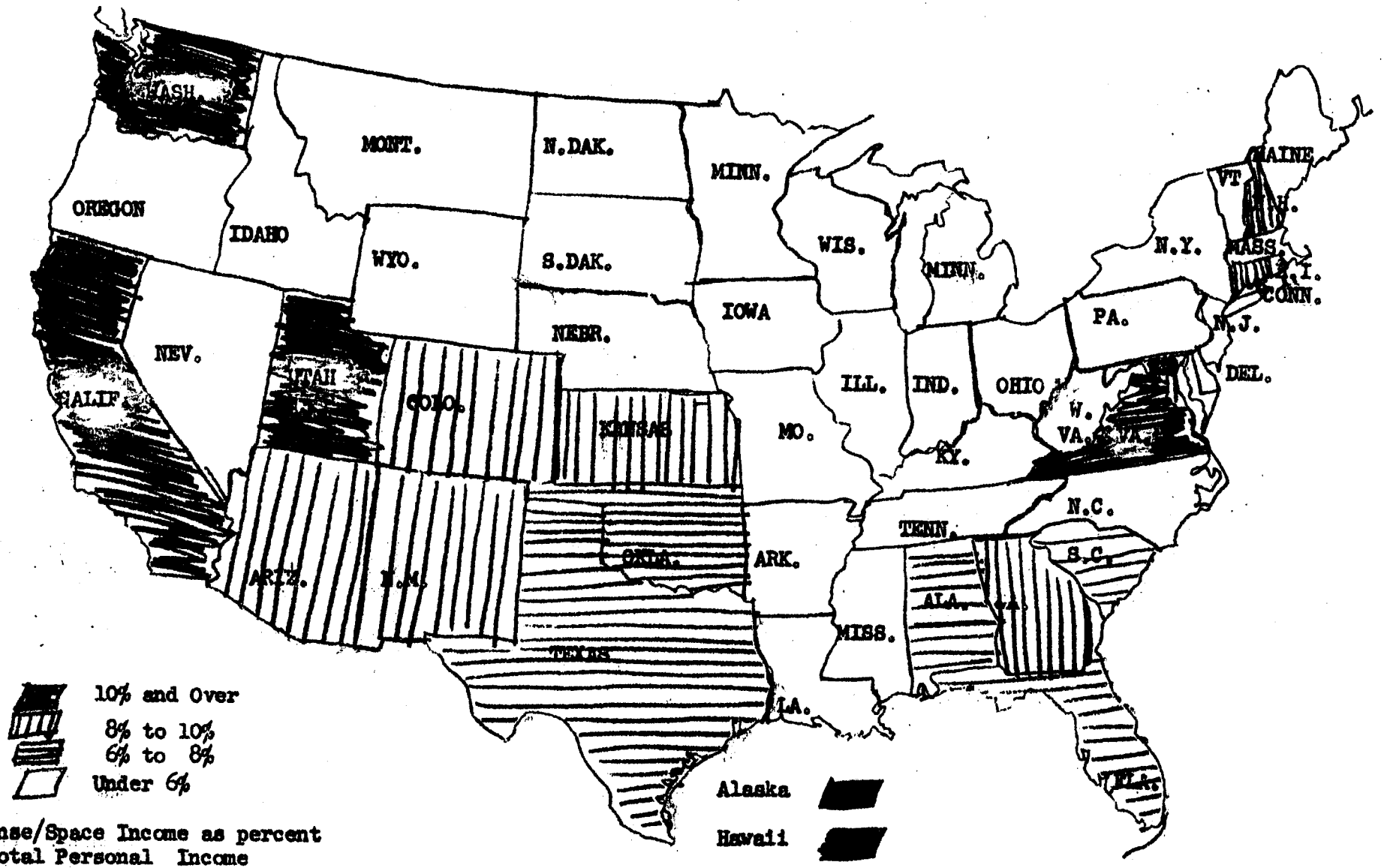
Within various states, the concentration is far greater; important examples are such metropolitan areas as Washington, D.C., Boston, Wichita, Huntsville, Cape Kennedy, Los Angeles and Seattle.

