

INFORMATION TO USERS

This manuscript has been reproduced from the microfilm master. UMI films the text directly from the original or copy submitted. Thus, some thesis and dissertation copies are in typewriter face, while others may be from any type of computer printer.

The quality of this reproduction is dependent upon the quality of the copy submitted. Broken or indistinct print, colored or poor quality illustrations and photographs, print bleedthrough, substandard margins, and improper alignment can adversely affect reproduction.

In the unlikely event that the author did not send UMI a complete manuscript and there are missing pages, these will be noted. Also, if unauthorized copyright material had to be removed, a note will indicate the deletion.

Oversize materials (e.g., maps, drawings, charts) are reproduced by sectioning the original, beginning at the upper left-hand corner and continuing from left to right in equal sections with small overlaps. Each original is also photographed in one exposure and is included in reduced form at the back of the book.

Photographs included in the original manuscript have been reproduced xerographically in this copy. Higher quality 6" x 9" black and white photographic prints are available for any photographs or illustrations appearing in this copy for an additional charge. Contact UMI directly to order.

UMI

A Bell & Howell Information Company
300 North Zeeb Road, Ann Arbor, MI 48106-1346 USA
313/761-4700 800/521-0600

MILITARY SPENDING AND INVESTMENT IN THE UNITED
STATES SINCE WORLD WAR TWO

by

DAVID GOLD

A dissertation submitted to the Graduate Faculty in
Economics in partial fulfillment of the requirements for the
degree of Doctor of Philosophy, The City University of New
York.

1995

UMI Number: 9605597

UMI Microform 9605597

Copyright 1995, by UMI Company. All rights reserved.

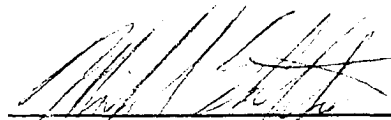
This microform edition is protected against unauthorized
copying under Title 17, United States Code.

UMI

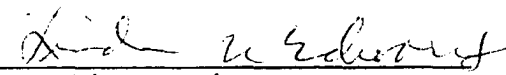
300 North Zeeb Road
Ann Arbor, MI 48103

This manuscript has been read and accepted for the Graduate Faculty in Economics in satisfaction of the dissertation requirement for the degree of Doctor of Philosophy.

August 8, 1995
Date


Chair of Examining Committee

August 9, 1995
Date


Executive Officer

Professor Michael Edelstein

Professor Michael Grossman

Professor Salih Neftci
Supervisory Committee

THE CITY UNIVERSITY OF NEW YORK

For Helaine

Acknowledgements

This dissertation has been a long time coming, and a number of people have provided substantial assistance that made the process easier in important ways. I would like to take this opportunity to thank them.

My greatest debt is to my dissertation adviser, Michael Edelstein, who has been generous with his time and with sharing his ideas, who was alternately, and appropriately, patient and prodding, and who has been a supportive friend as well as a demanding supervisor. I would not have completed this project without his help.

Michael Grossman, Executive Officer of the Department of Economics at the City University of New York Graduate Center, was instrumental in my return to graduate studies after a substantial absence, and his many actions taken to support and encourage my progress are greatly appreciated.

Gordon Adams, former Director of the Defense Budget Project at the Center on Budget and Policy Priorities in Washington, D. C., provided both financial and intellectual support for my research at an early stage of this project, and for that support I am grateful.

My supervisors at the United Nations, Manuel Agosin, Karl P. Sauvant and Cristian Ossa, encouraged my interest in the economics of military spending, even when that interest was outside of my work assignments.

Portions of this research were presented at conferences and seminars at the Stockholm International Peace Research Institute, co-sponsored by the International Economics Association, the Joan B. Kroc Institute for Peace Studies at the University of Notre Dame, co-sponsored by Economists Allied for Arms Reduction, Columbia University, the City University of New York, Rutgers University, and the Peace Science Society International. I received numerous comments and suggestions from attendees at these conferences and seminars, and I would like to thank them all, without implicating them in any way in the final product.

Unpublished data was made available to me by the National Income and Wealth Division of the Bureau of Economic Analysis, United States Department of Commerce. John Musgrave and Michael Glenn graciously and speedily responded to my requests, and they also have my thanks. They, of course, bear no responsibility for how I have used that data.

Chapters II, III, and IV were previously published. I would like to thank the publishers of the works in which they appeared, St. Martin's Press, Harwood Academic Publishers GmbH for the journal **Defence Economics**, and New York University Press, for permission to re-publish this material.

The final copy of this dissertation was prepared by Juliet Capili, whose contribution was far above and beyond the call of duty. I would like to thank her for her efforts, and the good cheer she brought with them.

My wife, Helaine, while undoubtedly despairing that this project would ever be finished, never wavered in her commitment to my abilities; she deserves more thanks than I can adequately express. This modest work is dedicated to her.

Table of Contents

<u>Chapter</u>	<u>Page</u>
I. Introduction	1
II. The Economics of Military Spending: Is the Military Dollar Really Really Different	5
III. Defense Spending and the American Economy	55
IV. Military Spending and Investment in the United States	95
V. The Trade-off Between Military Spending and Investment in the United States	121
VI. Conclusions	160
Bibliography	165

List of Tables

<u>Table</u>		<u>Page</u>
III.1	U.S. Scientist and Engineers Employed on DOD Sponsored Projects	80
IV.1	Trade-off Coefficients Between Military Spending and Investment	106
IV.2	Major Spending Items as Percent of Potential GNP	109
V.1	Regressions on Military Spending-Investment Trade-off	125
V.2	Comparison of Real GNP and Real Potential GNP as Normalizing Variable	131
V.3	Regressions on Alternative Measures of Investment With and Without Adjustment for Autocorrelation	135
V.4	Significance of t-statistics from Regressions Against Time	142
V.5	DF and ADF Tests for Order of Integration	144
V.6	Regressions on First Differences	150
V.7	Bi-variate Granger Causality Tests Between Military Spending and Investment	153
V.8	Cointegration and ECM Regressions	157

List of Charts

<u>Chart</u>		<u>Page</u>
III.1	Defense and Space-Related Research and Development as a Share of Total Research and Development Outlays	70
III.2	Defense Outlays for Research and Development	71
III.3	Federal Share of Industrial Research and Development	72
V.1	Military Spending and Total Investment as Shares of Gross National Product	127
V.2	Military Spending and Total Investment	146

Chapter I

Introduction

There is a long-standing debate in the United States as to whether military spending stimulates or retards economic performance. One of the main issues in this debate is whether military spending occurs at the expense of spending on new investment. Because military production utilizes goods and services similar to that used in the production of capital goods and in the conduct of research and development, it has been argued that military budgets deplete the economy of these key resources. In addition, some econometric research has supported the existence of a trade-off between military spending and investment spending. On the other hand, other studies have found that military spending appears to occur at the expense of consumption, not investment.

This dissertation examines the issue of whether military spending has negatively impacted upon spending on physical capital formation in the United States in the period since World War II. The context for examining this issue is the debate over the macroeconomic impacts of high military budgets. Consequently, the dissertation begins, in Chapter I, with an evaluation of research on the economic impacts of military spending, in the context of the debate about the appropriate size of the United States military budget that occurred during the Reagan Administration's military buildup. Most research has focussed on military spending and its likely

impacts on the most widely utilized indicators of macroeconomic performance -- unemployment, inflation and economic growth. However, as shown in Chapter II, the strength of conclusions about military spending's impacts are rarely accompanied by an equivalent strength in the assembled evidence.

In Chapter III, the analysis focuses on capital formation. Those who attribute negative aggregate impacts to military spending have tended to locate the primary source of such impacts in the links between military spending and physical capital formation. The notion of a trade-off -- a shift of resources to military spending that would otherwise be devoted to investment -- is a key element in these analyses. Chapter III summarizes this research, and analyzes some important problems, including the consistency of the hypotheses underlying the empirical studies, the applicability of cross-national research to the experience of the United States in the years after World War II, and competing evidence regarding a possible trade-off between military outlays and consumption spending.

Chapter IV narrows the discussion to a single hypothesis that seeks to explain why a military spending-investment trade-off might occur. Evidence gleaned from testing this hypothesis has been widely accepted as supporting the trade-off conclusion. Econometric evidence on variants of this hypothesis are tested, and their applicability to the postwar United States experience evaluated. One issue raised is

whether the observed trade-off is consistent over the postwar period as a whole. If it is not, that would cast doubt on the assertion that a military spending-investment trade-off is due to the unique characteristics of military spending.

Additional empirical evidence is developed in Chapter V, where time series properties of the data are examined. A military spending-investment trade-off implies the existence of a relationship between the two variables over time such that they should not move too far apart in any short term period. If they are linked in a long-term trade-off relationship, short-term movements that depart from the long-term relationship should be corrected over time. The time series properties of both an investment-military spending relationship and the main alternative posed, a consumption-military spending relationship, are examined in this chapter, to see if they shed light on the location of the opportunity costs of military spending in the postwar United States.

The results obtained in this research, and the main conclusion of this dissertation, are summarized and presented in the final chapter.

The main substantive chapters (II-V) were written over a period of ten years. Chapters II, III and IV were published in 1987, 1990 and 1993, respectively, and are reprinted here with the permission of the publishers of the original works. Minor changes were made in these chapters to insure stylistic uniformity throughout the dissertation as a whole. In addition, several data series were updated, making use of more

recently available data. And in one instance (Chart III.2) a more accessible data source was substituted for one that might be difficult to obtain, in case other researchers want to examine this information. In all other respects, these three chapters remain as originally published.

Chapter II

The Economics of Military Spending: Is the Military Dollar Really Different?¹

Introduction

The economic impact of military spending has been a subject of intense debate in the United States. During the 1980s, military spending grew to unprecedented levels. In fiscal year (FY) 1980, national defense outlays were \$134 billion; by FY1985 outlays were almost twice that, or \$252.7 billion, representing real growth (after inflation) of over 35 per cent. By FY1989 U.S. national defense outlays reached \$303.6 billion. American defense spending grew 126 per cent, including inflation, over the decade of the 1980s (CEA, 1990 Table C-77). In fact, by 1987, U.S. national defense purchases in constant dollars surpassed any previous year in American history since 1946 (CEA, 1990 Table C-2).

The Defense Department and its contractors often argue that the budget has an important impact on the economy. For example, Caspar Weinberger, Secretary of Defense in the Reagan Administration, stated that cutting \$1 billion out of defense would reduce U.S. employment by 35,000 jobs (DOD, 1982 p. 68).

1. This chapter was originally published in Christian Schmidt and Frank Blackaby, eds., **Peace Defense and Economic Analysis** New York: St. Martin's, Press, 1987. See Adams and Gold (1987). It is reprinted with permission of the publisher.

The Pentagon created a Defense Economic Impact Modelling System, in part to project the economic opportunities business would encounter when military spending expands. Defense contractors use analyses of the economic impact of weapons they are building to lobby Congress on behalf of the programs.²

Critics of nuclear weapons programs and of high levels of defense spending also muster economic arguments. Military spending, they argue, spurs inflation by pumping money into the economy without adding to the supply of goods. Moreover, high levels of military research and development sap the nation's technological strength by consuming funds and personnel that could be used to enhance American competitiveness in international markets. Finally, fewer jobs are created by military spending than by almost any other form of federal spending.

Beyond their arguments over national security issues, supporters and critics of weapons programs and the military budget also use a language of economic argument. Their competing research efforts gather data, create models and issue broadsides as part of the political conflict over such weapons as the B-1 bomber, MX missile and "Star Wars" and as part of the debate over the distribution of the federal budget.

2. See, for example, the case of the B-1 bomber campaign conducted by Rockwell International, described in Adams (1976).

Despite the vociferous arguments and the mustering of facts, neither side has convinced the other on the issue. Those who argue that military spending is harmful to the economy have not moved communities to reject defense industry, nor has the argument caused the media to conduct systematic exposes of the economic dangers of high levels of military spending. Economists do not treat military spending as a central issue in their work on the United States economy. Few political leaders call for a shift in federal spending priorities to halt the supposed "damage" to the economy caused by military spending. It was the end of the cold war, not any realization of economic consequences, that led to declines in real defense outlays in the 1990s.

In the 1980s, moreover, the trends in the American economy seemed to suggest that the critics of military spending were not having the better part of the argument. Inflation levels declined dramatically after the beginning of the decade. American technology seemed to be entering a new phase of expansion and jobs were being created in the United States economy at a rapid rate, as a business-cycle expansion took hold.

A re-evaluation of the argument over the economic impact of military spending is clearly overdue. This chapter lays out such a re-evaluation. It does not describe new original research. In many of the areas in dispute, research has been ample. Instead, the chapter reviews this body of work, draws

some conclusions about its validity, and suggests areas for further research.

This review of the existing literature suggests that the argument over the economics of defense is, at its heart, political. Defense Department claims are exaggerated, promoting the defense budget and positive Congressional decisions on weapons proposals. The critics also overstate their views, however.

The economic impact of military spending is only marginally different from that of other forms of federal spending. The key difference is not at the level of macroeconomics - arguments over inflation, productivity or employment - but rather at the microeconomic level - where military spending affects regions, sections of industry and segments of the labor market. These microeconomic impacts have created a political economy of military spending, where political decisions draw strength from microeconomic impacts. Fundamentally, defense economics involves public policy choices about the directions of the nation's economic development; the macroeconomic issues are, at best, of marginal importance.

Inflation

Military spending is often seen as a cause of inflation. Analysts point to numerous historical examples, most recently the experiences of the Second World War, when price controls,

rationing, and other restrictive devices were needed to keep inflation in check, and of Vietnam, which saw the beginning of more than a decade of high rates of inflation.

To some, military spending is inherently inflationary because it creates income and purchasing power without also creating additional goods and services for people to purchase. As described in a United Nations report "effective demand is created without offsetting increases in immediately consumable output or in productive capacity to meet future consumption requirements. This excess demand creates an upward pressure on prices throughout the economy" (United Nations Centre for Disarmament, 1978 p. 41).

This explanation, while seemingly clear and obvious, provides very little guidance as to whether military spending is a cause of inflation. Some government expenditures may have a positive long-term impact on productivity and an economy's ability to produce goods and services. At the time they are undertaken, however, practically all government outlays, whether for health, public works, police, the military or something else, increase purchasing power without expanding the quantity of products for sale on the market.

This excess demand is the reason why rising government outlays can restore an economy in recession. To treat such demand as always inflationary assumes that the economy is always near full employment. If growth in government outlays occurs when an economy is expanding or already suffering from inflationary pressures, then greater inflation could result.

Here the inflationary potential of government spending can be offset if outlays are financed by taxation or forced savings, removing from the economy the amount of purchasing power equivalent to the new expenditure.

Different financing mechanisms can lead to different impacts on inflation. Wartime spending, for example, can create inflationary pressures since demand increases so rapidly, and production is diverted to the war effort. If taxes are raised and savings are stimulated, demand can be brought back into balance with available supply. If, instead, higher military expenditures are financed by deficits, and the central banks step up their buying of bonds and boost the money supply, inflation is a likely result.

Without a war, the inflationary impact of an increase in military spending will depend on the method of financing, as well as on the state of the economy as a whole.

In the case of Vietnam, the increase in United States military outlays occurred as the economy was in the midst of a long boom. The Johnson Administration made an explicit decision to allow the deficit to rise and not to seek a tax increase to finance Vietnam outlays. In this instance, higher military outlays without any compensating action on the revenue side were a direct initial cause of higher deficits. A significant increase in inflation followed as monetary policy was not restrictive enough to offset the fiscal stimulus. The transmission of inflation abroad appears to have been linked to the fact that other countries, under the

fixed exchange rate system, had to absorb the dollars the United States was spending in Asia (Stevens, 1976 Chapter 6).

During the Reagan Administration, an increase in military outlays was accompanied by large tax cuts, reductions in civilian government outlays, rapid growth in federal interest payments, and large deficits. The deficits resulted from many changes, notably the 1981 tax cut. It is not clear that they resulted from the military build-up. More important, the high deficits of the mid-1980s coincided with lower inflation, thus calling into question the claim that a military build-up, combined with large deficits, is automatically inflationary.

When the Reagan build-up began, a number of critics hypothesised that the size and speed of the increase in military outlays, and its concentration in hardware would lead to inflation since there were simply not enough resources available quickly enough to satisfy both civilian and military demands. Shortages and bottlenecks in civilian and military industries would increase sectoral inflation and that could spread throughout the economy. Even the military was worried about the bottleneck problem (De Grasse, 1983 pp. 117-126; Thurow, 1981; Gold and DeGrasse, 1981).³

In reality, tight monetary policies and the deep recession of 1981-2 broke the inflationary momentum and generated substantial excess capacity. As the recovery gained momentum, a rapid increase in imports of both capital goods

3. For a contrary view see CBO (1983).

and consumer goods also kept capacity utilisation rates lower than expected. The large increase in foreign capital inflows aided the financial system in meeting both governmental and private credit needs.

Econometric evidence is inconclusive on the relation between military spending and inflation. Bezdek's simulation study, in which five-year, 30 per cent increases in military spending, compensated by an equal dollar-increase in non-military outlays, was compared with both a "no change" alternative and with a 30 per cent cut in military outlays compensated by equivalent increases in non-military programs, found that the higher level of military spending was accompanied by lower GNP and employment, and a higher price level (Bezdek, 1975). Since the military spending changes were fully offset by other spending changes, no deficit financing was involved. Hence the link must lie somewhere else.

Studies of actual data, however, have found that military spending has essentially no effect on inflation. DeGrasse (1983 Chapter II), in a cross-national study using rank correlation analysis, found that a country's rank in the sample with respect to military spending as a share of gross domestic product had no relation to its rank with respect to inflation rates. Vitaliano concluded that adding variables measuring military spending to an expectations-augmented Phillips Curve, an equation which explains current inflation in terms of unemployment and expectations of future inflation

"do[es] not support the hypothesis that defense spending exerts a separate, discernable effect on the inflation rate" (Vitaliano, 1984 p. 25).⁴

It is possible that the link between military spending and inflation occurs in a manner not made visible by traditional testing methods. Melman (1974, 1983), Dumas (1982), and others have argued that military spending's negative impact on productivity growth creates an inflation-prone industrial structure, which makes inflation more likely over time.

The depletion view points to the large quantity of capital inputs and skilled labor used by the military sector and denied to the civilian sector as a source of declining productivity in the industrial sector as a whole. Case studies of specific industries, such as machine tools, are pointed to as evidence, and the paucity of R&D and new investment and the decline in productivity in basic industries such as automobiles and steel are also mentioned. Without significant productivity growth, production cannot keep pace with demand, especially when the latter is stimulated by expansionary

4. Starr, Hoole, Hart, and Freeman (1984), using statistical techniques designed to assess whether a relationship between two variables exists, concluded that the tests did not support the existence of a relation between military spending and inflation for the United States and the United Kingdom, but did suggest one for France and West Germany. The tests are not able to suggest what that relation might be, however. Smith (1977) found no statistically significant relation between military spending and inflation.

policies. In such a situation, there will be a tendency for prices to rise.

Defense-industry contracting and pricing policies would seem to suggest that this sector is a likely source of cost-push inflationary pressures. There is very little competition within defense industries and there are significant barriers to both entry and exit. The Pentagon's long-standing insistence on high performance, state-of-the-art equipment, the growth of top-heavy administrative structures in both industry and government, and military contracting practices all tend to validate the tendency for costs to rise (Adams, 1983). Drawing on Hong's econometric work (Hong, 1979), Dumas (1982) and Melman (1983) argue that military producers can be characterised by "cost-pass-along", rather than cost-minimising behavior. Moreover, they argue, this behavior spills over into civilian sectors and produces cost-push inflationary pressures that explain the stagflation that dominated the United States and much of the world economy after 1966.

Hong's empirical work on cost-pass-along consists of estimating an equation for prices and one for wages, with the latter including a measure of administrative overhead, a key variable cited by Melman as indicative of military industry cost-push behavior. Hong's results indicate that cost-pass-along behavior became dominant in the United States economy after 1966, coinciding with the onset of stagflation.

If depletion has an inflationary effect, however, it would be over long periods, and in any given shorter time period might well be swamped by cyclical movements and policy changes. After 1966, for example, a number of economic variables changed. The decline and collapse of the Bretton Woods system, the Nixon Administration's failures in macroeconomic management and the international oil crisis would have generated a more inflationary environment in the United States, regardless of cost maximising defense management.

The relationship between Hong's results and these changes has not been explored. It is also not clear how cost-pass-along behavior spills over into non-military sectors of the economy, especially when these sectors are much more subject to competition than the military sector. Did cost-pass-along characterise such industries as automobiles, computers, telecommunications equipment and semiconductors in the 1980s, where costs were falling, not rising, amidst intense competition and rapid technical change?

The military spending-inflation link is not so clear as sometimes supposed. Methods of financing deficits, general economic conditions and the complex realities of production in the economy all make this relationship uncertain.

Military Spending, Technology and Investment

The impact of military outlays on new investment, technological progress, and economic growth is one of the more contentious issues in the debate over the economic impacts of military spending. A long-standing view, going back at least to Adam Smith, treats military spending as an unproductive activity that draws potentially productive resources from the economy while providing little or no stimulation in return (Melman, 1974, 1983). An alternative position sees the military as a source of significant technological innovation that spills over into the civilian economy while at the same time providing demand stimulation.

There is a substantial literature and some statistical evidence that suggests there is a trade-off between military spending and investment (Bezdek, 1975; Smith, 1980; De Grasse, 1983; Leontief and Duchin, 1983; Oden, 1992), and a few case studies on the negative impacts on civilian technology of trends within military technology (Kaldor, 1981 pp. 4, 5; Melman, 1983, Noble, 1984). At the same time, there are historical studies of how military technology has stimulated civilian industries (Rosenberg, 1976; Trebilcock, 1969).

This issue was strongly debated in the 1980s. At the beginning of the Carter-Reagan build-up in military spending in the United States, numerous analyses were put forward suggesting how it would draw needed technological resources from the civilian economy, stimulate further inflationary

pressures, and undermine the chances of a substantial recovery (De Grasse, 1983; Thurow, 1981; Gold and DeGrasse, 1981). Instead, after a deep recession brought on by tight monetary policy, the U.S. economy began a boom that lasted the remainder of the decade, with an expansion of new investment, significantly lower inflation, and technological progress in established industries like automobile-manufacturing and telecommunications and new industries such as robotics and bioengineering. This strong recovery occurred despite the fact that some of the critics' predictions have come true, such as a shift of engineering talent to the military sector and large federal budget deficits. The negative side of the argument seems to miss something.

A number of statistical studies show a negative relationship between military spending and investment and between military spending and the level of GNP or the rate of growth of GNP. Rank correlation analyses across countries have yielded negative correlation coefficients whereby countries with higher shares of GNP devoted to the military tend also to have lower investment shares and lower rates of growth (De Grasse, 1983; Szymanski, 1973). Econometric models have yielded negative regression coefficients when military spending is related to investment (Smith, 1977, 1980).