An indication of this concentration is shown in an estimate of the defense impact on the Los Angeles - Long Beach area in 1960, which is the largest defense/space complex. Direct employment of prime defense and space contractors amounted to 7.7 percent of total employment. When employment of subcontractors and suppliers was added, an additional 7.9 percent of the labor force was estimated to be involved. The direct and indirect effects accounted for over 15 percent of total employment.

As a result of the income and employment generated directly and indirectly via defense expenditure in a region, consumer and business incomes rise. In turn, part of this is spent in the region on retail goods, services, housing and other consumer and industrial items. This creates

Figure 2

GEOGRAPHIC IMPORTANCE OF DEFENSE/SPACE ACTIVITY, 1963



Defense/Space Income as percent of Total Personal Income

Source: U.S. Department of Labor.

additional income and employment. This employment may be termed "induced employment." By adding induced employment to direct and indirect employment, the total impact swells the effect of defense expenditure on employment to 43.5 percent of total employment in Los Angeles. Estimates made in a similar way for the Seattle-Tacoma, Washington area show a similar relationship--42 percent of total employment could be related to defense and space expenditures.[16]

The tendency of defense and space programs to cluster in a relatively few areas, and in a pattern different from that of American industry generally, is of fairly recent origin. In World War II the distribution of defense contracts more or less followed the then prevailing pattern of manufacturing activity. The major industrial states--Michigan, New York, Pennsylvania, Ohio, and Indiana--ranked high in prime contract awards. Korea marked the beginning of the change. The older manufacturing states began to decline in relative position. California displaced New York as number one and Texas appeared in place of Indiana, as aerospace and electronics activities grew in terms of military importance.

As long as automotive and conventional ordnance products were a substantial part of defense procurement, the capabilities of established manufacturing firms were drawn upon. With the increasing importance of aircraft, missiles, electronics, and space systems, newer firms became increasingly important and they tended to locate in the newer industrial states of California, Texas, Washington, or in rejuvenated New England states. The dominance of California is even more striking at the present time and Washington State, another center of aerospace activity, also appears high on the list of defense/space industrial activity.

It may be of interest to note that the state-by-state distribution of NASA prime contracts at the present time bears a close relationship to the geographic pattern of missile work in 1958 prior to the expansion of civilian space programs. Clearly, the regional and also the industrial distribution of NASA contracts with private industry is based on the industrial structure developed to meet the needs of the defense program. /7 The advanced and unique aerospace electronics and propulsion technology developed for military aircraft and missile programs are used in very substantial amounts for civilian space explorations. In large measure, the major space systems are technical outgrowths of earlier military developments in R&D.

Some Long-Term Effects

The impacts of defense and space expenditures on the economy manifest themselves in various ways. The incomes of government and private industry employees working on these programs show up directly in personal income, and also are reflected in the Gross National Product. The investment outlays by government contractors also are reported in GNP. In addition, as the recipients of defense-related income respend the proceeds for various types of consumer and investment items, further effects are felt of an induced nature (so-called multiplier and accelerator effects). The multiplier effect of government purchases from private industry has been estimated in the neighborhood of 1.3. Of some interest also is the further estimate that a billion dollars of such public outlay would generate additional Federal tax revenues of about 488 million dollars, state and local revenues of 30 million dollars, and reduce unemployment insurance costs by 160 million dollars.[18] Hence, the net budgetary costs of defense and space programs would appear to be rather less than the gross or clearly visible expenditures.

There is yet another aspect of the economic impact of defense/space programs which may be more illusive, more controversial, and possibly in the longrun of greater significance. That is the "spillover," "fall-out" or transfer of defense and space technology to other areas of the economy. There is no simple method of measuring what the dollar impacts of national security spending on research and development have been or will be for the economy.

From the point of view of investment in the private sector, four main effects have been identified:[19]

(1) The emergence of the new technologies, such as electronics, is stimulating investment in new industries.

(2) These technologies are enabling existing industries to develop a new range of equipment, instruments, and materials which are replacing, improving or extending old types of production. Computing machines, control devices, and synthetic chemicals are examples of private investment being so induced to create new or modify old factories and production equipment.

(3) The tools and materials forthcoming from the new technologies make possible economies of production in other industries, calling forth new investment to finance cost-saving innovations and increased output. Examples which have been offered include computers and recordkeeping equipment in the office and automatic controls for factories and railroads.

(4) Induced investment results from changes in the location of industry made possible by the new technologies.

Attempts to date to quantify these induced effects of defense/space technology have yielded extremely limited results. One detailed survey resulted in an impressive catalogue of the various types of technology which have had effects on the civilian economy (see Table 5). However, no comprehensive quantification was available. /10

A more limited survey of large aerospace companies reported that, other than the few firms selling equipment to the airlines, the large defense suppliers have obtained 1 or 2 percent of their sales, or even less over the years, from products based on their defense/space work which have been sold in commercial markets. The list of abandoned commercial ventures is a long and growing one, ranging from stainless steel caskets to powered wheelbarrows to garbage reduction machinery. Many surviving efforts continue at marginal levels--either actually losing money, barely breaking even, or showing profit results considerably below military levels. /11

Table 5

Tabulation By Type and Degree of Identified Missile/Space Contribution

Area of Technology	Dominant Types of Identified Contribution					Apparent Degree of Contribution		
	Stimulation of Research	Development of New Processes and Techniques	Improvement of Existing Products	Development of New Products	Cost Reduction	Strong	Moderate	Slight
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Instrumentation:								
Resistance Strain Gages	x		x	x			x	
Infrared Instrumentation					x		x	
Pressure Measuring Equipment	x			x			x	
Temperature Measuring Equipment			x	x			x	
Instrumentation Amplifiers			x					x
Electronic Components:								
Semiconductors	x		x	x	x		x	
Microsystems Electronics	x				x	x		
Thermoelectric Refrigeration			x		x			x
Connectors, Cables, and Printed Circuits			x				x	
Display Systems				x			x	
Control Systems:								
Inertial Guidance	x					x		
Electronic Computer Systems	x		x	x			x	
Power Sources:								
Solar Cells	x				x		x	
Energy Conversion	x					x		
Fuel Cells	x						x	
Magnetogydrodynamics	x					x		

Table 5 (continued)

Tabulation By Type and Degree of Identified Missile/Space Contribution

Area of Technology (1)	Dominant Types of Identified Contribution: Stimulation of Research (2)	Development of New Processes and Techniques (3)	Improvement of Existing Products (4)	Development of New Products (5)	Cost Reduction (6)	Apparent Degree of Contribution: Strong (7)	Moderate (8)	Slight (9)
Propulsion:								
Cryogenics	x				x		x	
Fluid Transfer Systems			x		x		x	
Fabrication:								
Filament Winding	x	x				x		
Chemical Milling	x	x				x		
High Energy Forming	x	x				x		
Solid State Bonding	x	x				x		
Materials:								
Refractory Metals	x					x		
Maraging Steels	x							x
Physical Metallurgy	x							x
Superalloys	x						x	x
Epoxy Resins				x			x	
Medical Technology:	x	x		x				x
Telemetry and Communications:	x		x				x	
Management Control Systems:		x				x		

Source: Denver Research Institute

A variety of reasons has been offered for the inability of the large, specialized defense/space companies to utilize their resources in commercial endeavors, including their lack of marketing capability and their inability to produce large numbers of items at low unit prices. These weaknesses are not necessarily handicaps in defense and space work, where other capabilities are more important. For example, the lack of commercial marketing capability of these firms results from their preoccupation with meeting the rigorous technical requirements of the governmental customers. Their inability to produce large volumes at low cost also reflects their unique capability to design small numbers of large-scale systems of great technical complexity.