Simulation studies using econometric and input/output techniques have concluded that when the military share of the economy is projected to rise, investment and total output is lower (Bezdek, 1975, Leontief and Duchin, 1983; Dunne and

Smith, 1984). Some of these studies covered the United States, some other OECD countries or a pooling of data from OECD countries, while Leontief and Duchin investigated future conditions for the entire world economy. This negative conclusion is not universally accepted, however. Rank correlation analyses compare two variables with each other; the measured trade-off may, however, result from some unmeasured third variable that affects both the primary variables. When data for a number of countries are pooled, the resulting coefficients are averages, and it is not clear whether they are measuring a meaningful economic relationship within any single country.

The direction of causation between military spending and investment and economic growth, especially in a cyclical context, is also unclear. A negative relation is usually interpreted as showing that growth in military spending causes a fall, or slower growth, in investment and GNP. Some researchers have argued that military spending is used by the U.S. government as a counter-cyclical device, so that a negative relationship would be consistent with a causal mechanism running the other way -- from GNP and investment, and other measures of cyclical activity, to military outlays (Cypher, 1981; Griffin, Wallace and Devine, 1982).

Boulding's study illustrates some of the problems researchers must confront in analyzing this relationship (Boulding, 1973). He analyzed U.S. national income data for two years -- 1929 and 1969. Each year was the peak of a long

business-cycle boom. Between the two years, military spending as a share of GNP had increased dramatically. However, there was no fall off in the investment share of GNP; instead, it was the private consumption share that fell. In addition, the level of GNP was substantially higher in 1969.

Interpreting these findings, the growth in military spending may have been largely financed out of taxes on income from wages and salaries, which are the primary determinant of consumption, rather than taxes on property income, which would affect investment. Boulding's results reflect long-term relationships, while other studies measure movements confined to a shorter period of time. Thus, it is difficult to generalise about a trade-off between military spending and investment.

Boulding's results also illustrate another difficulty with such possible trade-offs; there need to be mechanisms by which it occurs. Military spending may attract investment resources via the government budget process, obtaining private funds through taxing and borrowing and obtaining a large share of those funds in competition with other government programs. In the United States, however, taxation has tended to have more of an impact on consumption than on investment. The impact of deficit financing is uncertain; moreover, deficits have only recently made an important contribution to federal government revenues and could not account for much of the resource shifts before the mid-to-late 1970s.

It is more likely that military and civilian government expenditures move together, rather than in opposite directions. Russett (1982), examining data on U.S. government spending on military, health and education from 1941 to 1979, found no systematic pattern of trade-off. In his view, the Reagan Administration was an exception to a more general pattern. Domke, Eichenberg and Kelleher (1983) similarly found no statistically significant trade-off between military and welfare expenditures, except for wartime periods. Even if there were a trade-off between military spending and domestic spending, it is not clear how a shift within the government budget would affect capital formation in the economy as a whole.

Another way of approaching the problem is to argue that military-industry bids key investment resources away from the private sector during a period of rising military outlays, creating bottlenecks in the private sector, stimulating inflationary pressures, and raising the costs and reducing the effectiveness of private investment spending (De Grasse, 1983; Thurow, 1981).⁵ Some of this market-generated crowding out occurred during the Korean and Vietnam build-ups. There is no reason, however, why an economy operating at less than full capacity should experience such bottlenecks over a long period. The Reagan build-up did not generate inflation nor used up available capacity, suggesting that an increase in

5. For a contrary view see CBO (1983).

military spending is not sufficient, by itself, to generate such a problem. Macroeconomic and specific industry and labor-market conditions may be more important. Only research on how an economy adjusts to changes in military spending over both short and long periods of time will assess the validity of such a trade-off mechanism.

It is a common piece of wisdom, however, that Japan's superior economic performance in recent decades is due to its low level of military spending, while countries with higher military burdens such as the United States and United Kingdom have been unable to find the right formula for sustained economic growth. Some statistical analyses argue that countries that devote a small proportion of their output to military spending tend to have higher savings and investment ratios, higher productivity growth, and higher GNP growth than countries with higher ratios of military spending to GNP (De Grasse, 1983; Szymanski, 1973). This argument places far too much weight on one factor. Japan's rapid economic growth is linked to several social and economic circumstances and government policies: large numbers of relatively low-paid workers ready to move into industrial and commercial activities in the 1950s and 1960s; close relationships among financial, marketing, and industrial enterprises allowing firms to weather recessions and concentrate on long-term objectives; a production strategy emphasizing product quality and the continual updating of process technology allowing Japanese firms to penetrate Western markets with high quality,

low-cost products; and government policies that stimulate savings and investment and reinforce technological dynamism.

Would such policies and circumstances have been as effective if military spending had been higher? For example, would the Japanese have adopted policies that financed higher military outlays by reducing consumption, or investment? Would a larger Japanese military industry have cost-control problems and could the government insulate the civilian economy from such inefficiencies? These questions need to be addressed before any conclusions can be formed about the role of low military spending in Japan's economic performance.

Similarly, while both the United States and the United Kingdom have experienced problems with respect to capital formation and economic growth, it is not clear how much of this can be attributed to military spending as opposed to other variables. In the United States, economic-growth rates have been highest when military spending has been high or rising, as in the mid-1950s, mid-to-late 1960s, and the 1980s, while the period when military outlays fell coincided with the stagflation of the 1970s. Military spending's impact on productivity could occur over a long period of time, and stagflation could be attributed to past high military outlays. However, this explanation needs to be compared with alternatives: the impact on U.S. growth of the decline of the Bretton Woods monetary system or the impact of stop-go macroeconomic policies and the protection of British financial interests on British economic growth.

Some analysts argue that the military imposes its requirements on civilian industries, thus weakening the latter as a competitive force. For example, the relative decline of U.S. semi-conductor and electronic products industries compared with those of Japan has been attributed to the dominance of military research and development with its emphasis on exotic requirements and its de-emphasis of cost control (De Grasse, 1983; Kaldor, 1981; Borrus, Millstein and Zysman, 1983).

On the other side, there are a number of examples of military technology and military products that spill over into civilian sectors. Weapons production appears to have been a source of significant technological innovation during the nineteenth century in the United States (Rosenberg, 1976) and during and immediately after the Second World War (Gansler, 1980). Moreover, such technologies as aircraft, aircraft engines, microcircuits, computers, fibre optics, lasers, composite materials and metallurgy can all be linked to military spending. Finally, while excessive costs do characterize defense production and are consistent with defense industry contracting practices, it is not clear how they are passed along to the private sector. The transfer of technology between military and civilian sectors needs to be clearly described and its costs and benefits more adequately measured.

The historical process surrounding technology transfer also needs to be explored. Kaldor has argued that "military

technology is rarely in phase with civilian developments" over the long term being "very advanced, stimulating new civilian technology" in some periods, but being "decadent, dragging the economy backwards" at other times. Britain at the end of the nineteenth century and the United States after the Second World War are cited to argue that military technology has become dominated by "elaborate custom-built product improvements that are typical of industries on the decline instead of the simpler mass-market process improvements which tend to characterize industries in their prime" (Kaldor, 1981 pp. 4, 5). It is difficult to generalize from this analysis. There are only a few examples and the concept of a long wave has been difficult to pin down both theoretically and empirically. But Kaldor's analysis strongly suggests military spending can be either "advanced" or "decadent".

Further research on spin-off should analyze the conditions under which a stimulative or retarding effect occurs. Such research is especially useful when large, research-intensive programs are dominant, such as the Strategic Defense Initiative and Very High Speed Integrated Circuit programs of the 1980s. Because of their size and their explicit goal of creating new technologies, such programs could clarify the spin-off relationship.

While military spending can impinge upon investment and technical progress, there are unanswered questions about the importance and direction of this effect. While R&D is a determinant of economic growth, its importance is not clear.

Future research should compare military spending with other influences on investment and technology, as well as analyze the impact of military spending in different historical periods and under different economic conditions.

Military Spending and Employment

Implications for the number of jobs

The impact of military spending on employment is another highly contentious issue in the military/economy debate. Critics of military spending frequently argue that it creates fewer jobs than virtually any other form of federal spending, that a shift of federal funds from the defense budget to other parts of the federal budget or to a tax cut would create a larger number of jobs, and even that continuing to spend money on the military actually costs the economy jobs (Gold, Paine and Shields, 1981, p. 157; Bezdek, 1975; Chase Econometric Associates, 1975; Brancato and Le Grande, 1984).⁶

The Defense Department and the defense industry, on the other hand, have argued that military spending is labor-intensive, creating 35,000 jobs per billion dollars

6. See also M. Anderson (1982 p. 1), who states that "contrary to long held and popular belief, military spending is not good for the economy. It does not create employment - it generates unemployment ... every time the military budget went up \$1 billion, 10,000 jobs disappeared in the United States."

spent (DOD, 1982 p. 68). They also point to the historical experience of the Second World War, when military spending clearly mopped up an enormous reservoir of unemployment, and ask what would happen to employment in the communities where defense plants and military bases are located were military spending to be cut.

The argument is an important one. Critics of the defense budget use the employment argument to demonstrate that lower military spending will mean greater economic security. The Defense Department uses its employment argument to suggest, forcefully, that Congress should support defense spending because of the jobs at stake.

Considerable research exists on the debate over military spending and employment. The assumptions made in this literature vary and the conclusions are widely different. Depending on the source, one could conclude that defense spending makes a big difference to the number of jobs in the American economy, a little difference or virtually none at all.

The variations in the number of jobs created by military spending is the first point of disagreement. Data from the Bureau of Labor Statistics, some critics argue, shows an enormous difference between the number of jobs generated by spending on health or education and those generated by defense purchases. Some studies using input-output models of the U.S. economy (looking at the employment requirements generated by a given amount of final demand for military and civilian

products) show similar, if less exaggerated, results. Comparing a given military product (for instance, the MX missile) to a set of alternatives, some of these studies suggest, almost any alternative expenditure of defense funds would create a larger number of direct and indirect jobs in the economy than would defense spending.⁷

An input-output analysis performed by the Congressional Budget Office (CBO) in 1983 comes to the conclusion that the number of defense jobs generated per \$100 billion of expenditure is not terribly different from other kinds of federal spending. Using an economic model developed by Data Resources International, Inc., the CBO concludes:

additional spending on defense and on non-defense purchases of goods and services appear to have roughly equal expansionary effects on employment in the short run. Econometric model simulations suggest that an additional \$10 billion in defense spending in the current fiscal year could create up to 250,000 additional jobs; the same \$10 billion spent on non-defense purchases in the public and private sector could also create almost 250,000 jobs.⁸

7. See, in particular, M. Anderson (1982b) for a large gap and Gold, Paine and Shields (1981), Brancato and LeGrande (1984), and Bezdek (1975) for smaller ones.

8. CBO (1983 p. 43). The CBO study makes the reasonable assumption that defense spending includes salaries and benefits for the Defense Department's military and civilian

The difference between these outcomes depends on the assumptions being made in the model and on what is being compared. Defense spending clearly generates a number of direct and indirect jobs, ranging roughly from the 25,000 estimated by CBO to the 35,000 cited by the Defense Department in testimony.⁹ This number, however, is relatively meaningless unless one compares it with the number of jobs created by other kinds of federal or private spending.

The Defense Department clearly overstates the conclusions one might draw from its 35,000 jobs per billion figure. Cutting this amount from the budget would not necessarily mean the loss of those jobs; the outcome depends very much on what is done with the billion dollars, or the comparative use of the money. Returned to the economy in the form of deficit reduction, a billion-dollar defense cut could result in lower federal borrowing requirements, lower interest rates, increased private sector borrowing, and, consequently, significant new job-creation. Spent elsewhere in the federal budget, these funds might directly employ more people than the number of jobs lost as a result of the defense cutback. Of course, these funds might also be used on programs that could

employees. When CBO focused solely on defense purchases from industry there was some difference with non-defense purchases, the former creating 210,000 jobs per \$10 billion spent.

9. Direct jobs are those employed by federal funds; indirect jobs are those that result from purchases of inputs for production.

create significantly fewer direct or indirect jobs, for instance, transfer payments, which are less stimulating to the economy than purchases of goods and services (DOD, 1982 p. 68).

On the other hand, the conclusion that defense spending actually costs the economy jobs is also overstated.¹⁰ If alternative forms of federal spending create marginally more direct and indirect jobs than defense, the issue is not one of "jobs lost", but, rather, of jobs one might have preferred in other sectors rather than the jobs created by defense spending.

The reason why such comparisons are unsatisfying lies in the assumptions made in these analyses of military spending and employment. One common assumption is that defense dollars come out of another slice in a fixed federal pie; if defense goes up, domestic spending goes down. Another version of this assumption is that taxpayers, who might otherwise spend their tax dollars on other activities that would create more employment, are funding defense.¹¹

10. The job loss argument is most clearly stated in the work of M. Anderson (1982b). For a critique of this argument, see CBO (1983), Mosely (1985), and Riddell (1984).

11. M. Anderson (1982b) makes this argument: "If people all over the country are paying high taxes, a substantial percentage of which goes to the Pentagon, they do not have control over that money. This means that they build fewer houses, buy fewer cars, take fewer vacations, and vote lower taxes for their state and local governments ... One must also ask how that dollar would have been spent if the Pentagon had not received it - if instead it had been used by consumers to buy the goods and services which they needed

These arguments assume that the federal budget is a zero-sum game, funded entirely out of tax dollars. With a budget deficit, however, federal spending is not zero-sum. Defense can be funded out of borrowing, not necessarily out of programs for the poor. Moreover, depending on how such a deficit is financed, taxpayers are not denied significant disposable income because of taxes for defense.¹²

Input-output models also assume that the economy operates at full employment. This makes the jobs-impact issue difficult to resolve. It means that a shift of funds to defense automatically means taking economic resources away from other activities. Were this true, those engaged in the other activities will find they lose their jobs, unless their skills can be transferred to defense activities. At the very least, one more job in defense means more than one job less in some other activity.

The problem here lies in the model. The American economy has scarcely ever operated anywhere near full employment since the end of the Second World War. If there is less than full employment, spare plant capacity and labor exist in the

or had been turned over to state and local governments to meet public needs."

12. One might argue that federal borrowing can affect the supply of available capital for other investment purposes, and exert upward pressure on interest rates. This relationship is, at best, unclear. Even if it were true, the consequences for job creation (or presumed job loss) are far from clear.

economy. An increase in military spending may use or employ this spare capacity and labor, leaving virtually no impact on employment in other areas.¹³

Existing analyses also encounter problems with the assumptions they make about the nature of the defense sector itself. Defense, it is argued, is a high technology sector; more of the funds in this industry go for materials, technology and equipment and less for labor relative to other sectors of industry.¹⁴ There is, however, little evidence that defense production overall is significantly more capital intensive than other sectors. While airframes, air engines, and missiles can be highly capital-intensive, electronics assembly, shipbuilding, and communications equipment are far less so.¹⁵

13. CBO (1983 p. 43, note 4). The CBO study makes this point, linking the spending and employment arguments. Some research, CBO notes, assumes "that, because a higher share of GNP spent on defense is associated with a lower share spent on other things, higher real defense spending will necessary lead to lower real spending elsewhere. Such a conclusion follows only if the economy is at full employment, which is hardly an accurate description of today's US economy."

14. See De Grasse (1983) and M. Anderson (1982b) who argues (p. 1) that defense production is "technically very complex, it involves large amounts of expensive raw materials, and even more expensive equipment. Therefore, less of the money spent goes towards hiring people and more goes toward buying high priced equipment than when the money is spent on civilian purchases".

15. Duchin (1983) suggests that a breakdown on defense employment among the different types of defense production would probably show variations of labor and capital intensity. There is also little evidence that defense

Finally, the models are not always clear about whether or not all defense-related and induced jobs are being included. Defense employment estimates should be comprehensive, including the jobs in the Defense Department, as well as those in the private sector, since both sets are essential to the performance of military tasks.¹⁶ In addition, models need to make clear whether they are including the induced jobs which result from the wages spent by those directly and indirectly employed by military spending.

The CBO analysis clearly includes all Defense Department spending, not just defense purchases, and thus counts all direct and indirect jobs created in the Defense Department and in industry by military spending. Since its assumptions are the most comprehensive, the comparative outcomes from the CBO study are probably the most comprehensive and accurate. The CBO study also calculates induced employment, showing that military spending has a relatively higher ability to create induced jobs (higher multiplier) than other forms of federal

sector production equipment is more expensive than that used in other sectors of manufacturing. Much of the defense sector machinery is quite old, dating, in some cases, from the 1950s. See Gansler (1980).

16. As of the mid-1980s, over 3.3 million people worked directly for the Department of Defense. There is a curious discrepancy in one study between the researcher's estimate of jobs in the defense sector and data from the Defense Department. In M. Anderson (1982b) p. 6, military industry employment is estimated at 790,800 in 1977 and 1978. The Defense Department estimated 1977 defense-related industry employment at 1,710,000, a difference of nearly 1 million jobs. See DOD (1985) pp. 118-19 and Mosley (1985) p. 91.

spending. However, CBO notes in an appendix that a different model would show a larger multiplier for non-defense spending, which would change the comparisons (CBO, 1983).

If the CBO estimates are the most reliable defense may not have a substantially different impact on the number of jobs in the economy from other forms of public and private spending. The number of jobs created by defense spending, however, may not be the most significant measure of the employment impact of defense spending. If defense dollars create jobs in some areas of the country, but not others, jobs for certain types of workers, but not others, or jobs in some sectors of industry, but not others, then defense dollars represent a choice, explicit or implicit, about the job creation effect federal spending will have on American society. The employment impact of military spending may be an issue of jobs where and jobs for whom.

Geographical implications

Federal spending in general and defense spending in particular, are not distributed evenly across the population and territory of the U.S. Defense spending data for 1984 show a strong concentration of spending in fifteen states (by rank): California, Texas, Virginia, New York, Florida, Massachusetts, Missouri, Maryland, Connecticut, Georgia, Pennsylvania, Washington, New Jersey, Ohio, and North

Carolina.¹⁷ Weighted for the state's contribution to the federal income tax, its share of GNP or of population, this pattern is clearly uneven.

Moreover, the geographic distribution of defense contracting has shifted dramatically over time toward southern and western states. The north-east/mid-west regional share of prime contract dollars dropped from 71.8 per cent in 1951 to 37 per cent in 1983, while the south-west states increased their share from 28 per cent to 63 per cent. This shift affected Indiana, Iowa, Michigan, Minnesota, Ohio and Wisconsin, whose share fell precipitously from 31 per cent in 1951 to 9.8 per cent in 1983. Michigan and Illinois actually received fewer real (after inflation) prime contract dollars in 1983 than in 1951.¹⁸

17. California alone received over 20 percent of total Defense Department prime contract awards and compensation payments in FY 1984. While military and civilian pay and retirement benefits tend to be spent largely in the state in which they are paid, it can be argued that roughly half of prime contract dollars are subcontracted, some of which leave the state. Subcontract data is difficult to obtain, making a precise estimate of its impact on the overall distribution of defense spending difficult to estimate. There is, nevertheless, some evidence that subcontracting is also highly concentrated in the prime contract states. Data calculated from DOD (1985).

18. North-east-Mid-west Institute (1984 pp. 1, 24, 26). Other analysts agree. Markusen (1984a, 1984b) argues that military contracting has stimulated industrial growth, especially in high technology, from Boston to Long Island (but not the rest of New York State), Florida, Texas and California, while the old industrial heartland (Milwaukee, Chicago, Cincinnati, Buffalo, New York City, Philadelphia, Baltimore and presumably Detroit) have not had that stimulation. In 1982 the staff of the Joint Economic Committee concluded that the U.S. defence build-up,

The loss of Pentagon investment in plant and equipment, wage dollars paid into the local economy and orders and subcontracts to other suppliers probably had an impact, over time, on the gradual shift of economic activity and, consequently, job creation, away from the American mid-west and toward the periphery of the country.

This relationship should not be overstated, however. Clearly defense spending shifts are not the only explanation for the larger changes in American economic geography. Changes in the productive process in industry, in the costs for labor and raw materials, in the investment climate in different areas, in domestic and overseas markets, among many other factors, have an impact on plant location, the creation of jobs and the movement of the labor force. Moreover, since the defense share of U.S. GNP has declined since the end of the Vietnam War, regional economic changes cannot be explained solely or even principally in terms of defense spending.¹⁹

concentrated in high technology procurement, "is likely to exacerbate the regional imbalances in the national economy", since the mid-west, with idle plant capacity, is not the region where military equipment is purchased. See JEC (1982).

19. It is also not reasonable to examine the distortions in the American economic geography caused by federal spending by focusing solely on Defense Department spending. See J. Anderson (1982), which makes the case on the basis of defense spending alone. In order to understand these potential distortions, one must review all federal spending and do so over a considerable period of time. Senator Daniel P. Moynihan reviews all federal taxes and federal spending in his annual report on New York State's fiscal relationship with the federal government. According to the 1985 report, in 1984 thirty states were in surplus with the

The impact of defense-spending choices on economic geography clearly requires further study, using data over a period of time, in the context of wider economic changes.

Sectoral employment differences

Defense spending has an immediate and pronounced impact on employment in several specific sectors of industry, as input-output models show. Defense employment is highly concentrated in such sectors as ordinance (79.7 per cent of 1982 output), missiles and space vehicles (67.5 per cent), radio and TV communications equipment (58 per cent), aircraft engines (53.5 per cent) and aircraft (40.4 per cent).²⁰

Funds for defense can encourage employment growth in these sectors or sustain existing employment when demand lags on the commercial side. Other kinds of federal spending would stimulate employment in other sectors. Transfer payments, for example, tend to have an impact widely across the economy, with particular gains in non-durable manufactures, services, and public-sector employment. Spending on health creates jobs in services and public employment. Public-works projects, infrastructure, education, energy, among many other

federal government, while twenty states were in deficit. See Moynihan (1985 pp. 40-42).

20. Markusen (1984a p. 35).

alternatives, all create employment in construction and manufacturing.

The key issue is the choice being made. If defense spending is expanding while, at the same time, spending for other programs is declining, employment in the sectors where defense jobs are concentrated tends to gain, while employment declines in other sectors.²¹ In other words, federal spending decisions represent conscious or unconscious choices with respect to job creation in different sectors of the economy. Since U.S. unemployment is especially concentrated among lower skilled workers, minorities, women, and teenagers -- parts of the United States labor force that work in the sectors of the economy stimulated by non-defense spending -- defense spending, at the expense of non-defense spending, can have clear social and political consequences.