Nevertheless, additional undertakings are continued to be reported, particularly attempts to transfer advanced technology to governmental and industrial areas, rather than to consumer markets which require so much of the capabilities which defense/space contracts find in short supply. More recent attempts have included an automatic parcel sorting system for a railway terminal, converting jet airplane engines to pumping gas and generating electricity for public utilities, and computerized systems to maintain inventory records for retail firms.

Capabilities Utilized	Typical Commercial Products and Services
Manufacturing (especially metal fabrication	Prefabricated homes, aluminum boats, wall panels
Production methods, processes, and equipment	Sealants, welding equipment, gauges, test equipment, adhesives
Technology	Architectural/engineering design services, data processing equipment, automated distribution systems, cargo loading equipment and systems
Product adaptation (application of military end-products to commercial use)	Computers, gas turbine engines, honeycomb structural materials, electronic stethoscopes, portable oxygen generators

The National Aeronautics and Space Administration, especially through its technology utilization program, has been attempting to accelerate the flow of space technology to business firms that can apply it to commercial goods and services. A number of universities and research institutes are cooperating in order to serve as a transmission belt between governmental and industrial defense laboratories and commercial industry. /12

Economic Constraints on Defense/Space Spending

From time to time the question has been raised as to how much national security spending the economy can afford; the companion concern is that short-run considerations may impair the long-term capability of the economy to support a large and sometimes expanding array of national security programs.

There is no simple or generally agreed on method to measure or determine the "burden" of defense and space programs on the economy, much less what, if any, economic ceiling exists on such programs.

Using the GNP comparison, the portion of our national resources devoted to armaments has tended to diminish rather than increase in recent years, from 10.5 percent in 1957 to 8.4 percent in 1964. During much of that period, considerable unutilized or underutilized capacity existed in the economy, far more than was generally desired. Price inflation has not been particularly troublesome in recent years; the wholesale price index has fluctuated within the narrow range of 99.0 to 100.7 from 1957 to 1964. (Base of 1957-59 = 100).

With reference to the concern over budgetary deficits, it should be recalled that the major increases in Federal expenditures in recent years have occurred in the domestic civilian area, particularly in the education, welfare, and health programs. The balance-of-payments problem continues.

However, the impact of national security programs here is not in terms of its total, but of the allocation between domestic and overseas outlays. In this latter connection, NASA programs have little impact on the balance of payments and the DOD has taken numerous steps to reduce its adverse influence on U.S. international accounts.

The real cost to society of allocating productive resources to defense and space programs may be said to be that these resources are unavailable for other purposes. Yet, such resources may not be entirely diverted from other uses in practice. Some or all of the resources so used might have remained unemployed but for the expansion of defense or space activities. On the other hand, if there is any such sacrifice in a given time period, and if the loss is in investment, additional sacrifices will accrue in subsequent time periods as society foregoes the returns on the absent investment.

Even where resources utilized by defense and space programs are diverted from other sectors, the value of the resultant output does not necessarily measure the value of the output diverted from the civilian sectors. For example, when resources shift from comparatively low-valued products such as agriculture to high-valued products such as space exploration systems, the increment of GNP so absorbs exceeds in value the output yielded by the private sector. Such structural shifts are a characteristic of the development of the American economy and a manifestation of its relatively rapid growth pattern. /13

There still may be an important opportunity cost involved in some of the highly specialized resources required by DOD and NASA. The most striking case may be that of R&D where over half of all the work performed in private

industry is financed by these two agencies. A corollary of this is that a majority of the scientists and engineers in American industry are devoting their efforts to defense and space work. Those who decry private affluence amid public poverty may well reflect as to the allocation of one of our most vital resources, science and technology.