Here, too, the case should not be overstated. Defense spending is not the only thing that stimulates sectoral differences in job creation. Tax policies which stimulate private-sector-investment decisions also have an employment impact. Independent private-sector-investment decisions probably have the most important impact on employment growth and decline in different sectors of the U.S. economy. Further

21. As defense spending rose in the 1980s, for example, domestic spending was also being cut. These latter cuts led to declining membership in unions that organize among public employees and service industries. See Compa (1984) p. 34. See also Bezdek (1975), Gold, Paine and Shields (1981), Reppy (1985), DOD (1980).

research should clarify the relative role of defense spending in creating and maintaining employment in different sectors of the economy.

Labor market differences

The American labor market is segmented into different types of work. Defense spending affects some types more heavily than others. The Defense Department civilian workforce and defense industry workers tend to have more skilled machinists, metal workers, aeronautical and electronic engineers, scientists, social scientists, lawyers and managers than the American economy as a whole and it is often argued that a high proportion of total U.S. employment in these categories is in the Defense Department and the defense industry.

This argument needs to be made with some care, however. A high proportion of total U.S. employment in some subsets of these categories was employed by the Defense Department or the defense industry, including, for example in 1981, 61 per cent of vocational education teachers, 60.4 per cent of mathematical specialists (not otherwise classified), and 47 per cent of aero-astronautical engineers.²²

22. In addition, 30.3 per cent of mathematicians, 24.7 per cent of life and physical scientists, 24.4 per cent of physicists, 21.5 per cent of engineers (not otherwise classified - NOC), 18.3 per cent of electrical engineers, 15.8 per cent of industrial technicians, 15.8 per cent of social scientists (NOC), 15.7 per cent of mechanical

When one combines all the subsets with the highest proportions in defense work, however, they still do not constitute a large share of the total U.S. job market -- only 1.6 per cent in 1981. The vast bulk of the U.S. labor market is far less dependent on defense-related employment.

Even when one explores the share of such categories in total employment in the Pentagon and with its contractors, they constitute a minority of total employment: 309,000 people, or 9.2 per cent of total employment in the Pentagon and the industry in 1981. The largest number of employees on the civilian side of the Pentagon were mechanics, repairers and installers, clerical workers, managers, secretaries, stenographers and typists, among others. Many of these are "service" types of employment open to a wide range of workers in the labor force.

Even in the defense industry, many jobs are not extremely technical. In 1981, 43.2 per cent of all defense industry employment was in the following categories: clerical workers, crafts workers, assemblers, operatives, laborers, metal-working operatives, professional and technical workers, and food-service workers.

engineers, 14.2 per cent of lawyers, 13.1 per cent of technicians (NOC), 12.2 per cent of mechanical engineers, 11.3 per cent of computer programmers and 10.9 per cent of electrical and electronic technicians were employed by the Defense Department or the defense industry. See CBO (1983 Table 6, p. 27 and Table A-11, Appendix A). See also Bezdek (1975) and De Grasse (1983) on the composition of the defense industry labor force.

Although the defense labor force may not be dramatically different from the rest of the American labor force,²³ the highest rates of U.S. unemployment occur in the less skilled parts of the labor force, not in the highly skilled parts of defense contracting. Here, too, federal spending choices constitute an industrial policy by stealth or inadvertence.

The research and development part of the defense labor force merits separate consideration. A significant proportion of U.S. scientists, engineers and technicians are employed in defense-related work which, some analysts argue, deprives the civilian economy of these skills, with serious consequences for technological development in the wider economy (Hartung, De Grasse et. al., 1985, Chapter 3; De Grasse, 1983; Hartung, 1984; M. Anderson, 1982b). Were a very high proportion of such personnel employed in the defense sector, this problem could be serious.

However, there is considerable disagreement on the exact size of this "brain drain". Estimates range from 20 per cent of scientific, technical and engineering personnel to over 50 per cent who are employed in the defense sector.²⁴ This

23. The specialised nature of that workforce is occasionally overstated, for example, "the specialized nature of military employment reduces its economic usefulness. Much of the new employment generated by a military buildup goes to people who need it less" (DeGrasse, 1983 p. 32).

24. M. Anderson, M. (1982a, p. 9), argues that "over half of the US scientists and engineers have been working on military and space contracts". Reppy (1985) estimates that 42 per cent of US scientific manpower is in defense-related

disagreement makes a considerable difference in terms of the pressures on the labor market for technical personnel and the availability of such personnel for commercial work.

In the long run, this problem may be less serious than it seems. Neither the supply of such personnel nor the total U.S. investment in R&D is static. Thus, the available jobs, civilian and commercial, for technical personnel can grow and the supply may also be able to respond, over time, to those changes in demand. The market for R&D talent is clearly rising. In 1960, the U.S. federal government spent \$8.7 billion on research and development, (64 per cent of the total national investment, public and private). This figure rose to \$29.6 billion by 1980, or 47.6 per cent of total national spending on R&D.²⁵

Moreover, as the government market for R&D employees rose, so did the private market. In 1960, private industry spent \$4.5 billion on R&D (33.3 per cent of the national total); by 1980, this had risen to \$30.4 billion, or 48.9 per cent of total national R&D. Clearly a larger number of R&D

work. DeGrasse (1983 p. 102), using National Science Foundation data prepared in the late 1970s, estimates that 25-35 per cent of U.S. scientists and engineers were working on defense projects. Data presented by the National Research Council (1986 p. 74-76) for the mid-1980s suggest a figure of 20% or lower.

25. CBO (1983 Table A-10), for this and the data which follows.

employment choices were available in 1980 than twenty years earlier.

Defense spending may have more significant impacts on employment viewed from the perspective of geography, industrial sectors and types of work than it does on the overall number of people employed. The central issue with respect to employment is one of choice. If one knows how jobs are distributed across the country, among sectors of the economy and within the labor market, does defense spending choices, constitute an industrial and labor policy by inadvertence? Conscious of the employment impacts of their spending choices, would policy-makers prefer to have different employment outcomes? How are these preferred outcomes revealed in the priorities chosen for federal spending?

The Political Economy of Military Spending

The economic impact of military spending is neither as dramatically positive as sometimes claimed by the Department of Defense, nor as uniformly negative as sometimes argued by critics. However, military spending is far from neutral. Implicitly or explicitly, military spending is an economic development policy. The local, industrial and labor force impacts of this kind of spending create a "political economy". The steady, even tenacious persistence of constant high dollar levels of U.S. defense spending, with strong political

support, can be explained in part because of this political economy.

Throughtout most of the postwar period, U.S. defense budgets arose, in part, out of a clear, detailed definition of (principally Soviet) "threats" to the U.S., despite clear disagreement about such threats and about the weapons and forces required to meet them (DOD, 1982; Holzman, 1980; Stubbing, 1982; Collins, 1980; Levin, 1983; Defense Budget Project, 1985; Committee for National Security, 1985). Bureaucratic structures in the Pentagon also explain, in part, high U.S. defense budgets (Peck and Scherer, 1962; Fox, 1974; Sapolsky, 1971; Fitzgerald, 1972). Bureaucratic self--promotion, budgetary inventiveness and "logrolling" in the Defense Department have lives of their own linked only indirectly to perceptions of the "threat".

All four U.S. military services, for example, have air forces, each one with several different types of aircraft. There are no examples of successful, long-term joint aircraft procurement. Inside one service, weapons programs can ensure that a particular office in that service maintains its separate mission and increases its budget. For example, despite Air Force testimony in the 1970s that the existing B-52 bomber could survive as a nuclear-cruise-missile carrier until the year 2000, the proposed B-1 bomber program clearly maintained that service's future commitment to the manned bomber mission and dramatically increased the Air Force budget (Adams, 1982b).

Moreover, the military frequently manages its procurement process in a way that keeps defense budgets high.²⁶ The revelations of wasteful spare parts purchases and excessive overhead charges in the early 1980s are only one of the obvious symptoms of a deeper management problem (Defense Budget Project, 1984; Adams, 1983; Peck and Scherer, 1962; Fox, 1974; Fitzgerald, 1971).

Bureaucratic self-promotion and wasteful management, however, do not fully explain why the U.S. Congress continued to fund high levels of defense spending, despite policy disagreements and Pentagon inefficiencies. At the heart of the defense spending process lies a political economy linking national security spending decisions to the microeconomic impacts already analysed. To understand this microeconomy, the historical relationship between two supposed antagonists in American society, government and the defense industry, must be examined .

Historically, the American defense industry and the government agencies which buy its goods have been involved in a close, highly cooperative relationship. The First World War brought about major growth in U.S. defense manufacturing, and brought industrialists from this sector into government decision-making positions (Cuff, 1973; Koistinen, 1980; Adams, 1980). This relationship took a more permanent form after the

26. In 1983, the presidential business commission investigating government waste pointed to roughly \$30 billion a year in wasteful Pentagon spending. See President's Private Sector Survey on Cost Control (1983).

Second World War (Kaufman, 1972 p. 248; Fox, 1974; Peck and Scherer, 1962; Melman, 1970, 1974). Within the framework of global U.S. commitments, a large permanent military establishment and significantly higher defense spending, the military services and the defense industry developed a close self-conscious interaction. For defense contractors, this close interaction was of crucial importance, prime contractors found defense a stable and profitable business (Gansler, 1980).

For the defense bureaucracy close interaction was also desirable. Not only did it facilitate communication over defense needs, it also provided different Pentagon offices with external allies in the process of defending missions and expanding their budgets. By definition, as this relationship grew, the Defense Department became ever more involved in decisions which affected parts of the American economy at the microeconomic level.

The funds to continue this relationship, however, derived from neither party, but from the Congress. Elected representatives and congressional committees have, thus, become a third party in the political economy of defense. Budgetary and spending decisions on defense have been made for some time within this policy triangle: an intimate interaction over policy decisions between federal agency (the Pentagon), its client group in American society (the defense industry), and Members of Congress with a special interest in that part of the federal budget (the members of the Armed Services

committees, the Defense Appropriations subcommittees, and members from congressional districts and states where defense dollars are spent) (Adams, 1982a).

This type of "iron triangle", or "sub-government", is common in American politics (Adams, 1977; McConnell, 1967; Freeman, 1955; Cater, 1964; Hayes, 1978). It has the following characteristics:

- A close working relationship, in a clearly delineated arena of policy between the bureaucratic agency, key committees and Members of Congress, and a specific, private sector interest.
- A close interpenetration between the private-sector interest and the bureaucratic agency. Individuals on each side move freely back and forth, interact formally and informally, and tend to develop shared values, interests, and perceptions about future policy (Ziegler and Peak, 1972, p. 180). Through this interaction, authority over policy comes to be shared; private-sector individuals become, in effect, policymakers and administrators (Seidman, 1970; McConnell, 1967; O'Connor, 1973 p. 66).
- A slow emergence over time. Such iron triangles are not wilfully created in a single moment as a conspiracy, but grow out of constant interaction

among the players. Each side seeks to maintain the structure as circumstances change; disagreements, which do happen, are reconciled within the framework.

- A strong tendency to become "iron" - closed off from the surrounding political arena. The key actors in Congress, in the industry, in the agency make strenuous efforts to protect the structure from external penetration (Adams, 1982a; Schattschneider, 1975; Hayes, 1978). This isolation means that perspectives on alternatives to the existing policies become narrow and outside proposals are rejected as threatening. Government and private actors come to share the assumption that they act not only in their own interests, but in the "public interest", as well (Neustadt, 1976 p. 172).

This iron-triangle structure, operating within, but often independent of national security considerations, is a major source of continued high levels of U.S. defense spending. The economic effects of military spending described above are a crucial element in maintaining this triangle. The structure depends on a constant flow of information, access, influence, and, especially, money. Both Defense Department and industry officials are highly conscious of this flow and its economic

impact, since the fiscal and economic outcomes can be translated into political support for the defense budget.

The defense industry is a crucial actor in this political-economic process. Defense is big business: the Pentagon's contract market was roughly \$150 billion per year in the 1980s. It is a concentrated and stable business: most of the top twenty-five contractors to the Defense Department have been in the business for over forty years and, together, receive 50 per cent of all of the contract dollars the Defense Department awards. The business is important to the companies; many of them do over 50 per cent of their sales with the federal government (Adams, 1982a, Chapters 6, 7, 9, 11, 13 and company profiles).

As a result, defense contractors work hard within the iron triangle to translate the economic benefits of defense spending into political support for high budgets and contracts. To a contractor, a weapon program is not only a contribution, real or symbolic, to national security, it constitutes a significant corporate fiscal stake in the procurement part of Pentagon spending. Once underway, such programs can be sustained, in part, by the constituencies which depend, politically or economically, on the flow of contracting dollars.

This flow depends on decisions made in the Congress, which makes committees and Members of Congress important participants in the defense iron triangle. Given the fact that most major weapons programs are already well underway, with

strong bureaucratic commitment and corporate involvement, by the time they reach high levels of visibility in Congress, committees and members on Capitol Hill already have limited room for manoeuvre. This "political space" grows even smaller as defense contracting companies (and the Pentagon) focus pressures and incentives on Congress, coordinated largely through their Washington offices.²⁷

For the defense contractor, the fiscal and economic benefits of defense contracting are tools in this process of political influence. Direct lobbying, campaign contributions and the intelligent use of the local economic impacts of contracting are all parts of the lobbying effort. Congress, as an institution, is well structured to render this lobbying effort effective. Members of the Armed Services and Defense Appropriations Committees jealously guard their jurisdiction and close off the defense decision-making process in Congress from encroachment by other committees. Moreover, individual members, especially in the House of Representatives, are acutely sensitive to the local economic impacts of federal spending, including defense. Their re-election fortunes

27. Adams (1982a), company profiles section. From 1977 to 1979, the eight leading defense contractors employed 200 people in their Washington offices, and forty-eight registered lobbyists. According to audits by the Defense Contract Audit Agency, Boeing, General Dynamics, Grumman, Lockheed, and Rockwell International together spent \$16.8 million on their Washington offices in 1974 and 1975, or an average of \$1.5 million each per year. Rockwell alone spent \$7 million from 1973 to 1975.

depend, in part, on remaining sensitive to the developments in the local economy (Adams, 1982a Chapter 8).

In addition to the direct lobbying and campaign contributions defense contractors make to Members of Congress, the local "constituents" of defense spending are brought to bear in the political process (Adams, 1982a Chapter 13). Grass-roots mobilizations, based on the microeconomy of defence spending, can be an important part of the contractor's effort to ensure a favourable Congressional vote on weapons programs. The geographic, sectoral and labor market impacts of defense spending all become an important part of the message conveyed to Congress from the grass roots. Contractors consider the communities in which they are located, subcontractors in other parts of the country, the labor force and trade unions inside their plants, and even their stockholders parts of the constituency committed to a weapon program. Part or all of the elements in this constituency can be mobilized directly to lobby the Congress; their dependency on defense contracting is part of the lobbying pitch a company makes directly to a Member of Congress.

Contractor-mobilization of the defense microeconomy can sometimes take the form of a full-scale campaign. In the mid-1970s, for example, Rockwell International mounted such an effort on behalf of the B-1 bomber program, then on the brink of cancellation. The company urged its 115,000 employees and the holders of its 35 million shares of stock to write to their Congressmen. More than 3,000 subcontractors and

suppliers in forty-eight states were also asked to tell their Congressmen about the adverse impact cancellation of B-1 would have in the districts they represented. Rockwell acknowledged that it spent \$1.35 million on the grass-roots effort alone between 1975 and 1977. In addition, Rockwell put together district-by-district descriptions of the economic impact of the B-1 program, which it used as part of its direct lobbying presentation to Members of Congress (Adams, 1982a Chapter 13).

Given the resources which can be mobilized on behalf of each weapon program the constituency in Congress favoring continued high levels of procurement spending is large. Virtually every member has some kind of prime or subcontracting impact in their state or district. The rather thorough penetration of this kind of constituency-building throughout the Congress is one central element in keeping defense budgets at consistently high levels. For this reason, when Congress does reduce the Pentagon's initial budget request, cuts generally affect spending for personnel and operations and maintenance, which have far less effective supporters in the defense microeconomy. When weapons programs themselves are cut, savings generally take the form of stretching out anticipated purchases, rather than the outright termination of a program (Defense Budget Project, 1985). Hearings and legislation in Congress on spending issues which do not directly touch the budget - waste and fraud measures, for example - have little impact on the votes taken on weapons programs or on how overall defense spending might be reduced.

While national security considerations clearly have an impact on defense budget and policy decisions, they do not fully explain the size, scope, and political clout of the iron triangle. Bureaucratic sources of defense spending also provide, at best a partial explanation of where and how weapons originate, why they are so hard to cancel and why the Congress does not make major shifts in the defense program and budget proposed by an administration.

The microeconomy of defense spending is an important part of the puzzle. While the macroeconomic effects of military spending may not be terribly different from other government spending, the microeconomic effect is clearly of critical political importance. The regions, labor force and industries which derive employment and revenue from Defense Department spending have become an important element in keeping such spending itself at high levels. A high flow of funds continues to fuel the political machinery. The result is a net gain for some in the economy and foregone opportunities for others who might make political claim to the same federal resources.

Conclusion

This brief analysis of the existing literature on the economic impact of military spending points in some new directions for both supporters and critics of high levels of military spending. For those who argue that defense spending

is inflationary, this analysis concludes that it is not particularly more inflationary than other forms of federal spending. Instead, the impact of military spending on inflation depends on how that spending is financed and the general state of the economy in which it occurs. The links between defense and inflation are neither obvious nor simple.

The relationship between military spending, productivity and technology are also more complex than the existing debate suggests. Defense spending may actually be funded out of personal consumption, rather than investment, leaving ample room for private sector investment to grow. Here, too, movement in the wider economy has an important role in determining the relationship of military technology to investment and GNP. Moreover, it is not at all clear that military technology is either intrinsically harmful or beneficial for technological development in the American economy. Its contribution appears to depend on the kind of technology and the economic setting in which the invention is occurring.

The picture is far from unidimensional, as well, with respect to employment. Military spending clearly creates jobs; it is not clear that it creates fewer jobs than other forms of federal spending, as some critics charge. Once one has fully counted the defense labor force - public and private - and made appropriate assumptions about the economy in which jobs are being created, defense and other government programs seem to create fairly similar numbers of jobs.

The key employment issue is not the number of jobs, but the location and nature of those jobs as well as the sector in which they are found. Here, military spending appears to have quite a different impact from other programs: the jobs are in certain parts of the country, for certain parts of the labor force and in certain industries.

Even here, however, the differences should not be exaggerated. There are many larger forces influencing the growth and direction of the American economy; military spending is only one of them.

Perhaps the greatest significance of military spending's effect on the economy is its role in creating a "political economy" of defense. High levels of defense spending may have far more to do with the regional, sectoral and labor market effects of that spending than with its macroeconomic impact.

Some issues require further exploration, especially the rather complicated relationship between military spending and technology. There is, however, clearly a middle ground in the debate over military economics, to which this chapter makes an initial contribution.

Chapter III

Defense Spending and the American Economy¹

Introduction

Since the beginning of the Cold War there has been recurrent concern in the United States about the impact of defense spending on the U.S. economy. Revived each time there is a major increase in the defense budget, this concern focuses on the idea that defense spending systematically hampers U.S. economic growth, drains the economy of capital and human resources that are critical to such growth, and is a major source of the economic ills the United States may be suffering at the time (inflation, unemployment, low productivity).

Such concern resurfaced in the 1980s, with the intensified defense build-up of the Reagan Administration. The size and speed of this buildup, coming in the context of substantial tax cuts, rising budget deficits, high inflation, and an economy on the brink of recession, led a number of economists to warn that rapid growth in defense spending would be harmful to the American economy. For example, Lester Thurow (1981) wrote that the Reagan buildup would "wreck the economy" by diverting resources needed for capital formation

1. This chapter was originally published in **Defence Economics**, 1990, 1(4), pp. 275-293. See Gold and Adams (1990). It is reprinted with permission of the publisher.

and sound economic growth into unproductive defense expenditures. He also warned that the buildup would increase the federal budget deficit, add to inflation, and undermine investment in plant and equipment as defense contractors outbid civilian firms for key resources.

A number of analysts shared this perspective, arguing that defense spending has long-term negative effects on capital formation, productivity, and economic growth in the United States (see, e.g., Kaldor 1981, DeGrasse 1983, Melman 1983, Dumas 1986). To many observers, lagging innovation and productivity, weaknesses in traditional industries, a spiralling debt, both public and private, and a crumbling infrastructure were among the many signs that the U.S. economy had been undergoing a transition for the worse. The once preponderant U.S. share of global trade and manufacturing production had disappeared. Japan and West Germany, along with such newcomers as South Korea and Taiwan, invested, increased their productivity and grew in ways that far outstripped U.S. economic performance.

The most widely discussed version of this argument was put forward by Yale historian Paul Kennedy in 1987. Kennedy analyzed shifts in the world-wide distribution of political, military, and economic power over the course of the last five centuries and described "economic and technological developments" as a chief driving force behind change, "which then impact upon social structures, political systems, military power, and the position of individual states and

empires." The expansion of military power, he argued, can weaken the prospects for further economic growth, as a significant proportion of a nation's resources are devoted to economically unproductive activities (Kennedy, 1987 p. 439).

Kennedy's economic analysis of the current U.S. situation was brief, but explicit:

. . . if the United States continues . . . to devote 7 percent or more of its GNP to defense spending while its major economic rivals, especially Japan, allocate a far smaller proportion, then *ipso facto* the latter have potentially more funds "free" for civilian investment; if the United States continues to invest a massive amount of its R&D facilities into military-related production while the Japanese and West Germans concentrate upon commercial R&D; and if the Pentagon's spending drains off the majority of the country's scientists and engineers . . . it seems inevitable that the American share of world manufacturing will steadily decline, and . . . its . . . growth rates will be slower than in those countries dedicated to the marketplace and less eager to channel resources into defense (Kennedy, 1987 p. 532).

Defense Spending and Economic Decline

This critique of defense spending took place in a setting of what appeared to be long-term U.S. economic decline. It is

not clear, however, that defense spending compellingly explains either the peaks and valleys of U.S. economic performance or the change in its economic position relative to other countries. It is important to note that defense spending is neither constantly growing nor an ever greater share of the U.S. economy. Though defense spending in the 1980s was at historically high peacetime levels, after inflation, it was also significantly lower as a share of U.S. Gross National Product or manufacturing output than it was in the 1950s and 1960s.

Moreover, the variations in U.S. defense spending and economic performance since 1950, both short-term and long-term, do not suggest such a relationship. When defense spending was a higher share of U.S. GNP and manufacturing output (in the 1950s and 1960s), U.S. economic growth, productivity and international competitiveness were also high. When the defense share fell in the 1970s, U.S. growth rates and productivity performance declined. As defense rose again in the 1980s, growth and productivity also improved, although international competitiveness remained problematic.

During the Carter-Reagan years, and especially during the first four years of the Reagan Administration, the buildup was rapid. In the four years from 1981 to 1985, defense spending doubled in current dollars, and rose by more than 55 percent after adjusting for inflation. The United States was spending more on defense, in constant dollars, than in any peacetime year since 1946. The dire economic warnings of Thurow and

others, however, had not yet come to pass. The rate of inflation had dropped markedly and, following a deep recession in 1981-82, the economy had entered a period of sustained recovery. At the same time, federal budget deficits had reached unprecedented levels as a share of Gross National Product (GNP), the United States had developed a persistently high trade deficit and U.S. companies were losing ground in world markets for key manufactured goods. After 1985, real growth in defense spending halted, while the economic recovery continued until the end of the decade. Many of the economic issues of the 1980s, however, including high federal budget and foreign trade deficits, continued to be serious public policy problems.

This relatively confusing data should not suggest that defense is either good or bad for the economy, but, rather, that other determinants of economic activity may be more direct and more significant causes of the ebb and flow of U.S. economic performance. Whatever link exists between defense and overall economic activity needs to be explored with sophisticated research tools and a substantial amount of caution and subtlety in interpretation.

Defense spending is singled out for criticism because defense is assumed to contribute little unique to economic growth, while absorbing resources that otherwise would increase productivity and investment. The argument that defense spending is harmful to the economy contains some relatively straightforward contentions: First, it is argued,

there is a trade-off between defense expenditures and capital formation; growth in defense spending, relative to GNP, comes largely at the expense of new investment. Second, defense spending has a specific, negative impact on non-defense research and development, draining the economy of key resources, weakening its potential for innovation and causing declines in productivity growth and international competitiveness. Third, the negative impact of defense spending on civilian research and development is particularly noticeable in the steady drain of large numbers of talented scientists and engineers to the defense sector, depleting the civilian economy of this crucial resource. Finally, the proof of the pudding is in the comparison of the post-war economic performance of the United States with its main economic competitors, Japan and West Germany, neither of whom devote as large a proportion of their resources to their defense sectors.

Defense Spending and Capital Formation

The first component in the general critique of the economic impact of defense spending is that defense spending crowds out investment in the American economy. Melman (1983 pp. 177-80) and Dumas (1986 Chapters 9 and 10), for example, have both argued that the defense sector "pre-empts" a substantial share of the capital stock of the United States economy. Dumas (1986 pp. 217-22) claims that, as of 1983, the

defense sector, including the Pentagon and private contractors, owned a stock of capital goods equal to 46 percent -- almost one half -- of the value of the capital equipment, structures, and inventories owned by all U.S. manufacturing industry and that this constitutes a massive pre-emption of capital that could be used for productive investment.²

This contention is unconvincing. In obtaining his estimates, Dumas adds together the value of plant and equipment, land, structures, and the stock of weapons owned by the Department of Defense, including the latter because they represent the "tools" with which the services of national security are performed. Thus, he includes not just the capital stock used in manufacturing defense goods, but the capital used in producing defense services. Against this, the capital used in producing all civilian goods and services should be included in the denominator, not just the capital stock in manufacturing. The land, buildings, inventories, and equipment used in agriculture and in services such as finance, real estate, retail and wholesale trade, and private education and health care should also be included, as should land,

2. Dumas' argument is that defense is the most important of a number of unproductive sectors in the American economy, and that the resources going to unproductive activity have been growing faster than the resources devoted to productive activity. This particular calculation, however, compares defense to manufacturing, and does not compare defense capital to capital engaged in productive activities. For a more general version of the argument that unproductive activities have grown faster than productive activities in the United States, see Wolff (1987a).

buildings, and equipment used in civilian government activities, including roads and highways, bridges and tunnels, rivers, lakes, and parks used for recreation and commerce, etc. If these are all added to the denominator, Dumas' estimate of capital pre-emption by the Defense Department falls far short of fifty percent. Indeed, the share of defense-owned capital falls to five percent as of the end of 1983.³

More important, by describing defense capital as a "pre-emption" and a "diversion" from productive use, Dumas assumes that the money, labor, and materials used in defense sector activities would otherwise have been used for productive investment. However, to the extent there are unemployed resources that are used as a result of defense spending, defense production might be a net addition to output. Moreover, defense production could utilize resources that

3. According to Department of Commerce figures, the value of the stock of fixed, reproducible tangible wealth, net of depreciation, stood at \$9.775 trillion at the end of 1983, while Dumas estimates the stock of Defense Department capital at \$470 billion. Subtracting the Defense Department figure from the total leaves \$9.3 trillion, approximately five percent of which is defense. The Defense Department figure is a little low, since it was for the end of the fiscal year, three months earlier than the end of the calendar year. Also, the denominator includes the value of capital owned by defense contractors and used in defense production. However, the figure for non-defense capital does not include land, which would increase the denominator by a substantial amount. The value of land is included in Dumas' estimate of defense-owned capital. Thus, the five percent figure is probably an overstatement. The net fixed capital owned by state and local governments alone, excluding land, is valued at \$1.4 trillion in 1983, almost three times larger than Dumas' estimate for the Defense Department (BEA, 1988 p. 35).

otherwise would have been used in consumption, rather than investment. Before they are actually used, money, labor power, and raw materials can potentially be used for almost any purpose. It is not possible to tell, simply by looking at what is built with a given set of resources, what was not built as a consequence.

Rather than comparing resources used in defense activities with resources used in some specific set of civilian activities, what needs to be explored is whether the existence of defense spending results in a large and systematic reduction in other categories of economic activity, and whether this association can be adequately explained. There is a substantial amount of statistical evidence suggesting a negative relationship between defense spending and investment, and between defense spending and economic growth, based on econometric models of the United States and other industrialized nations (Smith, 1977; Smith, 1980; Cappelen, Gleditsch and Bjerkholt, 1984; Rasler and Thompson, 1988; see also Lindgren 1984; Chan 1985; Mosely, 1985 Chapter 4).

A defense-investment trade-off should be symmetrical, working to reduce investment when defense spending grows, and serving to expand investment when defense spending is cut. If a defense-investment tradeoff existed for the United States, one might expect that as defense spending fell as a share of GNP, there would be an investment boom, with the investment share of GNP rising. Such a boom would, presumably, impart a

stimulus to economic growth. In fact, between 1954 and 1979, the defense spending share of GNP declined substantially, from more than 10 percent of GNP to under 5 percent, yet the investment share stayed basically the same, while GNP growth rates slowed.

A possible explanation for this outcome is that defense spending does have a negative impact on investment, which is measured by the partial regression coefficient for defense in equations explaining investment, but that effect is offset by other non-defense factors. But if defense has a weaker impact than other factors, one cannot assume that it is a major determinant of U.S. investment spending. Indeed, if cutting the defense burden in half has no apparent impact on investment, then it is legitimate to question the importance of defense in explaining changes in capital formation.

There are also problems with the data and methods in these studies, despite the consistency of their results. The use of different models and methods makes the statistical results difficult to compare. Two of the more thorough studies use data from OECD countries that is pooled (Smith, 1980; Cappelen, Gleditsch and Bjerkholt, 1984), with equations estimated for all of the countries taken together, or some subset of countries. While such a procedure expands the sample and improves estimation, it is tantamount to assuming that the underlying economic processes are similar across countries, an assumption that is questionable in practice. Thus, the results indicating a trade-off between defense and

investment may be strong statistically for the group, while weak or erroneous for a country taken by itself.

For the United States, two analyses of long-run data suggest that the tie between defense and investment may be weak. Boulding (1973) compared data for 1929 and 1969 (both years of near full employment) to see if the investment share of U.S. GNP fell over a period of time during which the defense share rose significantly. Instead of a decline in the investment share, the data showed a decline in the private consumption share of GNP. Edelstein's study (1990) of U.S. national income data from 1891 to 1979 also indicates that changes in private consumption spending, not investment, paid for U.S. post-war defense spending. For the post-war period alone, Edelstein shows that the investment share of GNP has been stable when cyclical fluctuations are removed, while the defense share has, on balance, declined substantially.

The fact that the investment share of GNP has been relatively constant in the United States over long periods, while the defense share has changed substantially, should suggest that defense spending is not a major determinant of the investment share. If a variable is reasonably constant over long periods of time, then the process or processes determining that variable are also likely to be substantially constant. Defense spending has been substantially higher since World War II than it was before the war; and since the end of the Korean War, the defense share of GNP has exhibited a sharp downward trend. Yet the investment share of GNP, with

the exception of the Great Depression, has stayed reasonably constant.⁴

The studies suggesting a negative relationship between defense spending and investment also have problems explaining how such a trade-off might take place. Smith (1977) suggests, for example, that political forces tend to keep the social wage, defined as private consumption expenditures plus government social outlays, constant since, except during periods of hot war, working class organizations fight against cuts in such consumption. While struggles over expenditure shares certainly occur, it is not clear why the result should be a constant consumption share, leaving only the investment share available to bear the cost of a defense burden. For the United States, the results reported by Boulding and Edelstein suggest that it is the investment share, not the social consumption share, that has been constant. One possible explanation for a trade-off between defense spending and consumption, rather than between defense spending and investment, is that tax burdens in the United States have tended to fall more heavily on income from labor than on income from property, in effect shifting spending from wage

4. The gross private investment share of GNP was 15.25 percent in 1921-29 and 15.74 percent in 1946-79, while the defense spending share rose from 0.92 percent to 7.66 percent. For 1949-79, using business cycle averages, the investment share ranged from 14.92 percent to 16.09 percent while the defense share went from a high of 10.06 percent to a low of 4.97 percent. The relative constancy of the investment share holds if government civilian investment is added to private investment (Edelstein, 1990).

and salary earners to state, local, and federal governments (Edelstein, 1990).

Another possible mechanism might be tradeoffs in the federal budget, with defense spending coming at the cost of spending for other purposes. Until the Reagan Administration, however, the evidence for the United States indicates that the shares of public sector spending for defense did not vary inversely with the shares committed to non-defense spending. Indeed, there is some evidence in the pre-1980 period that both sides of public spending -- military and civilian -- tended to grow and decline together (Russett, 1982).

One other possible mechanism for a trade-off between defense spending and investment is the market economy itself. Cappelen, Gleditsch and Bjerkholt (1984 p. 370) suggest that defense producers may obtain capacity that is then denied to civilian manufacturers. There is some evidence that such market "crowding out" may have occurred during the Vietnam War (Leontief, 1967). There is, however, little evidence that it occurred during the 1980s, or that it has occurred over time (CBO, 1983). The main difference between the late 1960s and early 1980s is to be found in the level of economic activity: the economy was operating close to capacity in the 1960s and no significant new taxes were raised to fund the war, while there was a recession in the early 1980s, leaving spare labor and industrial capacity. Defense spending *per se* may not be

the key element in such a tradeoff, but rather the state of the economy as a whole.⁵

Defense Spending and Economic Depletion

Defense research and development activities consume significant amounts of U.S. public and private sector research funds and scientific, technical and engineering personnel. As a result, it has been argued, defense may "drain" or "deplete" the economy of the resources -- fiscal and personal -- it requires to enhance productivity and compete in the world economy (Melman, 1965; Kaldor, 1981).

It is not clear that defense research and development represents a major drain on the resources available for R&D in the economy as a whole. National Science Foundation data indicate that the defense and space-related share of total national outlays for R&D (public and private) was 57 percent in 1959, averaged 53 percent per year in the 1960s, averaged 36 percent per year in the 1970s and had fallen to a 1980-88 annual average of 34 percent, even with the sharp rise in

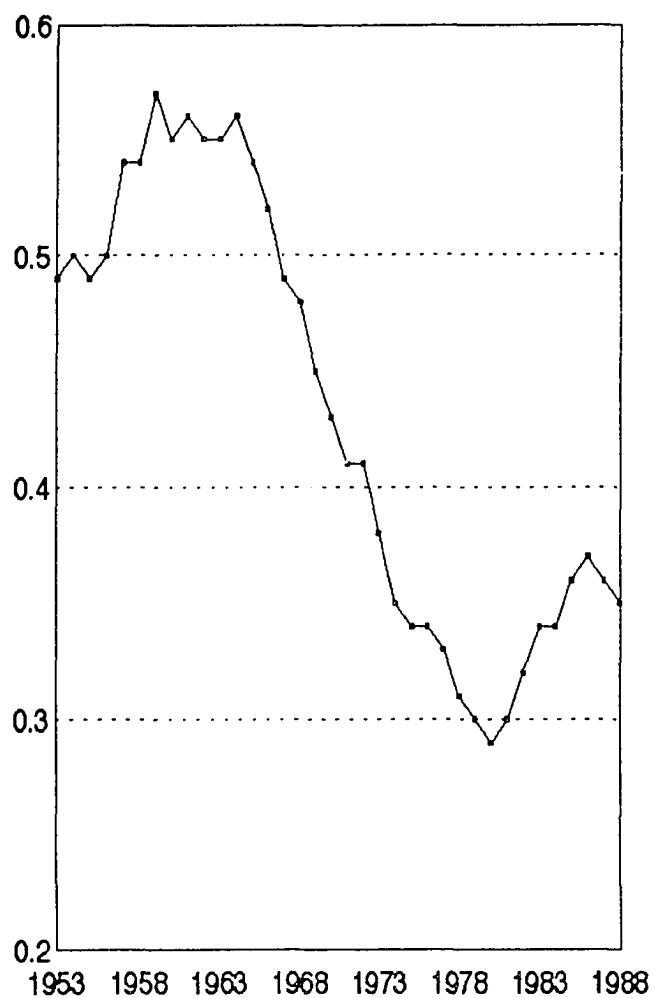
5. There was one period where defense itself was crowded out on the market. In the 1970s, after the Vietnam War, defense production dropped and a number of firms left the defense business. The Carter Administration's defense buildup ran into a problem of insufficient production capacity and rising prices for materials and subcomponents. The problem gradually disappeared as defense capacity was expanded and the civilian economy slowed down. After the 1981-82 recession, industrial capacity was sufficient to accommodate both the economic recovery and the defense buildup (CBO, 1983).

defense R&D spending during the Reagan Administration (Chart III.1). Historically, outlays for defense R&D rose rapidly, after inflation, during the 1950s, but fell during the 1970s (Chart III.2). By 1980, defense R&D was almost 40 percent lower than it had been in 1960, after inflation, and by 1986-88 it was only 12 percent higher than in 1960. Moreover, with particular attention to manufacturing, federal government funding, as a whole, shrank as a source of funds for industrial R&D from 49 percent in 1968 to 32 percent in 1982, as private sector funding expanded rapidly (Chart III.3).

As these data suggest, spending on non-defense-related R&D, especially in the private sector, was growing more rapidly than spending on defense R&D. "Drain" and "depletion" do not characterize the relationship between the two; the overall pool of financial resources for R&D has grown. The claim that a rise in defense R&D comes at the cost of private sector R&D is tantamount to assuming a zero-sum game, which is not borne out by the evidence.

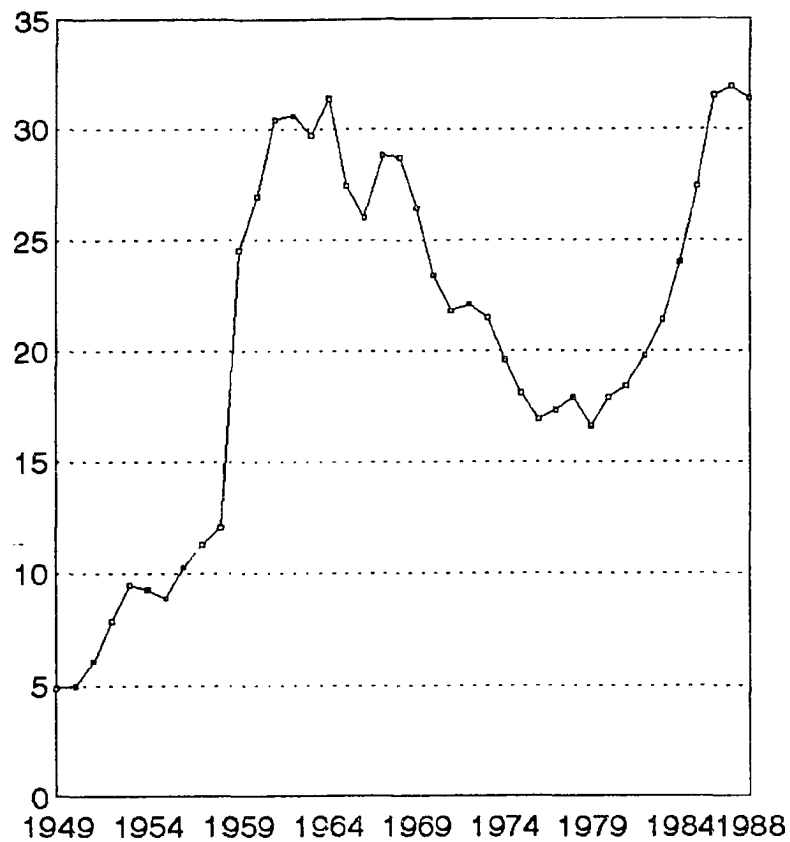
It should be noted, however, that there do seem to be tradeoffs between defense and non-defense funds with respect to public sector R&D. The share of federal R&D dollars absorbed by national defense needs rose rapidly during the 1980s, from 48.4 percent in 1980 to 68.4 percent in 1986 (OMB, 1988 pp. 177-82). If NASA R&D, some of which is defense-related, is included, the share rises from 62.5 percent to 73.9 percent. In theory, of course, the public sector pool of R&D dollars could also expand, making it possible to meet both

Chart III.1. Defense and Space-Related Research and Development as a Share of Total Research and Development Outlays
(annual data; 1953-1988)



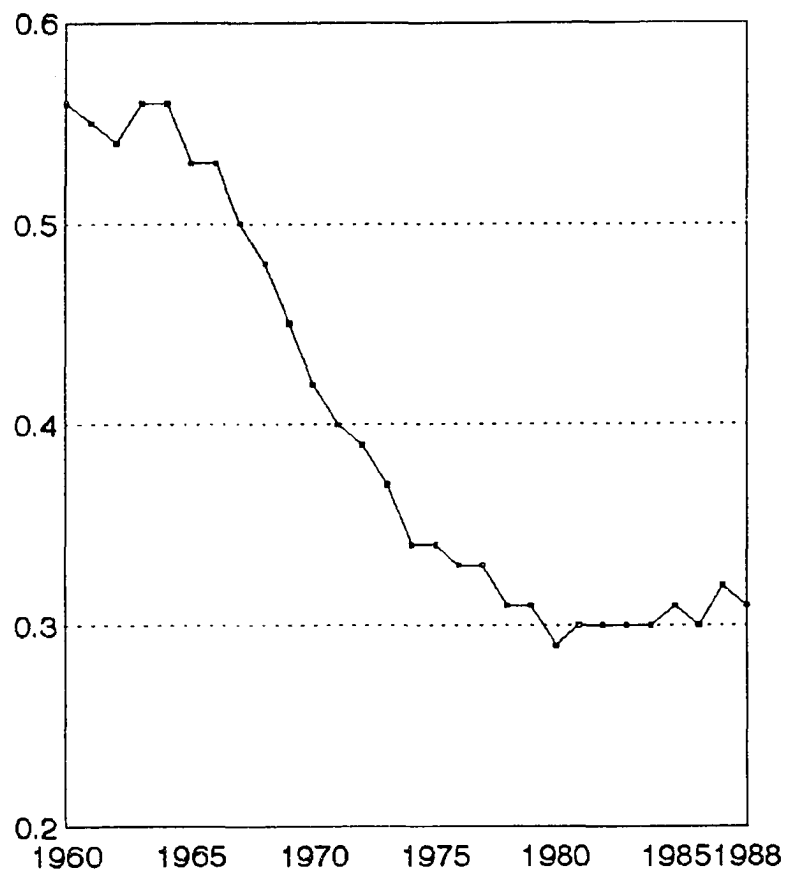
Source: NSF, various annual volumes.

Chart III.2. Defense Outlays for Research and Development
(annual data; FY1949-FY1988)
(billions of FY82 dollars)



Source: OMB, 1991 Table 10.1.

Chart III.3. Federal Share of Industrial Research and Development
(annual data; 1960-1988)



Source: NSB, 1993 Appendix table 4-3.

defense and non-defense needs. The budgetary realities of the 1980s, however, indicate a tradeoff between the two kinds of spending at the federal level. This trade-off depends on a host of political and economic factors, of which the growth of defense R&D is only one.

The existence of a trade-off within the federal budget does not, of course, imply the existence of a trade-off within the economy as a whole. It is, however, widely assumed that private firms underinvest in R&D since it is difficult for firms to recapture all of their R&D costs in profits. Public sector R&D spending might be able to make up for such underinvestment, with widespread economic benefits, though there is little evidence that the United States has targeted its non-defense R&D to such purposes. To the degree it has benefits for the economy, however, a tight federal R&D budget may have a negative impact on economy-wide R&D.

Productivity is a key element linking capital accumulation to economic growth, and it has often been argued that the drain of R&D resources to the defense sector is a cause of the productivity slowdown in the United States. Yet research on changes in the rate of productivity growth does not show a clear connection to defense spending. Empirical literature has identified a large number of possible causes of the productivity slowdown, including a slowing of the rate of growth of capital relative to labor, a reduced rate of improvement in the quality of capital, a rise in anti-pollution requirements, the post-1973 energy price rises, a

shift in the composition of output toward lower productivity sectors, an increase in government regulations, and reductions in the rate of growth of research and development (Wolff, 1985). In each case, the empirical estimates cover a fairly wide range of values, due to differences in data, time periods, empirical methods, and definitions of variables, as well as to the theories that underlay the specific formulations tested. Obviously, there is room for substantial disagreement as to the importance of these results, as well as substantial scope for additional research.

At the same time, reductions in the rate of growth of R&D spending were not found to be a major cause of the productivity slowdown. One study found, for example, that privately financed R&D explained between 6 and 12 percent of productivity growth in the 1948-82 period, but that changes in private R&D contributed nothing to the explanation of the post-1973 productivity slowdown (Sveikauskas, 1986). Denison (1985) concluded that R&D explained none of the productivity slowdown, and that privately financed R&D was just as productive in the 1970s as it had been before 1965.

One of the leading researchers on the economics of productivity, Zvi Griliches (1988), re-evaluated the existing body of empirical work, and concluded that factors other than a shortfall of R&D explain the slowdown. Griliches (1988 p. 13) explicitly rejects an important role for R&D in explaining the productivity slowdown:

First, the R&D slowdown was much less pronounced in other Western countries and in Japan, in spite of the even larger declines in productivity growth in those other countries [compared to the United States]. Second, most of the slowdown in the growth of R&D occurred in its governmentally supported components . . . while most of the available evidence argues that this type of R&D has had only a relatively small role in generating productivity growth in industry Third, a direct computation of the potential contribution of the slowdown in R&D growth to the explanation of productivity growth results in a rather small number.

After 1973, productivity growth rates dropped sharply both in countries where military R&D had been important throughout the postwar period, and in countries where military R&D had been relatively small. Japan and West Germany, countries often cited as benefiting economically from low military R&D, both saw their productivity growth rates drop by substantial amounts. Thus, not only does the world wide drop in productivity growth rates cast doubt upon the importance of falling R&D as an explanation, it also casts doubt upon there being a significant negative role for defense R&D.