Overall, available analyses of the "burden" of defense/space expenditures have generally concluded that, if necessary for military or political reasons, the American economy could handle, with a minimum of dislocation or hardship, a far higher level of such spending than has been experienced in recent years. Such studies or statements have been made by such diverse groups as the Committee for Economic Development, the National Planning Association, a panel of the United States Arms Control and Disarmament Agency, and a group of outstanding university and research economists appearing before the Joint Economic Committee of the Congress. However, many such analyses also concluded that the long-term growth and prosperity of the United States do not require even the current level of national security spending. /14

Hence, economic constraints do not appear to be an important limitation on the level of defense or space spending--directly. Indirectly, and essentially through the Federal budgetary process, financial constraints have and are likely to continue to restrict the portion of the Nation's resources devoted to these purposes. This, of course, reflects the fact that governmental appropriations for these items are not made in isolation, but result from the interplay of many conflicting requirements and demands, including those of numerous other Federal programs and of taxpayers who wish to reduce the portion of their incomes taken by the Federal Government.

The Nation's past experience testifies to the ability of the economy to adjust successfully to major reductions in national security spending. Demobilization after World War II was extremely rapid, and no sizable unemployment problem developed. Between June, 1945 and June, 1946, over 9 million men were released from the armed forces, about three times the present total of military personnel. Between 1945 and 1946, national defense purchases of goods and services were reduced by 75 percent. This reduction was equivalent to more than 25 percent of the GNP in 1945, about three times the present proportion of GNP that is represented by defense/space spending.

The end of the Korean conflict involved a much smaller reduction in defense spending, which in turn started from a much lower peak than at the end of World War II. Tax reductions helped to maintain aggregate consumer income and personal consumption spending. The level off in the total of defense and space spending in 1963-64 was accompanied by a decline in the national unemployment rate, clearly indicating the capability of the American economy to adjust rapidly at least to moderate changes in defense or space expenditures.

Numerous studies of the economic impact of arms control and disarmament have concluded that the United States is fully capable of making the necessary economic adjustment to fundamental reductions in the level of national security expenditures; the limitations are considered to be mainly in the political sphere--the willingness of the Nation to take measures of sufficient magnitude and promptness to utilize the resources that would be released in such eventuality. /15

Footnotes

/1 Arthur E. Burns, "Military Expenditures, Economic Growth, and Stability," in U.S. Congress, Joint Economic Committee, Federal Expenditure Policy for Economic Growth and Stability, 1957, p. 509; M.L. Weidenbaum, "The Timing of the Economic Impact of Government Spending," National Tax Journal, March 1959, pp 79-85.

/2 Merton J. Peck and Frederic M. Scherer, The Weapons Acquisition Process, Boston, Graduate School of Business Administration, Harvard University, 1962, p. 118.

/3 Murray L. Weidenbaum, "The Impact of Military Procurement on American Industry," in J.A. Stockfisch, editor, Planning and Forecasting in the Defense Industries, Belmont, Wadsworth Publishing Co., 1962, p. 156.

/4 Charles L. Schultze and Joseph Tryon, Prices and Costs in Manufacturing Industries, Study Paper No. 17, Joint Economic Committee, U.S. Congress, 1960, p. 14.

/5 Robert Brandwein, "The Dyna-Soar Contract Cancellation--A statistical Summary," University of Washington Business Review, October 1965.

/6 Charles Tiebout, "The Regional Impact of Defense Expenditures: Its Measurement and Problems of Adjustment," in U.S. Senate, Committee on Labor and Public Welfare, Nation's Manpower Revolution, Part 7, 1963, pp. 2516-2523.

/7 Murray L. Weidenbaum, "Shifting from Defense to Non-Defense Government Spending: The Implications for the Regional Distribution of Income," Papers and Proceedings of the 1965 Annual Meeting of the Regional Science Association.

/8 Daniel Suits, "Econometric Analysis of Disarmament Impacts," in Emile Benoit and Kenneth Boulding, editors, Disarmament and the Economy, New York, Harper and Row, 1963, p. 104.

/9 George H. Hildebrand and Norman V. Breckner, "The Impacts of National Security Expenditure Upon the Stability and Growth of the American Economy," in U.S. Congress, Joint Economic Committee, Federal Expenditure Policy for Economic Growth and Stability, 1957, p. 536.