Defense Spending and the Employment of Scientists and Engineers

The substantial employment of scientists and engineers in defense production and research has often been cited as evidence of that defense spending diverts technical labor away from pursuits that would benefit the wider economy. According to this argument, defense spending, especially defense R&D, absorbs a large portion of the economy's scientific and engineering talent, leaving fewer trained people available for civilian work and leading to a decline in civilian R&D, a falloff in innovation, a drop in productive competence, and a fall in productivity growth for the economy as a whole. Dumas (1986 p. 211) states that

it would appear likely that an important fraction of the engineering and scientific personnel in the United States has been devoting its talents to the development of military-oriented technology. This fraction probably is not less than 30 percent; in all likelihood, it is much higher. And whatever the precise figure may be, it is important to understand that this magnitude of preemption of technological resources has been maintained for three decades or more.⁶

6. Ramo (1980 p. 80) placed the proportion of scientists and engineers employed on defense projects much higher, at up to 50 percent, although the empirical basis for such estimates is not shown. Weidenbaum (1974 p. 27) and Baldwin (1967 p. 146)

In addition, Dumas (1986 p. 212), citing earlier research (Folk, 1970), suggests that the supply of scientists and engineers is relatively fixed so that the demand for scientific labor for military projects can only be satisfied at the expense of the availability of technologists for civilian projects. Dumas cites "some evidence to indicate that the elasticity of the size of the technological labor force with respect to enlarged job opportunities and higher salaries is rather low." He sees "a shifting among fields of science and engineering" rather than an expansion of the supply to those professions as economic conditions change. The notion that a fixed proportion of the labor force goes into scientific professions seems counter-intuitive. Why wouldn't demand growth lead to higher salaries and draw more people into science and engineering? Empirical studies indicate that the supply of scientists and engineers does adjust to demand with a lag of roughly four years, largely due to the amount of time needed for education (R. Freeman, 1976; McPherson, 1986). In addition, the possibility of greater immigration and the increasing entry of minorities and women into technical professions suggests there is significant scope for growth in the supply of scientists and engineers.

claim a 50 percent figure for the 1960s. DeGrasse (1983 p. 80) suggests the figure fell from 25 to 35 percent in the 1960s to 15 to 25 percent in the 1970s, but "this percentage is likely to rise significantly during the 1980s" as a result of the Carter-Reagan buildup. In fact, the percentage appears to have continued to fall throughout the 1980s.

Accepting Folk's arguments, which were derived from data covering the 1950s and 1960s, to project a constant relative supply of scientific labor is tantamount to accepting the permanency of an almost totally white, male labor force in science and engineering. Expanding the participation of women and minorities would more than double the share of the population as a whole that are potential scientists and engineers, since white men make up less than half of the population. The supply is beginning to expand in this direction. In the 1960s, one percent of engineering college students were female; this share had grown to fifteen percent by 1985 (Ginzberg, 1986 p. 35).

Moreover, the existence of a significant demand from military-oriented research and production is itself a factor drawing more people into science and engineering. If this pool were growing, or at least capable of growth in response to incentives such as higher salaries, then the Pentagon may be taking a share of a growing pool, with less potential damage to the civilian economy. The issue then would be whether the Pentagon's share was constant, growing, or declining.

Available data suggests that the supply of scientists and engineers has been growing substantially. Total employment of engineers, life and physical scientists, mathematicians, and engineering and scientific technicians rose by 340 percent between 1950 and 1985, while U.S. employment in all occupations rose by 90 percent (NRC, 1986 p. 70). Employment

in other scientific occupations would have had to exhibit very low growth rates, or even decline, in order for the constant pool argument to be correct.

Moreover, despite the recent increase in spending for military procurement and R&D, the defense share of scientific and engineering employment has fallen. Data on the proportion of employment in scientific and engineering professions attributable to defense-sponsored projects, derived from surveys conducted by the National Science Foundation and the National Research Council, show that in almost every specialty listed, for scientists and engineers with Bachelor's, Master's, and Doctor's degrees, the proportion employed on defense projects either fell from the 1971-75 period to the 1981-85 period or remained constant (see Table III.1). The numbers also indicate that the defense share of these occupations in the 1980s was, on the average, significantly lower than the 30 percent share suggested by Dumas, and probably, on balance, below 20 percent. Moreover, the totals were undoubtedly pulled upward by the very high concentration of defense work in a few specialties such as aeronautical engineering.

Thus, the argument that a high proportion of scientists and engineers were permanently employed on defense-related projects, and that the relative supply of such skilled people was fixed, seems contradicted by the evidence. The proportion of such people working in the defense sector appears to have

Table III.1. U.S. Scientists and Engineers Employed on DOD Sponsored Projects
(percent of total)

	1972	1973	1974	1975	1981	1982	1983	1984	1985
Scientists, engineers, compu- ter specialists, Bachelor's degrees	20.6%		21.4%			17.0%		17.2%	
Scientists, engineers, compu- ter specialists, Master's degrees	24.8%		26.7%			20.5%		20.6%	
Mathematics, PhD		11.5%		9.4%	10.2%		11.5%		11.8%
Computer science, PhD			18.7%	16.6%	19.1%	18.6%			19.2%
Physics and astronomy, PhD		25.3%		21.5%	19.5%		21.6%		21.9%
Chemistry, PhD		6.2%		5.1%	6.1%		5.3%		5.8%
Earth and environmental science, PhD		13.4%		12.2%	10.2%		12.3%		9.4%
Engineering, PhD		26.2%		23.1%	16.8%		22.0%		19.8%

Note: The data are derived from surveys undertaken by the National Research Council.

Source: National Research Council (1986 pp.74-76).

been declining, despite the substantial rise in defense budgets in the 1980s, while the total supply was rising much more rapidly than the labor force. The availability of scientists and engineers for civilian work may have grown significantly, despite high military budgets.

The quantitative dimensions of the personnel trade-off may not be the only concern. It is frequently assumed that military firms can attract the most productive scientists and engineers since they can pay high salaries and offer challenging work. While this may be correct in certain situations, the opposite can also be true. In the 1980s, some of the most challenging and lucrative scientific activities were in computer science and biotechnology. The revolution in personal computers, and the personal fortunes made by numerous individuals in both hardware and software, coincided with the defense buildup and undoubtedly attracted some of the most talented and aggressive scientists and engineers. Although defense funding played some role in these areas, they were largely civilian activities.

Country Comparisons and Long-term Economic Change

The relative success of the United States' major international competitors, who have carried a smaller defense burden for the past forty years, is often used as support for the argument that defense spending is harmful to the economy. If the case against defense spending is truly compelling, it

should be a critical variable in explaining these long-term changes in the global economy. If other factors explain these outcomes, however, defense may be the wrong target of analysis in seeking the solution to U.S. economic problems.

Statistical studies which rank countries seem to show some connection between economic performance and defense spending. Countries with low defense burdens appear to cluster at the top of productivity, investment and growth measures, while high burden countries rank low (DeGrasse, 1983 Chapter 2). Again, these rankings are not totally convincing. Once Japan is removed from the data, it is less clear that the correlation works for other industrialized countries (Cypher, 1985). The performance of industrialized economies in the middle of the scale, such as West Germany, cannot be easily explained using such data.

In the years after the end of the occupation, the West German economy experienced rapid growth, largely as a result of the capital inflow for reconstruction, tough anti-inflationary policies, currency reform, the presence of a skilled work force, regulated immigration policies and the creation of the Common Market. Starting in the 1960s, however, domestic investment weakened and unemployment rose, leading to lower economic growth and high structural unemployment. For the entire 1960-85 period, West German real Gross Domestic Product (GDP) growth averaged 3.1 percent, slightly lower than the U.S. GDP growth rate. Investment growth rates were also lower than those for the United States

(OECD, 1987 p. 44). This mixed record makes it difficult to argue that differences in the defense burden between the two countries explains their relative economic performance.

Some have pointed to differences in the allocation of research and development spending, and to a civilian-oriented industrial policy, to explain the relative success of both Germany and Japan (Dumas, 1986 pp. 215-16; Melman, 1983 pp. 158, 202-03). In 1983, for example, less than five percent of West German R&D was spent on military projects and the share of Japan's R&D going to the military was less than one-half of one percent, both significantly smaller shares than for the United States (Kaldor, Sharp and Walker, 1986 p 36).⁷ For Germany, the fact that its economic performance was sluggish for a quarter of a century does not point to overwhelming success for either its R&D outlays or its industrial policies, however. Germany's many successes in international markets and the vigorous international expansion of German corporations in such industries as automobiles, electronic products, chemicals, and engineering industries point to

7. These percentages should be treated with some caution. R&D outlays are not measured with the same accuracy as other components of GNP. For the United States, some nominally civilian R&D is actually privately financed military R&D while a significant portion of NASA's outlays are for military purchases. Apparently, similar considerations apply in Japan, where companies routinely fund their own R&D efforts designed to win military contracts and where some nominally civilian programs are primarily designed to produce "dual use" products, as in electronics, optics, and transportation equipment, that can be exported as civilian goods but which end up under military control (Drifte, 1986).

important strengths. These may be more attributable to policies that have emphasized exporting, historical competitive advantages in certain industries and weaknesses in domestic economic growth, than to the possible beneficial effects of a small military R&D effort.

Japan is the more interesting case, since the share of GNP devoted to defense spending and defense R&D is low, while the rate of investment, productivity growth and economic growth has been high for almost forty years. The growth of Japanese civilian R&D is relatively recent, however, and unlikely to be a significant explanation of the rapid burst of economic growth Japan experienced in the 1950s and 1960s. In addition, Japanese R&D is more concentrated in applied, product-specific areas, as opposed to the greater emphasis on basic, more general R&D in the United States. To the extent that civilian R&D efforts help explain more recent Japanese successes, the question remains as to whether this is because R&D in Japan is mostly civilian, or because it tends to be more product specific with clear commercial applications. Only recently has Japan introduced a major effort to improve its capacities in basic R&D.

The Japanese combination of low defense burden and strong economic performance has frequently led to the argument that the two are causally related (Melman, 1983 p. 106; G. Kennedy, 1983, p. 204). Stating that Japan's economic success can be related to the country's low defense burden is equivalent to stating that a higher defense burden would have led to poorer

overall economic performance. However, details and extensive research or argument have been missing from such discussions. Here, as in other discussions of the defense-economic performance link, it is not clear how important higher defense burdens could be in affecting economic performance. How high would the Japanese defense burden have to be to noticeably weaken that country's economy?

One possibility is that a higher defense burden would have come at the expense of investment. High rates of capital formation have been an important contributing factor behind Japan's high growth rates, and a defense-investment trade-off might have reduced growth rates. While no one knows what resource trade-offs would have emerged from higher defense spending, it does appear likely that investment would not have suffered greatly. The implied social contract that existed in Japan led to lower consumption, and higher savings and investment, than was the case in other countries. Even today, Japan's social consumption (education, health, and other government outlays) is far lower as a share of GNP than in other industrial countries. It is quite likely, then, that the bulk of a higher military budget would have been at the expense of consumption, not investment, as seems to have been the case for the United States.

In the case of Japanese R&D, research efforts have been heavily geared toward adapting and extending technology developed elsewhere. The Japanese proclivity to borrow and improve upon -- or at least find new and profitable niches for

-- technology developed elsewhere, is centuries old (Ozawa, 1981). Indeed, Japan's military producers have also been effective borrowers, both from military technology developed outside of Japan and from Japan's civilian technology (Drifte, 1986).

In addition, many of the Japanese advances in production have more to do with organization than with hardware. Such organizational factors as the "just-in-time" inventory system, flexible manufacturing systems, and the almost obsessive attention paid to product quality, are innovations that can be applied without the need for extensive and costly research on new products or production technologies. In Japan, at least until recently, the size of the R&D effort may have been less important than its orientation.

A larger military production system could also have hampered growth efforts by employing large numbers of trained technicians. In Japan, scientists and engineers receive less training in universities, and more on-the-job training, than is the case in the United States. This greater company-specific and product-specific training helps explain the relative lack of job mobility exhibited by Japanese workers. It also means that a larger military sector would have trained its own scientists, taking them from consumer goods industries to the extent larger defense spending cut into consumption, or more likely recruiting directly from the universities. The Japanese university system might well have been able to respond to this need.

More important, a larger military apparatus and its impact on economic growth would need to be evaluated in the context of Japan's social, political, and economic structure in the postwar years, a structure that seems notable for its level of consensus and its ability to weather a variety of storms. The fundamental issue is whether a higher level of military spending would have represented a social consensus, rather than a political victory for a single interest group. If the latter were the case, it would be important whether the interest group represented an attempted return to power of elements that fostered the dominance of Japanese militarism before the war. If a consensus existed, then larger military budgets would most likely have been accommodated, and the institutions that fostered Japan's remarkable growth performance would have essentially remained in place. If such a consensus was absent, then a revival of military spending might then have led to more fundamental conflicts, and the economy could have taken a very different direction.

The paths and rates of economic growth of various countries over the past century may, in fact, be largely independent of defense spending. The relative growth performance of industrial countries since 1870 appears to reflect a "catch-up" phenomenon. Countries with the highest levels of productivity in 1870, such as the United States and the United Kingdom, have experienced the lowest productivity growth rates since then, while countries with low levels of productivity in 1870, like Japan, have exhibited the highest

productivity growth rates in the ensuing century (Baumol, 1986; Maddison, 1987; Baumol, Blackman and Wolf, 1989). The reason for this inverse relation may be a form of massive international technology transfer:

. . . nations progress technologically not only from what they invent but even more from the innovations they acquire from . . . other nations at the forefront of technology. But the laggards have a good deal more to learn from the leaders than the reverse. Thus, the balance of trade in ideas inherently favors the laggards, and this has led to convergence in the 19th and 20th centuries, an era of innovation explosion (Baumol, 1987).

Maddison (1987 p. 669) sees the United States as benefitting, in the late nineteenth and into the twentieth century, "from its comparatively greater advantage in natural resources, its higher levels of education and research. . . . [and] the larger scale of the . . . economy. . . ." During the twentieth century other countries began to close the gap.

In the long run, as U.S. natural resource advantages become less significant, as the mechanisms for technical diffusion are improved, as levels of human and physical capital per head in the other countries come closer to U.S. levels, and the scale of markets is widened by

international trade, there are strong reasons for expecting a convergence of productivity levels. . . .

. . . the follower countries . . . enjoy "opportunities of backwardness," which means that over a considerable range of technology they can emulate the leader and get a given amount of growth with less expenditure on research and development. They can push the rate of capital formation per worker faster without running into diminishing returns, and structural change is rapid.

Convergence may occur because leading countries are also major foreign investors and foreign traders, which spreads their technological base and provides a relatively inexpensive boost to potential followers. Indeed, there are many examples of countries in a position of economic and technological dominance essentially giving away key elements of their technology.⁸ Japanese companies and government agencies continue to seek foreign technology actively, even as they are emphasizing the development of indigenous technology. At the same time, Japanese production techniques are being spread via

8. For example, AT&T sold licensing rights to the transistor to Sony for \$25,000. The failure of AT&T and most U.S. electronics companies to see widespread civilian applications for the transistor may be due to the success, and profitability, of products based on vacuum tubes. Japanese companies had no such success, were searching for new technologies to exploit, and were oriented more toward miniaturization due to space constraints brought on by the high cost of land in Japan.

foreign investment by Japanese firms and as American and European corporations consciously seek to apply these techniques to remain competitive.

Growth of military spending might be a concomitant to foreign investment and foreign trade. Countries that have a major foreign presence may develop an extensive military apparatus to protect their overseas interests. The research question, then, is whether relative decline is the result of military burdens draining a country's economy, or of foreign trade and investment spreading the basis of a country's economic strength. Data collected by Maddison suggests that the United States has been experiencing convergence, at least in terms of productivity levels, for more than a century, and that this convergence began when the U.S. military burden was small. During that period, the military burden in the United States has varied from under one percent of GNP to substantially more than ten percent (excluding the two World Wars), yet convergence appears to have occurred throughout (Edelstein, 1990).

Baumol (1986 p. 1073) also notes that the data for the United States exhibits "no sign of any long-term slowdown in growth of . . . productivity," and that "except in wartime, for the better part of a century, U.S. productivity growth rates have been low relative to those of Germany, Japan, and a number of other countries. . . ." Baumol's statements are consistent with a view emerging among a number of economic historians that the period since 1965 in the world economy is

close to the historical norm, and that the period from the end of World War II to the mid-1960s is more of an exception (Wolff, 1987b). In a similar vein, Paul Kennedy (1987 p. 533) sees the large share of world output possessed by the United States in the two decades after World War II being due to "historical and technical circumstances favorable to [the United States] . . . and what we are witnessing . . . is the . . . ebbing away from that extraordinarily high figure to a more 'natural' share."

Such arguments imply that much of the recent thinking about the decline in the position of the United States relative to other countries, and the U.S. productivity slowdown, may be misplaced, putting too much emphasis on internal factors. The United States dominated the early post-war period in part because of the strength of its economy and the relative weakness of others, but also because it was able to establish an international monetary and trading system, based upon the International Monetary Fund and the General Agreement on Tariffs and Trade, most suitable to its own needs. As other nations gained in economic strength, it is not surprising that the international economic system underwent substantial reorganization, and the U.S. position was no longer so dominant (Block, 1977).

Baumol points out that understanding the catch-up process as something normal does not mean countries and governments should be complacent. Policies to improve productivity growth in the United States remain desirable, since higher

productivity growth rates are a determinant of higher standards of living. The factors leading to both productivity growth and overall economic growth need to be better understood, including the impact of military spending and military R&D. On the basis of available evidence, however, it does not appear that differences across countries in the size of their defense sectors is a major factor behind observed differences in economic growth rates, or in productivity growth rates.

Conclusion

Is defense the achilles heel of the U.S. economy? Macro-level and micro-level evidence do not show convincingly that U.S. problems with investment, growth, productivity or competitiveness can be laid at the feet of defense spending, defense purchases or defense research and development. There seems to be some statistical evidence of a tradeoff between defense spending, investment and growth, but the statistical relationship for the United States is contradicted by other evidence. Moreover, there is no persuasive description of the mechanism by which defense spending would hinder these broader economic processes. If one contrasts U.S. economic performance with that of other nations, explanations other than the level of defense spending are more persuasive with respect to the economic success of such countries as Japan. Moreover, over the long term, Japan, and other competitors may

be doing nothing more than catching up with the United States, as might have been expected.

When one looks at the "wiring" that connects defense contracting and defense R&D to U.S. manufacturing, it cannot be said that defense is depleting the manufacturing economy. The share of U.S. R&D resources and personnel absorbed by defense needs is relatively high, which could have some long-term effect, but it has also declined significantly over the past thirty years, while the pool of public and private R&D resources has grown. Non-defense related practices may have more to do with U.S. industry's problems with productivity and competitiveness.

Linking defense spending and economic performance has frequently been a way of arguing that a solution to America's economic difficulties can be found by cutting the defense budget and freeing resources for civilian uses. Shifting resources from defense spending to investment may well be a desirable outcome, irrespective of whether defense spending has come at the expense of investment or consumption. It needs to be recognized, however, that current economic difficulties are far wider and deeper than the slender thread of defense spending can explain. They are likely to be more closely related to long term U.S. fiscal and monetary policies, changes in international production, deeply rooted management weaknesses in the U.S. private sector, and the absence of coordinated thinking between the public and private sector, among other sources.

More broadly, there remains a question about how to allocate increasingly scarce federal resources in order to address U.S. economic problems. Whatever the impact of defense spending on the economy, this issue remains important: what is the proper role of the federal government in addressing economic problems, whether it be through the relatively passive tools of fiscal and monetary policy, or more actively through its interactions with the private sector in such areas as research and development spending, industrial and labor policies. These choices must be resolved in the policy arena. They may require restraining defense R&D or defense budgets, not only in the service of deficit reduction, but because a different use has been defined for federal resources, one which directly addresses problems of inadequate investment, low productivity, slow growth or the lack of competitiveness. Changing the level of defense spending will not, in itself, address these problems.

In sum, the economic indictment of defense spending goes too far. If defense spending is, at its economic worst, only a marginal contributor to our economic ills, describing it as a prime culprit diverts attention from other, more fundamental economic policy choices which might address those problems directly.

Chapter IV

Military Spending and Investment in the United States¹

A series of econometric investigations appear to have established the existence of a trade-off between investment spending and military spending in the United States and throughout the member countries of the OECD. A model developed by Smith (1977, 1980) has been tested on pooled samples of OECD countries (Smith, 1980) with the conclusion that military spending completely crowds out investment, *cet. par.*, that is, the long-run coefficient of military spending on investment in a multiple regression equation is -1. The model has also been tested on individual developed countries (Smith, 1980; Martin, Smith and Fontanel, 1987) and on pooled samples of developing countries (Deger, 1986) and these results, with some exceptions, support the presence of a substantial trade-off between military spending and investment. A test on United States data based on Smith's approach (Rasler and Thompson, 1988) and a test on various pooled OECD samples using a different model (Cappelen, Gleditsch and Bjerkholt, 1984) support the presence of a unitary trade-off. One observer, summarizing the available evidence, concluded that "there seems to be a broad consensus

1. This chapter was originally published in Jurgen Brauer and Manas Chatterji, eds., **Economic Issues of Disarmament**, New York: New York University Press, 1993. See Gold (1993). It is reprinted with permission of the publisher.

that investment and [military spending] are substitutes in developed countries" (Lindgren, 1984 p. 376).²

The purpose of this chapter is to suggest that reports of a trade-off between military spending and investment, at least with respect to the United States, are decidedly premature. The first section evaluates the results obtained by Smith and others. Alternative empirical estimates for the United States, based on Smith's approach, are presented in the second section, and they cast doubt upon the existence of an important military-investment trade-off. The issue of how the economy adjusts to military spending is discussed in the third section. The chapter concludes by discussing some of the implications of the analysis.

The Smith Model

There is a substantial body of research which concludes that military spending occurs largely at the expense of spending on new capital formation. The most prominent example of this conclusion comes from the work of Ronald Smith and his collaborators (Smith, 1977, 1978, 1980; R. Smith and D. Smith, 1980; Deger, 1986; and Martin, Smith and Fontanel, 1987).

Smith derived his estimating equation from a national income identity where consumption is defined to include private sector consumption plus consumption undertaken by the

2. Similar conclusions can be found in Kennedy (1983 p. 198) and Chan (1985 pp. 413-414).

government sector, and investment is private investment plus civilian investment undertaken by government. Military spending is the only item of government spending not accounted for by consumption or investment. After rearranging and dividing by gross output, Smith has the investment share of output determined by the savings share and the military share. He hypothesizes that the savings share is determined by the growth rate of real GNP, to capture departures from permanent income, and by the aggregate unemployment rate, to reflect cyclical factors. His basic equation is

$$\text{IV.1) } I = f(M, \text{ gr}, U)$$

where I is real gross investment and M is real military spending, both expressed as a share of real gross output, gr is the growth rate of real gross output, and U is the unemployment rate. Smith tested this equation on pooled samples of data from OECD countries, using both single equation and three-equation models. He consistently obtained results indicating that the partial regression coefficient of M is equal to, or approximates, a value of -1 , suggesting that military spending completely crowds out investment, *cet. par.*

In one study, using a combined cross section and time series sample of fourteen OECD countries for 1954-73 (280 observations), Smith (1980) calculated the long run impact of military spending on investment as $b_6 = b_2 / (1 - b_1)$, from the following equation:

$$\text{IV.2)} \quad I = a + b_1 I_{t-1} + b_2 M + b_3 \text{gr} + b_4 U + b_5 X + u$$

where I , M , gr , U and u are defined as above, X is the combination of the current account surplus and the gap between actual and potential GNP, and real potential GNP is the denominator for the I , M and X variables. In a weighted average of fourteen individual country regression equations, with the weights derived as inverse values of the variances of the individual coefficients, b_6 was calculated to be -0.917 , within one standard error of -1 , implying a dollar-for-dollar trade-off between the military spending and investment shares of gross output, when the other determinants of investment are constant. A one-for-one trade-off between defense and investment is an important result, as it implies a substantial potential cost in terms of foregone physical capital formation that could result from a military buildup, as well as a substantial benefit to capital formation when military spending declines.

In explaining the trade-off coefficient, Smith sees the sum of private and public consumption, as a proportion of total product, as constant in the long term. Thus, an increase in military spending as a share of gross output can only come at the expense of investment. Smith never tests for the constancy of the total consumption share, which he calls the social wage. Instead, he puts it forward as an explanation for his finding that defense completely crowds out

investment. In a later study (Smith, 1980), he treats it as a basic hypothesis underpinning the model.

Cappelen, Gleditsch, and Bjerkholt (1984) also find a complete trade-off in pooled samples from OECD countries, and treat their results as a confirmation of Smith's. Cappelen, Gleditsch and Bjerkholt hypothesize that investment is determined by an accelerator mechanism with military spending and civilian government spending included in both structural and reduced form equations on the grounds that they crowd out investment through the government budget. The estimated coefficients for military spending on investment indicate a statistically significant trade-off of -1, leading to the claim that military spending completely crowds out investment. However, none of the reported coefficients on nonmilitary government spending are statistically significant. If the crowding out of investment operates through the government budget, as hypothesized in the model, both military and nonmilitary spending should be significant and negative when explaining investment. Cappelen, Gleditsch, and Bjerkholt (1984 p. 370) offer the explanation, "that the 'crowding-out' effect is not due to factors affecting the financial markets ... but due to effects via the labor market (different kinds of labor used) or other resource movement effects."

Thus, while the two models appear to reinforce each other, they end up offering different explanations for the trade-off. Smith emphasized trade-offs operating through spending flows and explicitly rejecting resource market trade-

offs (Smith, 1977 p. 70; Smith, 1980 pp. 20-1), while Cappelen, Gleditsch, and Bjerkholt initially hypothesize a budget-induced trade-off and end up proposing one operating through resource markets.

Smith's basic hypothesis is that total consumption, defined as private plus government consumption, is constant as a share of total output. Including all OECD countries in a single sample amounts to assuming that the underlying economic and political structures in these countries are similar to each other, in that they yield a total consumption share that is constant for the sample as a whole.³ Smith emphasizes the importance of policy responses as a mechanism for equilibrating savings and investment. He suggests that policy reaction functions, which include targets for unemployment and the current account, explain how a discrepancy between the supply of savings and the demand for its use are resolved. Important cross national differences make it difficult to see how such a model can be applied to the United States, where policy has clearly not been used in this manner.

Results from other studies indicate that there can be differences in the impact of military spending across countries, even countries that might be considered roughly similar in their institutional structures and their stage of

3. Smith is quite careful in explaining his model and his empirical approach, and many of the points raised in this discussion are raised by Smith. See, especially, Smith (1980).

development. For example, Aben and Smith (1987) and Dunne and Smith (1990) found differences in how changes in military spending affect employment and skills, while Starr, Hoole, Hart, and Freeman (1984), found cross-national differences in the impact of military spending on inflation. Country specific time series results obtained using Smith's model also indicate substantial differences across countries in the trade-off between investment and military spending, ranging from high negative coefficients to high positive ones (Smith, 1980; Martin, Smith, and Fontanel, 1987).

The issue is partly one of assessing whether an individual country, such as the United States, is part of the universe from which a sample can be drawn. Perhaps of even greater importance, however, is evaluating the applicability of the results from a pooled sample for individual members of the sample, given that policy responses can only be formulated for each country separately, and not for the sample as a whole.

The Military-Investment Trade-off in the United States

As part of his cross-national study, Smith (1980) estimated an equation for the United States for 1954-73. The short-run trade-off coefficient between military spending and total investment was $-.38$, and the long-run coefficient $-.44$. Smith felt his single-country results would be dominated by country-specific patterns of adjustment, both political and

economic, and would not be very revealing about the long-run processes at work.

A second attempt to apply Smith's model to the United States, by Rasler and Thompson (1988), tested an equation where the annual change in the investment to GNP ratio is explained by the annual change in the military to GNP ratio and the annual percentage change in GDP per capita. For the United States, 1946-1978, the coefficient of military spending was $-.835$, significant at the 5% level, and, taking into account the boundaries of the confidence interval, close to -1 .

However, the coefficient of $-.835$ was obtained by removing two sets of observations that are deemed to be outliers, defined as "regression residual values that are at least three standard deviations from the mean" (p. 76). Removing such outliers without providing an explanation in terms of the underlying structure of the process being investigated does not appear to be appropriate (Edelstein, 1990, p. 423). When the outliers were left in the sample, the trade-off coefficient was $-.331$ and significant at the 5% level, while the coefficient of the economic growth variable, which should be positive, was negative and insignificant. In addition, the percentage of the variance explained by the independent variables dropped from $.79$ to $.29$.

Recent work by Edelstein (1990), building on earlier work of Boulding (1973), casts doubt on the existence of a trade-off between military spending and investment in the United

States. Using national income data from 1890 to 1979, Edelstein divided his sample into business cycle episodes and calculated averages over each cycle for GNP and its components. He found that when the military share of GNP rose substantially across the "great divide" delineated by the Great Depression and World War II, the investment share rose slightly and did not fall as would be expected if a trade-off were operative. Similarly, from 1946 through 1979 substantial movements in the military share were accompanied by a constancy in the investment share. The fluctuations in the investment share which are observed in annual data tend to disappear when cycle averages are used; the investment share is essentially constant over long periods of time. With minor exceptions, changes that occur in the investment share across cycles have generally been substantially smaller than cross-cycle changes in military spending. And these patterns hold for both private investment and total investment, which includes federal and state and local government civilian investment.

For example, from the 1954-57 business cycle to the 1974-79 cycle, the military share of GNP declined from more than 10.06% to 4.97%. Instead of rising, however, the investment share stayed essentially constant, at 15.97% of GNP in the earlier period and 16.09% in the latter time period. Military spending fluctuated substantially in the intervening years, falling after the end of the Korean War, rising sharply during the Vietnam War, and then falling again through the middle of

the 1970s; yet the investment share, when measured as an average over each business cycle, stayed constant.

The negative partial regression coefficients obtained by Smith and others imply that a rise in the military share of GNP will be accompanied by a fall in the investment share if the impact of other explanatory variables is held constant. The negative coefficients also imply that a fall in the military share will be accompanied by a rise in the investment share, *cet. par.* It is possible that the trade-off between military spending and investment was operative during the period from the mid-1950s to the mid-to-late-1970s, but that the influence of other determinants of investment offset the trade-off and prevented the investment share from rising.

Edelstein (1990, pp. 434-435) suggests a possible reconciliation between his long-run data, showing no trade-off, and Smith's calculation of a trade-off using annual data. Increases in military spending that occur when the economy is close to capacity may lead to some crowding out of investment to the extent there are accompanying changes in government borrowing. Through the end of the 1970s, however, government budgets were, on average, close to being in balance, suggesting that any crowding out was offset by a later crowding in, leaving the investment ratio fluctuating around a constant long-term trend and leaving the consumption ratio as the repository of long-term changes in military spending. Edelstein (1990, pp. 426-433) concludes that the primary trade-off has been between military spending and consumption,

both public and private, and not between military spending and investment.

To further examine the trade-off issue, Smith's equation was estimated for the period 1948-1988.⁴ Total gross investment, public plus private, and gross private domestic investment, as shares of potential GNP, were used as dependent variables. In addition, on the assumption that inventory investment would be less likely to fit a model of savings-constrained investment determination, private fixed investment and private plus government fixed investment were also tested. Equations using quarterly data were tested using private investment only, since government investment data is not available on a quarterly basis. These results, which are not reported here, are similar to the results for annual data.

The trade-off coefficients for the 1949-88 period are negative, smaller in absolute value than those reported by Smith, and statistically significant (see Table IV.1).⁵

4. The equation is $I = a + b_1M + b_2gr + b_3U + u$, where I is a measure of real gross investment as a share of real potential GNP, M is real military spending as a share of real potential GNP, gr is the annual percentage change in real GNP, U is the aggregate unemployment rate, and u is a random error term. Equations with a lagged investment term, similar to the equations tested by Smith and discussed above, were also estimated, but the lagged investment term was not statistically significant. Thus, following Smith's framework, the coefficient of the military spending variable is a measure of the partial long-run trade-off between military spending and investment.

5. The data covers 1947-1988. The equations used 1949-1988 to allow for the growth rate of GNP and because one observation is utilized in the Cochrane-Orcutt procedure to correct for auto-correlation in the residuals.

Table IV.1

Trade-off Coefficients Between Military
Spending and Investment
(annual data; t-statistics in parenthesis)

Dependent Variable	1949-88	1949-71	1972-88
TI	-.26 (6.33*)	-.25 (3.64*)	-.42 (1.02)
PI	-.35 (6.94*)	-.23 (4.73*)	-.52 (0.91)
FI	-.32 (6.29*)	-.26 (4.76*)	-.10 (0.57)
TFI	-.20 (4.88*)	-.21 (2.87*)	-.08 (0.34)

Notes: The trade-off coefficients are the partial regression coefficients of military spending in the following equation: $I = a + b_1M + b_2gr + b_3U + u$, where I is real gross investment as a share of real potential GNP, M is real military spending as a share of real potential GNP, gr is the annual percentage change in real GNP, and U is the aggregate unemployment rate. The equations were estimated using the Cochrane-Orcutt procedure to correct for the presence of auto-correlation in the residuals.

TI is defined as gross private domestic investment plus gross civilian investment by federal, state and local government, in 1982 dollars.

PI is gross private domestic investment, in 1982 dollars.

FI is private fixed investment, in 1982 dollars.

TFI is private fixed investment plus civilian government investment, in 1982 dollars.

T-statistics in parentheses.

* - significant at the 1% level

Sources: BEA (1985), BEA (1986), BEA (various), Gordon (1990); data on government civilian investment after 1982 from computer printout supplied by BEA.

Examination of various subperiods, however, suggested that the trade-off was not constant over the entire postwar period. In fact, there appears to be a shift in the relationship after 1971. The trade-off coefficients for 1949-71 are similar to those estimated for the period as a whole, while the measured trade-off is statistically equivalent to zero for the period starting in 1972.⁶

Why should the relation between military spending and investment be different in the years up to 1971 than in the years after? Several explanations can be suggested. In the earlier period, through 1971, the economy was operating at higher rates of utilization and increases in military spending would more quickly face aggregate capacity limitations and force relative reductions in other expenditure components of GNP. Similarly, a decline in military spending would more

6. In commenting on an earlier version of this chapter, Robert Eisner suggested that the coefficient of the military spending variable might not capture the trade-off between military spending and investment, since it could not be ascertained what portion of the measured trade-off was due to changes in the numerators of the two spending variables, and what portion was due to changes in the denominator. He recommended using levels of the spending variables, rather than ratios. Subsequent tests using levels, first differences and percentage changes in military spending and investment did indicate some differences in the trade-off coefficients, but the fundamental results were the same: a statistically significant negative trade-off in the period from 1949 to 1971, and a trade-off that was not statistically distinguishable from zero in the period from 1972 to 1988, a shift that was supported by the Chow test for the equality of coefficients in the regression equations for the two subperiods.

likely be reflected in a rise in other expenditure items the closer the economy was to operating at capacity.

One measure of the economy's relation to capacity is the gap between actual and potential GNP, as a percent of potential GNP.⁷ The annual average of the gap ratio was positive (1.07% of potential GNP) during 1947-71, suggesting an economy operating one percentage point above its potential (see Table IV.2). The average of the gap ratio was negative (-1.88%) during 1972-88 and almost three percentage points lower than in the earlier period. Moreover, during the later period, military spending fluctuated within a narrow range, between 5.0 and 6.9 percent of potential GNP, compared to a range of 6.2 to 18.3 percent of potential GNP in the earlier period. During the later period, the range of fluctuation of military spending was approximately equal to the average gap between potential and actual GNP, illustrating the reduced potential for trade-offs in the later period. Also, the fluctuations in military spending in the later period were smoother and occurred over longer periods of time than in the earlier period, giving the economy more time to adjust.

7. This measure of potential GNP (Gordon, 1990) is based on the unemployment rate that is consistent with a zero rate of change of inflation. An alternative definition of potential GNP, for instance, using business cycle peaks as the reference point as suggested by Walker and Vatter (1989), would yield different measures of the gap but would similarly lead to the post-1971 years being further from potential than the years through 1971.

Table IV.2

Major Spending Items as Percent of Potential GNP

Category	1947-71	1972-88	Change
M	10.97	5.77	-5.20
GI	3.52	2.32	-1.20
GC	9.69	11.68	+1.99
C	60.20	62.44	+2.24
I	16.67	16.79	+0.12
NX	0.02	-0.88	-0.90
Total	101.07	98.12	-2.95
Y_{pot}	100.00	100.00	0
GAP	-1.07	+1.88	2.95

Note: The variables are military spending (M), civilian government investment (GI), government consumption (GC), private consumption (C), gross private investment (I), net exports (I), potential GNP (Y_{pot}), and the gap between actual and potential GNP (GAP). All variables in 1982 dollars and expressed as percentages of potential GNP, also in 1982 dollars.

Sources: See Table IV.1.

An economy operating close to its potential may explain why increases in military spending generate trade-offs with other components of GNP, but it doesn't explain why a substantial trade-off should exist with investment. Indeed, in the 1947-71 period, the military share of potential GNP was negatively related, as measured by simple correlation coefficients, to all the other major components of GNP, with the exception of civilian government investment. The existence of a trade-off between military spending and investment may be part of a general phenomena whereby changes in military spending lead to trade-offs with all or most components of non-military spending, with investment not being especially singled out in this process.

The 1947-71 period also contains two wartime episodes. In both cases, the buildups occurred during the expansion phase of the business cycle and helped push the economy even higher. If the two wartime episodes are removed from the sample, the average gap ratio for the period through 1971 is no longer positive and is slightly less than zero. These episodes would have to be examined more closely, but it is possible that they provide the major examples of a defense-investment trade-off for the entire post-war period.⁸

8. Edelstein (1990, pp. 434-435) makes a similar point, in hypothesizing that a short-term trade-off between military spending and investment might be observed out of the interaction of changes in military spending, government borrowing and investment. In the United States during the period from 1946-1979, increases and decreases in government borrowing tended to balance out, leading to an absence of a long term trade-off between investment and military spending.

The higher rate of utilization in the earlier period, which established a framework within which a trade-off could operate, may itself have been a consequence of the demand stimulus from the military budget. When military spending as a share of potential GNP declined after the Vietnam peak, the demand stimulus was not fully replaced, and one result was an economy operating, on average, below its potential.

The decline in the military share of potential GNP was accompanied by a decline in the civilian government investment share, and only partially offset by growth in the shares devoted to private and government consumption. The average private investment share was essentially constant across the two periods. The difficulty in replacing the military demand stimulus may be traceable to the stagflation of the 1970s and the trade deficit of the 1980s, and the unwillingness on the part of policy makers to generate greater stimulation.

The years after 1971 are also characterized by a change in the international financial regime and substantial growth in the role of foreign trade in the U. S. economy. This raises a second possibility for explaining the lack of an empirical trade-off between military spending and investment in the 1972-88 period. The impact of changes in military spending, rather than affecting investment, could have been diverted to affect net exports.

The mechanism is a familiar one. Changes in military spending affect the federal budget surplus (or deficit) which in turn impacts upon real interest rates. Changes in interest rates could directly affect investment, with higher interest rates reducing investment demand and lower interest rates stimulating investment. Alternatively, as the economy becomes more open, changes in interest rates could be seen as affecting the international value of the dollar, the trade balance and the inflow of foreign savings which then, by altering the supply of savings to the domestic economy, affects investment. Thus, an increase in military spending could either directly crowd out investment via budget deficits and high interest rates, or it could attract larger inflows of foreign capital to augment domestic savings and continue to finance investment.

A conclusion that the trade-off between military spending and investment has been deflected to become a trade-off between military spending and net exports needs to be examined more closely. The chain of connections involved in this trade-off are long and complex, and not all of the links are equally strong. For example, cross-national capital movements may not simply be a reflection of changes in trade balances, but may have a relatively independent existence. Evidence on a causal link from budget deficits to interest rates has not been conclusive (CBO, 1987 pp. 97-102; Evans, 1985). Because of the way it is usually measured, the potential impact of the budget deficit on interest rates and the value of the dollar

may have been overstated (Eisner, 1986). The rise in the dollar in the early 1980s probably owes as much to the Federal Reserve's fight against double digit inflation as it does to the growth of federal budget deficits (Epstein, 1985). Indeed, the dollar began its substantial decline in 1985 while the budget deficit, as conventionally measured, was still growing, as a share of potential output. In addition, the fall in the dollar since early in 1985 -- to well below its 1980 level versus the yen, for example -- has not brought either the trade balance or the inflow of foreign capital back to pre-1980 levels.

As for military spending's contribution to the deficit, the military share of potential GNP declined over the first half of the period, even as budget deficits began to grow, while the military's contribution to Reagan-era deficits was matched, and probably surpassed, by the contribution of the tax reduction program (CBO, 1985 pp 154-5). To the extent military spending contributed to the trade deficit via the budget deficit, the contribution may be confined to the period from 1982 to 1986, when the high employment budget deficit went from one per cent to over four per cent of potential GNP.

The Economy Adjusts to Military Spending

After reporting the existence of "a resource trade-off between the shares of output devoted to military expenditure and investment between nations in the advanced capitalist

world," Smith (1977 p. 73) then states: "But the result cannot be given a great deal of weight unless some theoretical mechanism is specified which would produce such a trade-off." As discussed above, Smith and Cappelen, Gleditsch and Bjerkholt, while both finding a trade-off coefficient of unity, propose different mechanisms for obtaining a trade-off. In this section, possible mechanisms for explaining a military-investment trade-off are examined.⁹

Smith explains the trade-off as the result of a political-economic system wherein total consumption as a share of potential GNP is constant and the supply of savings is then divided between investment and the military. In the United States, the sum of private and government consumption, expressed as a share of potential GNP, has not been constant over the post war period. Even ignoring short-term fluctuations, total consumption appears to have declined substantially at the time of the Korean War buildup, taken a jump in the mid-1960s, and possibly another move upward in the mid-1980s. Broad movements in the military share of potential GNP appear to be more closely related to movements in total consumption than they are to shifts in the investment share.¹⁰

9. For a discussion of how the economy might adjust to changes in military spending, see Gold (1990) and Chapter III, above.

10. The simple correlation coefficient between the military share of potential GNP and the total consumption share for 1947-88 is $-.74$; the simple correlation coefficient between

Within government budgets, research on the "guns-butter" trade-off has not turned up evidence that such a trade-off exists, on a consistent basis. Russett (1982), Domke, Eichenberg, and Kelleher (1983) and Mintz (1989), all found no trade-off between military spending and various measures of social spending in the years before the Reagan Administration. They did find evidence of trade-offs during the Reagan years, and concluded that the experience of the Reagan Administration represents an exception to the more general pattern. It is possible that the use of budget data, which includes transfer payments, would give different estimates of trade-offs than measures of government consumption obtained using national income definitions.

Smith suggests that civilian government investment is used as an element of stabilization policy, and could be seen as a response to a savings-investment imbalance brought on by a change in military outlays. Thus, one response to an increase in military outlays could be a decline in civilian government investment outlays. This scenario seems more applicable to budgetary conditions in Europe, where the centralization of budgets and the prevalence of parliamentary systems leads to faster budgetary adjustments than is the case in the United States.

the military share and the share of potential GNP devoted to civilian fixed investment, public plus private, is +.20. On this issue, see also Edelstein (1990 pp. 426-433) and Mosely (1985 pp. 70-71).

Data on civilian government investment in the United States does not, at least on the surface, suggest a negative link with military outlays. Civilian government investment as a share of potential GNP grew throughout the 1950s; it grew both during the Korean buildup and during the subsequent build-down. When civilian government investment began to decline, at the peak of the Vietnam buildup, military spending also declined, and the two components of government outlays declined together until the beginning of the Carter-Reagan buildup. Only during the Carter-Reagan buildup does there appear to be a trade-off between the two with the military share of potential GNP rising while the civilian government investment share continued to decline. Even here, the share of potential GNP devoted to civilian government investment turned up before the peak of the buildup.

DuBoff (1989) emphasized the importance of a trade-off between military spending and civilian government investment during the Carter-Reagan buildup. He also argued that Vietnam War-induced inflation and high interest rates squeezed state and local government budgets into the 1970s and helped cause the decline in civilian government investment, thereby suggesting that the military outlays during the Vietnam years had a long causal reach. This latter argument may place too much weight on the impact of the Vietnam War. Dollar devaluation, rising oil prices in a period of high oil dependency and macroeconomic policy errors all contributed to inflation and high interest rates in the 1970s. While

economic weaknesses stemming from Vietnam may have contributed to the importance of these factors, they also have independent origins.

The end of the postwar rise in civilian government investment outlays, and the beginning of a decline that lasted more than a decade, can be traced to two main components, highways and educational construction (BEA, 1985). Movements in spending on civilian government investment appear to follow long-term patterns, as for example with the interstate highway system, and not be heavily influenced by the type of adjustments required for stabilization purposes. (When Smith's equation is estimated using government civilian investment as the dependent variable, the results are dominated by the lagged dependent variable, with no statistically significant trade-off with military spending, for the period as a whole and for both subperiods.)