/10 John G. Welles et al, The Commercial Application of Missile/Space Technology, University of Denver, Denver Research Institute, September 1963.

/11 Murray L. Weidenbaum, "Adjusting to a Defense Cutback: Public Policy Toward Business," Quarterly Review of Economics and Business, Spring 1964, pp. 7-14.

/12 National Aeronautics and Space Administration, Technology Utilization Program; Charles Kimball, "The Relationship Between Economic Growth and the Transfer of Technology," in 1963 Proceedings of the National Association of Business Economists, 1963, pp. 80-90.

/13 Burns, op.cit., pp. 512-513.

/14 Murray L. Weidenbaum, "Costs of Alternative Military Strategies," in David Abshire and Richard Allen, editors, National Security, Political, Military and Economic Strategies in the Decade Ahead, New York, Frederick A. Praeger, 1963, p. 792.

/15 See Emile Benoit and Kenneth Boulding, editors, Disarmament and the Economy, New York, Harper and Row, 1963; U.S. Arms Control and Disarmament Agency, Economic Impacts of Disarmament, 1962; United Nations, Department of Economic and Social Affairs, Economic and Social Consequences of Disarmament, 1963, Report of the Committee on the Economic Impact of Defense and Disarmament, July 1965.

MAJOR STATISTICAL SOURCES

Joint Economic Committee, Congress of the United States, Background Material on Economic Aspects of Military Procurement and Supply, 1964, Washington, U.S. Government Printing Office, April, 1965.

National Aeronautics and Space Administration, NASA Annual Procurement Report Fiscal Year 1964, Washington, U.S. Government Printing Office, 1965.

Office of the Secretary of Defense, Military Prime Contracts Awards and Subcontract Payments, Washington, July-December 1964.

U.S. Arms Control and Disarmament Agency, The Economic and Social Consequences of Disarmament, Washington, U.S. Government Printing Office, June 1964.

U.S. Department of Defense, Military Prime Contract Awards by Region and State, Fiscal Years 1962, 1963, 1964, August 3, 1965.

U.S. Department of Labor, Manpower Report of the President and a Report on Manpower Requirement, Resources, Utilization and Training, Washington, U.S. Government Printing Office, March 1965.

SELECTED BIBLIOGRAPHY

National Science Foundation, Federal Funds for Research, Development, and Other Scientific Activities, Fiscal Years 1962, 1963, and 1964, NSF 64-11, 1964.

Peck, Merton J. and Scherer, Frederic M., The Weapons Acquisition Process, Boston, Division of Research, Graduate School of Business Administration, Harvard University, 1962.

Subcommittee on Employment and Manpower of the Committee on Labor and Public Welfare, U.S. Senate, Convertibility of Space and Defense Resources to Civilian Needs, Vol. 2 of Selected Readings in Employment and Manpower, Washington, U.S. Government Printing Office, 1964.

U.S. Congress, Joint Economic Committee, Federal Expenditure Policy for Economic Growth and Stability, Washington, D.C., U.S. Government Printing Office, November 5, 1957, Section VIII, "Federal Expenditures for National Security."

U.S. Council of Economic Advisers, Report of the Committee on the Economic Impact of Defense and Disarmament, Washington, U.S. Government Printing Office, July 1965.

Weidenbaum, Murray L. "Costs of Alternative Military Strategies," in National Security, Political, Military and Economic Strategies in the Decade Ahead. Edited by David Abshire and Richard Allen. New York, Frederick A. Praeger, 1963.

BIBLIOGRAPHY (continued)

Weidenbaum, Murray L. "Measures of the Impact of Defense and Space Programs," Proceedings of the 1965 Annual Meeting, The Business and Economics Section, American Statistical Association.

_____. "The Impact of Military Procurement on American Industry," Planning and Forecasting in the Defense Industries, Edited by J.A. Stockfisch, Belmont, California, Wadsworth Publishing Company, 1962.