A third transmission mechanism, or series of mechanisms, would involve changes in military spending affecting the main determinants of investment. Evidence on the impact of defense spending on markets for investment resources indicates the presence of short-term trade-offs, but not necessarily trade-offs that persist over time. Smith (1977), drawing on United Kingdom experience, argued that while military buildups would attract investment resources from civilian sectors, and presumably bid up their prices, resource supplies were sufficiently elastic to permit civilian industries to regroup

over time.¹¹ During the Carter-Reagan buildup, bottlenecks were not a problem due to a slowly growing economy (CBO, 1983; Henry and Oliver, 1987).¹²

The various mechanisms that could explain a defense-investment trade-off deserve additional investigation. In particular, a disaggregated analysis would seem called for, as specific markets are likely to be affected by components of defense spending, and not necessarily by defense demands as a whole. At present, these mechanisms have not been established either theoretically or empirically, and Smith's requirement has not been met.

Concluding Comments

The econometric results that establish the existence of a trade-off between military spending and investment for the OECD countries do not appear to be applicable to the United States. To the extent a trade-off exists, it appears to be confined to the period through 1971, and perhaps even more

11. For a contrary view, see Rothschild (1973).

12. Similarly, increases in the military's demand for scientists and engineers may have led to wage increases in some periods (Mowery and Rosenberg, 1989, p. 159), but these increases appear to be part of a cyclical process, as supply adjusts over time to higher levels of demand (R. Freeman, 1976; McPherson, 1986). Since the 1950s, economy-wide employment of scientists and engineers has grown at a faster rate than the labor force as a whole, and the defense share of this employment has declined substantially (Gold, 1990 pp. 32-35).

narrowly confined to the two wartime episodes. Instead, changes in military spending may be more closely related to changes in consumption and to the gap between potential and actual output than they are to changes in investment.

This should not be interpreted to mean, however, that the levels of military spending experienced since the end of World War II have not imposed costs upon the economy. A shift from private consumption to collective consumption through the military budget can be evidence of a reduction in living standards, to the extent military outlays are excessive for national security purposes and to the degree they are determined by a political process dominated by a military-political-industrial "complex" (Adams, 1982a). In addition, a number of items commonly included in private and government consumption, such as education, health, and civilian research and development, are important contributors to human capital formation and to the productivity of physical capital.

Since the peak of Korean War spending in 1953, military spending as a share of potential GNP has declined in 25 of the following 37 years. The buildup for Vietnam was short, and followed by an equivalent build-down; the Carter-Reagan buildup was longer but smaller than the one for Vietnam, and is being succeeded by a new build-down. If the trade-offs measured in the econometric literature discussed above were to hold, the declining trend in military spending observed since the 1950s would provide an element in the economy fostering greater levels of physical capital formation. Instead, broad data

patterns suggest this long term "peace dividend" has been used in part to stimulate consumption, and in part has been dissipated in lower levels of economic performance. Given the record, there is no reason to expect that the peace dividend of the 1990s will be any more likely to stimulate investment in physical capital than has been the case in the past.

Chapter V
The Trade-off Between Military Spending and Investment
in the United States

Introduction

It has often been argued that military spending imposes an opportunity cost upon an economy in the form of lower levels of physical capital formation, reduced outlays on research and development and inefficient management practices among firms selling to the military. The arguments regarding physical capital formation have in part been based upon a *priori* reasoning regarding the nature of military production and the processes by which the military production sector obtains its resources (Melman, 1983; Dumas, 1984). In addition, a substantial body of econometric work has identified and measured a trade-off between military spending and investment in a number of developed and developing countries taken together, and in individual countries, including the United States, when analyzed separately (Smith, 1977, 1978, 1980; R. Smith and D. Smith, 1980; Cappelen, Gleditsch and Bjerkholt, 1984; Deger, 1986; Martin, Smith and Fontanel, 1987; Rasler and Thompson, 1988; Mintz and Huang, 1990; Oden, 1992; for evaluations, see Lindgren, 1984; Chan, 1985; Gold, 1990).

On the other hand, additional empirical research for the United States has found little evidence of a military spending-investment trade-off in data covering long periods of time (Boulding, 1973; Edelstein, 1990). Earlier (Chapter IV), while I found a trade-off in data covering the postwar years taken as a whole, the trade-off appeared concentrated in the years of wartime activity (Korea and Vietnam), suggesting that it might result from an overheated economy rather than from the nature of military spending *per se*.

Much of the empirical work utilizes an estimating equation derived by Smith (1977, 1980) and applied to a pooled time series-cross section sample of OECD countries.¹ The equation is essentially a reduced form derived from a model where investment, defined to include both gross private investment and governmental non-military investment, is assumed to be constrained by the availability of domestic savings, determined by economic growth and the unemployment rate, and by the resources devoted to the military. The basic estimating equation is:

$$V.1) (I/Y)_t = a + b_1(M/Y)_t + b_2GR_t + b_3U_t + \epsilon_t$$

1. Smith explains the derivation of the model in Smith (1980). His single equation was also estimated in the context of three and four equation models (R. Smith and D. Smith, 1980; Deger, 1986) with little variation in the coefficient for the military spending-investment trade-off. For discussions of Smith's model, see Chapter III, above, and Oden (1992, Chapter III).

where (I/Y) is total real investment as a share of real output, (M/Y) is real military spending as a share of real output, GR is the annual percentage growth rate in real output, derived as the first difference of the natural logarithm of real output, U is the civilian unemployment rate, and ϵ is a random error term. For pooled samples, Smith estimated the trade-off coefficient at approximately -1 (Smith 1977, 1980), which can be interpreted as a *ceterus paribus* increase in the ratio of military spending to output resulting in an equal decrease in the ratio of investment to output. For the United States taken alone, Smith (1980) estimated a trade-off coefficient of between $-.38$ and $-.44$ for 1954-73, while Oden (1992) for 1951-87 obtained a trade-off coefficient of approximately $-.25$, similar to the result I obtained for 1949-88 (Chapter IV). While indicating a smaller trade-off than Smith's pooled unitary estimate and his estimate for the United States alone, these results still suggest a substantial resource cost in terms of lost physical capital formation from military outlays.

In this chapter, I present additional evidence on the relation between military spending and investment spending in the United States since World War II. In the first part of the chapter, I present estimates of Smith's model for the United States for the period 1949-88, including some modifications and extensions of the model; in the second part, I examine time series properties of the data and present re-estimations of the trade-off; and in the third part, I present

evidence on an alternative hypothesis, that military spending trades off with consumption, not investment.

Estimates of the Trade-off

Table V.1 presents estimates of equation V.1 using annual data for 1949-88, and for two subperiods, 1949-71 and 1972-88.² In initially examining the data, there appeared to be a shift in the time patterns in the early 1970s; 1972 was selected to delineate a possible shift because it appeared to signal the end of the decline in military spending accompanying the draw down in the United States military presence in Vietnam (Chapter IV).

The equation for 1949-1988 yields a trade-off coefficient of approximately $-.26$.³ Estimates for the subperiods

2. The equations were estimated using Micro TSP, version 7.0 (1990), on an AST Bravo 4/25s computer.

3. The previous data series for government civilian investment (calculated from BEA, 1985 Table B12, and updates provided by the BEA) utilized by Oden (1992) and Gold (1993), included investment in plant and equipment undertaken by the Department of Defense for use by private sector firms. This investment, known as GOCO (government-owned, contractor-operated), is funded from the defense budget for use by firms in meeting contractual obligations to the Department of Defense; the plant and equipment, however, is owned by the General Services Administration and is therefore counted as civilian-owned by the BEA. Including GOCO outlays as part of civilian government investment involves double-counting, since they are also included as defense purchases. As such, it would tend to bias the trade-off coefficient towards a smaller absolute value, since it would tend to make military spending and investment move more closely together. When the investment data are purged of GOCO outlays, the numerical value of the trade-off coefficient is slightly larger. I would like to

Table V.1. Regressions on Military Spending-Investment
Trade-off
(annual data; 1949-1988)
(t-statistics in parentheses)

	<u>1949-88</u>	<u>1949-71</u>	<u>1972-88</u>
Dependent Variable	I/GNP	I/GNP	I/GNP
Coefficients:			
a	0.25 (27.90*)	0.23 (21.11*)	0.25 (14.76*)
b ₁	-0.26 (-6.28*)	-0.27 (-5.44*)	-0.18 (-0.74)
b ₂	0.24 (5.58*)	0.27 (5.48*)	0.23 (3.91*)
b ₃	-0.64 (-6.96*)	-0.27 (-2.06***)	-0.81 (-7.49*)
Summary statistics:			
N	40	23	17
R ² _{adj}	0.77	0.78	0.88
LM(1)	0.47	0.04	1.12
LM(2)	0.27	0.18	1.32
D.W. statistic	1.65	1.69	1.31
Chow test	3.96**	-	-
White test	5.33*	1.78	1.01

Notes: The equation tested is $(I/GNP)_t = a + b_1(MIL/GNP)_t + b_2GR_t + b_3U_t + \epsilon_t$ where I/GNP is the ratio of real total investment (gross private investment plus civilian government investment) to real GNP, MIL/GNP is the ratio of real military spending to real GNP, GR is the annual percentage change in real GNP, U is the civilian unemployment rate and ϵ is a random error term.

* significant at the 1% level
 ** significant at the 5% level
 *** significant at the 10% level

Sources: For I , MIL , U , GR , BEA (1985), BEA (1986), BEA (various), additional data supplied by BEA and Michael Edelstein. For U , CEA (1990).

thank Michael Edelstein for generously sharing his data on GOCO expenditures. See, e.g., Edelstein (1994). I would also like to thank John Musgrave and Michael Glenn of the BEA for supplying additional data.

support the hypothesis of a shift in the trade-off after 1971, with the coefficient for 1972-88 becoming statistically insignificant. In addition, the Chow test is significant, supporting the possibility of a structural shift in the coefficients. These results suggest that the trade-off was concentrated in the period prior to 1972. One possibility is that the measured trade-off is the result of the two wartime episodes, Korea and Vietnam, when military outlays fluctuated sharply. Indeed, Chart V.1 would suggest that the possibility of changes in military outlays being a major influence on investment is not great outside of the two wartime periods, given the sharp movements in the investment ratio around a fairly constant trend, and the gradual movements in the military spending ratio in the context of a declining trend.

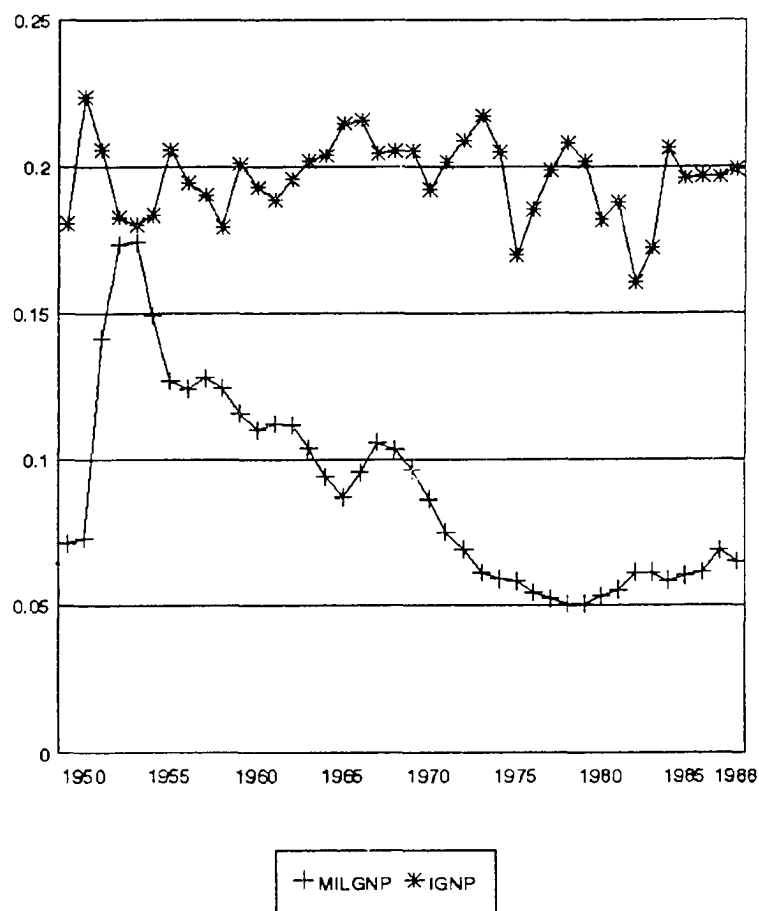
There are a number of differences between the estimates presented in Table V.1 and prior estimates of Smith's equation. Smith estimated three different versions of his equation:

$$\text{V.2a)} \quad (I/Y)_t = a + b_1(M/Y)_t + b_2GR_t + \epsilon_t$$

$$\text{V.2b)} \quad (I/Y)_t = a + b_1(M/Y)_t + b_2GR_t + b_3U_t + \epsilon_t$$

$$\begin{aligned} \text{V.2c)} \quad (I/Y)_t = a + b_1(M/Y)_t + b_2GR_t + b_3U_t + \\ b_4(W/Y)_t + b_5(I/Y)_{t-1} + \epsilon_t \end{aligned}$$

Chart V.1. Military Spending and Total Investment as Shares of Gross National Product
(annual data; 1949-1988)
(1982 dollars)



Notes: Total investment is gross private investment plus civilian government investment.

Sources: See Table V.1.

The new variable introduced into equation IV.2c, W/Y , is a combination of the gap between potential and actual GDP plus the current account balance, expressed as a share of potential GDP. This was included to measure the balance between domestic demand and supply, on the assumption that this balance was a major objective of macroeconomic policy. The lagged dependent variable, $(I/Y)_{t-1}$, was included to capture dynamic adjustment processes. When equations (V.2a) and (V.2b) -- the latter, of course, is identical to equation (V.1), above -- were estimated using pooled samples, the trade-off coefficient, b_1 , was within one standard deviation of -1. When equation V.2c was estimated on United States annual data for 1954-73, b_1 was estimated at -.38, while a long-run trade-off was derived as equal to $b_1/(1-b_5)$, or -.44.

In testing equation V.2c on U. S. data for 1949-88, the lagged dependent variable was not significant, implying that whatever adjustment processes were present were not being captured by this variable. In addition, W/Y was highly correlated with the unemployment rate, most likely due to the close link between fluctuations in unemployment and fluctuations in the gap between potential and actual output. As a result, including W/Y in the equation leads to an insignificant coefficient. Thus, both $(I/Y)_{t-1}$ and $(W/Y)_t$ were excluded from the equations reported in Table V.1.

The Durbin-Watson and Lagrangian Multiplier statistics reported in Table V.1 suggest the absence of first and second order serial correlation. Both Smith (1980) and Oden (1992)

report equations including an autocorrelation adjustment. It is not clear that using an autocorrelation adjustment adds to understanding the possible dimensions of a military spending-investment trade-off. When this is done, the coefficients of the military spending variable are slightly larger in absolute value, suggesting that the unexamined relationship producing autocorrelation is also masking a portion of the trade-off. However, the trade-off coefficient remains insignificant in 1972-1988, while the Chow test supports the hypothesis of a structural shift. More important, to the extent autocorrelated residuals are present, it would indicate a specification problem in the estimating equation, and most likely one that, if resolved, would lead to greater understanding of the dynamic processes underlying the possible trade-off.

An additional difference between the estimates presented here and earlier estimates has to do with the choice of variable to represent gross output. Originally, Smith (1977) used real GDP as the denominator for both the investment and military spending variables, and to calculate the growth rate of output. Later, Smith (1980) used real potential GDP as the denominator, while continuing to use actual real GDP for the growth rate. The trade-off coefficients in the two studies are similar whichever measure is used.

A comparison is presented in Table V.2 using annual data for 1949-1988. When real potential GNP is the denominator (the first column) as opposed to real GNP (the second column)

the trade-off coefficient is larger, and both the unexplained variance and measured autocorrelation are lower. In addition, the Chow test is insignificant, suggesting that the coefficients are equal across subperiods. However, when the equation using potential output is estimated for 1972-88, the trade-off coefficient remains insignificant.

An explanation for these differences may be found in the time pattern of the two output measures. The potential output series, taken from Gordon (1990), is dominated by its trend, whereas actual GNP contains substantial fluctuations. Since both investment and GNP contain pro-cyclical fluctuations, using GNP as the denominator may dampen the fluctuation in the investment series and reduce the explanatory power of the independent variables. Indeed, the coefficients and t-statistics of the growth and, especially, the unemployment variables, with greater cyclical variability over the period as a whole than military spending, show a larger relative rise when the shift is made from GNP to potential GNP. This implies that the potential GNP equation may do a better job of explaining investment as opposed to explaining the investment share; it also suggests that the use of ratios can color the results in these equations, a point that will be discussed in greater detail below. In addition, since potential GNP is a

Table V.2. Comparison of Real GNP and Real
Potential GNP as Normalizing Variable
(annual data; 1949-1988)
(t-statistics in parentheses)

Dependent Variable	I/GNP	I/YN
Coefficients:		
a	0.25 (27.90*)	0.27 (31.47*)
b ₁	-0.26 (-6.28*)	-0.30 (-7.53*)
b ₂	0.24 (5.58)	0.29 (7.21*)
b ₃	-0.64 (-6.96*)	-1.06 (-11.59*)
Summary statistics:		
N	40	40
R ² adj	0.77	0.88
LM(1)	0.47	0.07
D.W. statistic	1.65	1.92
Chow test (F-statistic)	3.96**	1.05
White test (F-statistic)	5.32*	1.96***

Notes: For equation, see Table IV.1.
I/YN is the ratio of real total investment to real potential GNP.

* significant at the 1% level
** significant at the 5% level
*** significant at the 10% level

Sources: See Table V.1.
For YN, Gordon (1990).

calculated variable, its trend and variability may be sensitive to the assumptions underlying its calculation.⁴

In examining the results, one issue is whether the relevant trade-off is between military spending and total investment, or between military spending and one or more components of investment. Smith designed his model to explain how the supply of savings is allocated between the military and physical capital formation, both public and private, and he specifically rejected its application to private investment alone (Smith, 1978). However, the mechanisms postulated to underlay the model appear more applicable to European experiences than that of the United States. In addition, the suggestion that short-run and long-run adjustments to changes in the military burden are different (Smith, 1980) focuses attention on how the different components of investment change over time. Civilian government investment, for example, appears to be dominated by long-term movements, especially in its two major components, education and highways. Oden (1992 Chapter 3) found no evidence of a trade-off between military spending and civilian government investment when the latter was analyzed separately from private investment, but he did find evidence of a trade-off between military spending and net non-residential

4. Gordon (1990 pp. A14) calculates his potential GNP series by geometrically interpolating values between points in the quarterly real GNP series that he designates as representing full employment output. The annual series is then calculated by summing the quarterly series.

investment.⁵ In both examples, Oden constructed specifications designed to explain the specific investment variable, and each specification included military spending.

In evaluating the dimensions of a possible trade-off, it should be kept in mind that a major objective is assessing the magnitude of the opportunity costs of military spending. It could make a difference, with respect to economic growth, for example, whether the primary impacts are on inventories, residential construction or plant and equipment outlays. Earlier (Chapter IV), I found differences in the size of the trade-off for different investment measure. Table V.3 presents estimates of trade-off coefficients derived from equations V.1 and V.2c, with different definitions of investment utilized in constructing the dependent variable. The four investment measures are total investment, gross private investment, fixed investment and business fixed investment, each expressed as a share of real GNP. The coefficients and summary statistics do suggest some differences in the trade-offs. For example, removing government investment raises the size of the trade-off, while removing inventories lowers the trade-off, suggesting that part of the adjustment to changes in military spending can be found in changes in the level of inventory accumulation.

5. Oden's results for government investment may have been biased towards finding no trade-off because of double-counting, since his civilian government investment series included GOCO outlays. It is not likely, however, that the bias would be large enough to offset a statistically significant trade-off, were one to be present.

These issues will be examined in greater detail in the second part of this chapter.

The trade-off coefficients reported in Tables V.1-V.3 are broadly similar to those calculated by Smith and Oden. However, in running the equations for the same time periods they analyzed, differences emerged. Smith (1980) found a trade-off coefficient of -0.38 in an equation that included the lagged investment share and the balance variable (W/Y) for the period 1954-1973. Here, using Smith's specification for 1954-1973 yielded a trade-off coefficient of -0.09 with a t-statistic that was significant only at the 10.17% level. This large difference in results may be attributable to two differences in the data.

First, there may be important differences in the calculation of potential output, the normalizing variable for investment, military spending and the demand-supply balance variable (W). As discussed above, results differ with different measures of gross output.

Second and perhaps of greatest importance, there may be measurement differences. The data on spending utilized here, taken from BEA (1985), BEA (1986) and BEA (various) for investment, military spending and the growth rate, and Gordon (1990) for potential GNP, utilized 1982-base year deflators. There is no BEA deflator for military purchases of goods and services for the period 1949-1971; the nominal military spending series was deflated by the implicit price deflator

Table V.3. Regressions on Alternative Measures of Investment With and Without Adjustment for Autocorrelation (annual data, 1949-1988)

<u>Dependent Variable</u>	<u>Key Statistics</u>	<u>Without auto-correlation Adjustment</u>	<u>With auto-correlation Adjustment AR(1)</u>	<u>With auto-correlation Adjustment MA(1)</u>
I/GNP	b_1	-0.26*	-0.27*	-0.26
	R^2_{adj}	0.77	0.77	0.77
	D.W.	1.65	1.92	1.97
	Chow test	3.96**	3.23**	3.18**
	White test	5.32*	5.28*	5.73*
PI/GNP	b_1	0.31*	-0.34*	-0.31
	R^2_{adj}	0.77	0.78	0.78
	D.W.	1.47	1.93	1.96
	Chow test	2.19***	2.06***	1.62
	White test	0.72	1.65	1.55
FI/GNP	b_1	-0.25*	-0.36	-0.24*
	R^2_{adj}	0.59	0.75	0.71
	D.W.	0.81	1.66	1.68
	Chow test	2.61***	1.43	0.93
	White test	0.24	1.99***	0.97
BFI/GNP	b_1	-0.27*	-0.23*	-0.23*
	R^2_{adj}	0.56	0.89	0.79
	D.W.	0.49	1.70	1.37
	Chow test	6.86*	1.60	4.52*
	White test	1.69	0.39	1.23
FI/GNP	b_1	-0.19*	-0.39*	-0.20*
	b_5	0.28**	-0.05	0.12
	b_6	-0.26		
	R^2_{adj}	0.63	0.75	0.72
	LM			
BFI/GNP	Chow test	3.73*	3.52**	2.89**
	White test	1.31	1.31	1.43
	b_1	-0.13*	-0.22*	-0.18*
	b_5	0.70*	0.19	0.51
	b_6	-0.43		0.37
BFI/GNP	R^2_{adj}	0.77	0.89	0.86
	LM			
	Chow test	5.48*	1.15	1.74
	White test	1.18	2.52**	0.67

Sources: See Table V.1.

for federal government purchases to obtain a real military spending series. For the earlier years, military spending was a very high proportion of federal government spending and it seems reasonable to treat the government purchases deflator as a measure of a military spending deflator; for 1972-1988, the government purchases deflator and the military spending deflator move closely together. As a check, I estimated equations for 1972-1988 using, alternatively, real military spending as reported by the BEA and real military spending derived with the federal government purchases deflator; the results were almost identical. Smith estimated his equation using deflated national accounts data with a 1963 base year.⁶

A final difference between the results reported here and earlier results is the finding of a structural shift in the relation between the investment share and its determinants. Earlier (Chapter IV), I suggested two possible reasons for such a shift. One is that in the earlier period (1949-1971), the economy was operating at higher levels of capacity

6. Other differences are likely to be of much less importance. Smith's data most likely included GOCO outlays as a component of civilian government investment. Any difference in results because of the inclusion of GOCO however, will be small. Moreover, excluding GOCO would tend to raise the absolute value of the trade-off, whereas Smith's results yield a much larger trade-off for 1954-1973 than estimated here. In addition, Smith used the Stockholm International Peace Research Institute (SIPRI) as his source for data on military outlays. While SIPRI and BEA data on military spending are very similar, there are some differences. Also, Smith uses GDP, while I use GNP, both for calculating potential output and the growth rate of gross output. For the United States, this difference is very small.

utilization, on average, and an increase in the share of real output going to the military would generate serious constraints on output expansion. Similarly, a decline in military spending would free resources for alternative uses. Conversely, after 1971, the U. S. economy operated, again on average, at lower rates of capacity utilization and a increase in the military to gross output ratio would be more likely to occur with slack in the economy and less likely to result in output trade-offs. As examples, both the Korean and Vietnam buildups occurred when the ratio of actual to potential output was already high, while the buildup under the Reagan Administration occurred with a much lower actual to potential output ratio.

In addition, the time path of military spending was much smoother, and the ups and downs smaller in relative magnitude, after 1971 than before (Chart V.1). Thus, combined with greater economic slack, the actual changes in military spending that occurred in the 1972-1988 years should not be expected to have as large an impact as in the 1949-1971 period.

A second possible explanation is that large capital imports after 1971 provided a source of investment financing that softened the constraint emanating from domestic savings and the resources utilized by the military. Under this view, the trade-off between military spending and investment remained in force, but was masked by the ability to finance investment from abroad. To test this proposition, I re-ran

equation V.1, including real net exports as a share of real GNP to measure the rising inflow of foreign capital. This variable was not significant, even at the 10% level, either for the period as a whole or the two subperiods.

Alternative Estimates of the Trade-off

Spending variables in estimating equations are frequently expressed as shares of actual or potential output. In the econometric literature on defense-investment trade offs, (Smith, 1980; Cappelen, Gleditsch and Bjerkholt, 1984; Rasler and Thompson, 1988; Mintz and Huang, 1990; Oden, 1992) and in estimates of trade-offs between military spending and non-investment spending items (Russett, 1982; Mintz, 1989); continuing to use it allows for easy comparisons. The issue being analyzed in studies of the defense-investment trade-off is whether increases in defense spending come at the expense of physical capital formation. There is, therefore, some logic to expressing these two variables as shares of total output, in order to measure how the total resource pie is being allocated.

In addition, normalizing spending variables is designed to adjust for two potential problems in the data series when the variables are growing substantially over time, the presence of heteroskedasticity and the absence of stationary time series. Normalizing spending variables by expressing them as shares of output has frequently and explicitly been

used to reduce the impact of heteroskedasticity in studies of military spending (Mintz and Huang, 1990) and in studies of investment behavior (Clark, 1979; Gordon and Veitch, 1984). Changes over time in individual data series also raise the issue of whether each series has a constant sample mean and variance, and an autocovariance which is independent of time, conditions required under the assumptions of the linear regression model.

Moreover, normalizing is not necessarily successful in reducing heteroskedasticity or inducing stationarity. When equation V.1 was tested for 1949-88, heteroskedasticity remained a problem, as indicated by the significance of the White test (Table V.1). In addition, as shown in Chart V.1, above, while the investment to GNP ratio appears to fluctuate around a constant mean, the military spending to GNP ratio exhibits a downward trend for much of the period being analyzed. While the former appears to be stationery, the latter would appear to have a shifting mean.

The issue of stationarity is also central to the development of cointegration techniques. If two (or more) variables are related to each other by a consistently-acting mechanism, such as a trade-off between military spending and investment, then their respective movements over time should be such that the variables do not drift too far apart. Thus, if one variable has a pronounced time trend and a second does not, it is not likely that the relation between the two will reflect a consistent equilibrating mechanism. It is not

necessary for the variables in an estimating equation to be stationary; instead, if the error term in the estimating equation is stationary then one or more co-integrating relationships can potentially be established among the variables. And the preconditions for establishing a cointegrating relationship is that the individual variables entering an estimating equation must be integrated to the same degree and that this must be one order higher than the integration order of the error term. Thus, if the error term does not need to be differenced to achieve stationarity, it is considered to be integrated of order zero, or $I(0)$. And for the error term to be $I(0)$, that is for a cointegrating relation to be obtained, the variables entering the equation must all be integrated of order one, or $I(1)$.

Various forms of the variables were examined and tested to see if they remained stationary over time, and to determine their order of integration. The data were examined visually, using plots of the data over time and correlograms, which are plots of the autocorrelations from a time series.⁷ The individual series were also regressed against a time trend and tested utilizing the Dickey-Fuller (DF) and Augmented Dickey-Fuller (ADF) tests for unit roots. While the DF and ADF tests

7. It is frequently suggested (Pindyck and Rubinfeld, 1991; Perman, 1991) that correlograms be examined to see if the values rapidly die down over time. Without formal criteria for determining what is rapid and what is not, this procedure involves substantial judgment, as does a visual inspection of a plots of a time series (Perman, 1991 p. 22).

are widely used, they are of low power and it has been recommended that they be used in conjunction with other diagnostic techniques (Perman, 1991; see also Korösi, Mátyás and Székely, 1992 pp. 68-72).

Regressions against time are shown in Table IV.4. The investment and military spending variables were tested as ratios, levels, natural logs of the levels and first differences. As already suggested from Chart V.1, I/GNP , the ratio of real total investment spending to real GNP, appears to be stationary, with no visible trend, while MIL/GNP appears to have a significant downward trend. When expressed as levels of the variables, I and MIL , and as logs of the levels, $\ln(I)$ and $\ln(MIL)$, total investment spending shows a marked upward trend while military spending appears to be stationary. As seen in Chart V.2, the levels of the two variables drift apart over time; the effect of normalizing by dividing by GNP is to change which of the two variables appears to be stationary and which exhibits a trend, but it does not change the relation between the two. Finally, when the two variables are expressed as first differences of their levels, $D(I)$ and $D(MIL)$, both appear to be stationary.

Table V presents results from utilizing the DF and ADF tests, to obtain evidence on the order of integration of the variables. The DF test is for the following equation:

$$V.3) \quad DX_t = a + bTIME_t + cX_{t-1} + \epsilon_t$$

Table V.4. Significance of t-statistics from
Regressions Against Time
(annual data; 1949-1988)

<u>Dependent Variable</u>	<u>T-Statistic for Time Coefficient</u>
I/GNP	-0.46
PI/GNP	1.62
FI/GNP	3.15
BFI/GNP	8.31*
MIL/GNP	-7.90*
I	21.28*
PI	20.44*
FI	25.82*
BFI	27.62*
MIL	1.48
ln(I)	22.04*
ln(MIL)	1.73***
GR	-0.88
U	4.75*
D(I)	0.67
D(PI)	0.78
D(GI)	-1.06
D(FI)	1.13
D(BFI)	1.38
D(MIL)	-0.59
D(U)	-0.49

Sources: See Table V.1.

The t-statistic for the coefficient c is tested for significance, under the null hypothesis of $c = 0$.⁸ If the null is accepted, and the residuals show the absence of autocorrelation, X would be considered to be $I(1)$, and DX would be $I(0)$. The presence of autocorrelation in the residuals of equation (3) would require adding lagged values of the dependent variable, converting the test to an ADF test, and re-estimating the equation in an attempt to purge the remaining autocorrelation.

As implied by the plot of the investment ratio (Chart V.1) and the regressions against time, the null hypothesis is not accepted for IGNP, implying that this variable is $I(0)$, that is, it does not have to be differenced to achieve stationarity. However, the military spending to GNP ratio tests as non-stationary, and likely to be $I(1)$. Again, this is consistent with the visual inspection of the plot of the

8. A series X is considered to be non-stationary if the coefficient $g = 1$ in the following equation, $X_t = gX_{t-1} + \epsilon_t$; if $g < 1$, the series would be stationary, or $I(0)$, i.e., X does not need to be differenced to achieve stationarity. If $g > 1$, X would exhibit explosive growth, a situation presumably not encountered in long-run time series. The DF and ADF tests reorganize the equation into: $DX_t = a + qX_{t-1} + k_1DX_{t-1} + \dots + k_iDX_{t-i} + cTIME + \epsilon_t$, where D is a first difference operator and $q = 1-g$, so that $q=0$ is equivalent to $g=1$. The hypothesis being tested is that $q=0$ (i.e., $g=1$), versus the one-tailed alternative of $q > 0$ (or $g < 1$); a significant t-statistic for q , using specially constructed significance levels, implies that $q > 0$ and that X is not stationary, and is most likely $I(1)$. For a discussion of the testing procedure, see Perman (1991), and for an application to a problem similar to the one being investigated in this chapter, see Buck, Hartley and Hooper (1993).

Table V.5. DF and ADF Tests for Order of Integration
(annual data, 1949-1988)

<u>Variable Being Tested</u>	<u>Dependent Variable</u>	<u>Lags</u>	<u>Explanatory Variables</u>	<u>t-statistics</u>
I/GNP	D(I/GNP)	0	I/GNP _{t-1} TIME	-4.60* -0.22
MIL/GNP	D(MIL/GNP)	6	MIL/GNP _{t-1} TIME	-0.78 -0.30
GR	D(GR)	0	GR _{t-1} TIME	-5.49* -1.14
U	D(U)	0	U _{t-1} TIME	-2.91 1.51
I	D(I)	3	I _{t-1} TIME	-3.99** 4.08*
ln(I)	D(ln(I))	3	ln(I) _{t-1} TIME	-2.20 2.16
MIL	D(MIL)	1	MIL _{t-1} TIME	-3.93* 0.64
ln(MIL)	D(ln(MIL))	1	ln(MIL) _{t-1} TIME	-4.15** 0.46
D(U)	D(D(U))	0	D(U) _{t-1} TIME	-6.36* -0.03
D(MIL)	D(D(MIL))	1	D(MIL) _{t-1} TIME	-4.15** -0.57
D(I)	D(D(I))	3	D(I) _{t-1} TIME	-5.30* 1.24

Notes: * significant at the 1% level
 ** significant at the 5% level
 The critical values are taken from MICRO TSP
 econometric software

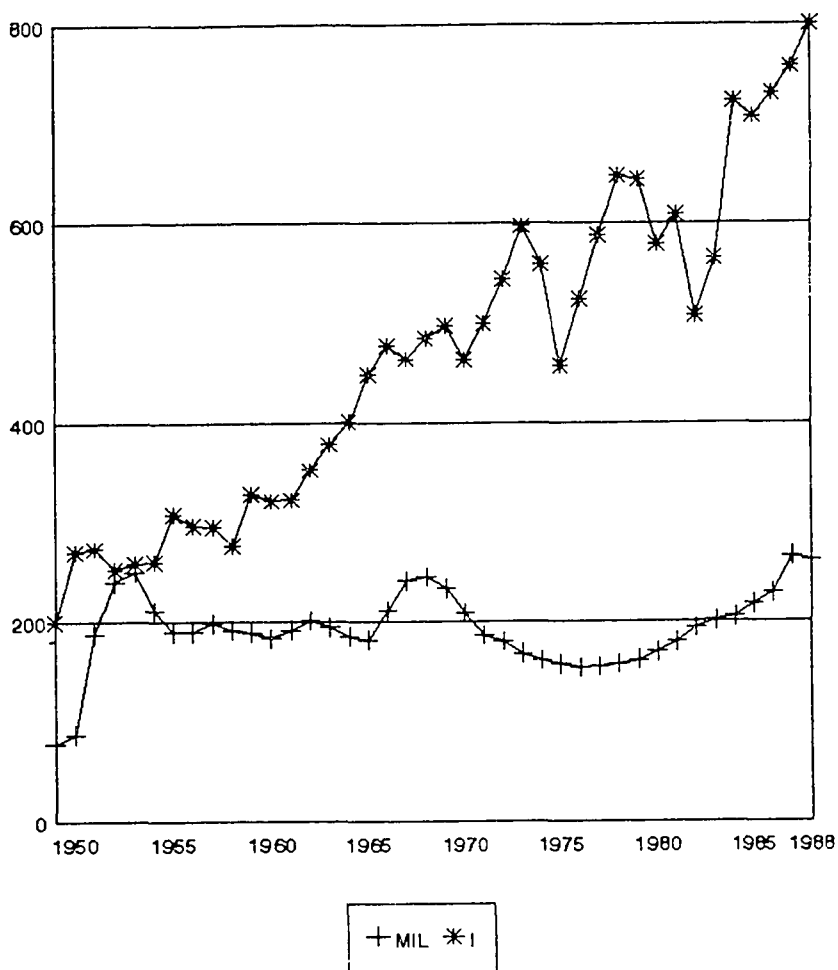
Sources: See Table V.1.

series and the significance of the time trend. Thus, we would not expect to find an equilibrating relation between the two. The growth rate tests as $I(0)$, while the unemployment rate is nonstationary, and probably $I(1)$.

When levels of the spending variables are tested, the t -statistic for investment is significant at the 5% level, implying that total investment spending is a stationary series, while the t -statistic for its time trend is significant at the 1% level. A finding that investment is stationary is not consistent with the impression from observing a plot of the series over time (Chart V.2) or the significance of the coefficient in a regression against time (Table V.4). In addition, a correlogram for investment shows the sample autocorrelations declining very gradually and not reaching zero even after 10 lags. The significance of the trend variable in the ADF equation for investment suggests that if investment is $I(0)$, it is a trend stationary process, that is, stationary around a time trend. The choices, then, are to treat investment as $I(1)$, or to accept the results of the ADF test, which implies that the investment series needs to be de-trended before being used in an estimating equation. The level of military spending more clearly tests as $I(1)$, which is consistent with the impression from Chart V.2, a correlogram, where the autocorrelations fall below zero on the third lag, and the time trend reported in Table V.2.

As an alternative, the natural logs of investment and military spending were tested. The log of investment spending

Chart V.2. Military Spending and Total Investment
(annual data; 1949-1988)
(billions of 1982 dollars)



Notes: Total investment is gross private investment plus civilian government investment.

Sources: See Table V.1.

appears to be $I(1)$, while the log of military spending is $I(0)$. It seems reasonable to accept these findings, given their consistency both with the other tests and with what would be expected from knowledge of the historical pattern of these series. Thus, as with the ratio form, investment and military spending do not appear to be linked in an equilibrium relationship.

One possible complication in interpreting the results on integration stems from the possibility of a structural shift in one or more of the variables. The results reported above support the likelihood of a shift in the relationships specified in equations V.1 and V.2c, with the shift occurring after 1971. A structural break in the time path of an individual series would make it more difficult to interpret the results from the DF and ADF tests (Perman, 1991 pp. 21). And since these are large sample tests, utilizing them on the two subsamples (where $N = 23$ and 17 , respectively), is not likely to yield reliable results. The investment series, either in levels or ratios, does not appear to contain any structural breaks. Military spending, however, is a far less consistently moving series. To the extent a structural break has occurred in military spending, this might provide an explanation of the inability of the relationships defined by equations V.1 and V.2c to hold over the entire sample period.

First differences in the levels of the spending variables and the unemployment rate were also tested for their order of integration. Investment, military spending and unemployment

test as $I(0)$. And since the growth rate tested as $I(0)$, there is no need for a cointegration test; all of the variables are stationary. Two equations were tested in first differences:

$$V.4a) \quad D(I)_t = a + h_1 D(MIL)_t + h_2 GR + h_3 D(U)_t + \epsilon_t$$

$$V.4b) \quad D(I)_t = a + h_1 D(MIL)_t + h_2 GR + h_3 D(U)_t + \\ h_4 D(W)_t + h_5 D(I)_{t-1} + \epsilon_t$$

These equations are equivalent to equations V.1, tested above, and V.2c, tested above and tested earlier by Smith and Oden. When using first differences, there is a loss of the information contained in the levels of the variables, whether expressed as spending levels or as ratios to output. But the results reported above regarding the order of integration of the variables indicate that there may not be information in the levels of the variables relevant to the trade-off issue, at least for the long-run.

The results from testing equation V.4a (Table V.6) are similar to the results obtained from equation V.1 (Table V.1), in that there appears to be a statistically significant parameter shift across the two subperiods, while the statistically significant trade-off is confined to the earlier subperiod. In addition, heteroskedasticity remains a problem. Since this is essentially a short-run equation, the similarity in the results suggests the estimates of equation IV.1 are dominated by the short-run effects estimated by equation V.4a. A fuller evaluation of equation V.4a is hampered by the

presence of substantial collinearity between the growth and unemployment variables. The presence of collinearity is strongest in the 1972-1988 subperiod; three of the variables in equation V.4b, GR, D(U) and D(W), have simple correlation coefficients with each other of greater than 0.9. Because of this collinearity, results for equation V.4b are not presented.

Several alternative formulations were estimated, deleting collinear variables and adding the first difference of net exports, D(NX), in an attempt to bridge the gap between the two subperiods. These equations are:

$$\text{V.5a)} \quad D(I)_t = a + j_1 D(\text{MIL})_t + j_2 \text{GR}_t + j_3 D(\text{NX})_t + \epsilon_t$$

$$\text{V.5b)} \quad D(I)_t = a + j_1 D(\text{MIL})_t + j_4 D(U)_t + j_3 D(\text{NX})_t + \epsilon_t$$

$$\text{V.5c)} \quad D(I)_t = a + j_1 D(\text{MIL})_t + j_5 D(\text{GAP})_t + j_3 D(\text{NX})_t + \epsilon_t$$

The results for equations V.5a, V.5b and V.5c contain some differences, with each other and in comparison with earlier estimates. But they each yielded a trade-off in the 1949-1971 years, and the absence of a trade-off in 1972-1988. And the structural shift tested as significant, utilizing the Chow Test.

When different measures of investment were tested as the dependent variable, there were marked differences in the trade-off coefficients, moving from -.97 for total investment,

Table V.6. Regressions on First Differences
(annual data; 1949 - 1988)
(t-statistics in parentheses)

	<u>1949-1988</u>	<u>1949-1971</u>	<u>1972-1988</u>
Dependent variable	D(I)	D(I)	D(I)
Coefficients:			
h_1	-0.95 (-4.98*)	-0.68 (-5.27*)	-0.59 (-1.17)
h_2	669.61 (5.74*)	543.01 (6.55*)	736.95 (3.63*)
h_3	-2220.71 (-5.55*)	-1027.52 (-3.33*)	-3566.40 (-5.61*)
Summary statistics:			
N	40	23	17
R^2_{adj}	0.73	0.73	0.87
D.W.	2.14	2.22	1.93
LM (1)	0.25	0.74	0.01
LM (2)	1.23	1.45	0.09
Chow test	10.04*	-	-
White test	4.84*	4.07**	1.05

Notes: The equation tested is $D(I)_t = h_1 D(MIL)_t + h_2 GR_t + h_3 D(U)_t + \epsilon_t$

* - significant at the 1% level

** - significant at the 5% level

Sources: See Table V.1.

to -1.01 for gross private investment, -.65 for fixed investment and -.30 for business fixed investment, all significant at the 1% level (all coefficients were estimated with a constant term, for consistently; the constant was not significant in the equation for $D(I)$ and omitted in Table V.6. This pattern in the coefficients is consistent with the absence of a short-run trade-off between military spending and civilian government investment, and the presence of substantial trade-offs with inventory investment, residential investment and business investment in plant and equipment.

Bi-variate Granger-causality tests were performed using $D(MIL)$ and the first differences of different investment measures, with lags of up to three years. For 1949 to 1988, the only statistically significant relation, at the 10% level of significance, was from $D(MIL)$ to $D(INV)$, the first difference of inventory investment, for a one year lag (Table V.7). For 1949 to 1971, there were significant two-way relationships between $D(MIL)$ and $D(I)$, the first difference of total investment, between $D(MIL)$ and $D(PI)$, the first difference of private investment, and between $D(MIL)$ and $D(INV)$, all for one year lags. In addition, there were significant one-way relationships from $D(MIL)$ to $D(I)$ and $D(PI)$ for three year lags, and from $D(INV)$ to $D(MIL)$ for both two and three year lags. There were no significant relationships between military spending and either business fixed investment or civilian government investment for either time period.

The existence of significant Granger causalities between military spending and investment in the 1949-1971 period is consistent with the interpretation, advanced in Chapter IV, that the trade-off between military spending and investment is confined to the period of large military buildups in the context of aggregate capacity constraints.⁹ The significant relationships for $D(INV)$ to $D(MIL)$, however, may illustrate a separate problem in interpreting these results. In the national income and product accounts (NIPA), military outlays are included at the point of final purchase by the Department of Defense (DOD). Goods in the process of production, which can be weeks for small items and years for large weapons systems, enter NIPA as inventories. Thus, while being financed by payments from the DOD, they are initially part of gross private investment. A military buildup, then, could initially expand private investment through a expansion of inventories, and then reduce inventories as military goods are completed and delivered (See Weidenbaum, 1967; Lee, 1967).

A Possible Consumption-Military Spending Trade-off

Smith (1977, 1980) formulated his model to test the hypothesis that military spending was accompanied by reduced expenditures on both private and civilian public physical

9. Granger-causality tests for 1972-1988 yielded no significant relationships for any of the investment measures.

Table V.7. Bi-variate Granger Causality Tests Between
Military Spending and Investment
(annual data; 1949-1988 and 1949-1971)

Variables and Direction of Causality	Lag Length and F-statistics		
	1 yr	2 yrs	3 yrs
<u>1949-1988</u>			
D(MIL) to D(I)	0.42	0.07	0.13
D(I) to D(MIL)	2.30	1.08	1.76
D(MIL) to D(PI)	0.66	0.16	0.17
D(PI) to D(MIL)	2.19	1.07	1.68
D(MIL) to D(FI)	0.10	0.03	0.12
D(FI) to D(MIL)	0.56	0.24	0.59
D(MIL) to D(INV)	1.48	0.78	0.58
D(INV) to D(MIL)	2.99***	1.26	2.21
<u>1949-1971</u>			
D(MIL) to D(I)	3.44***	1.47	1.13
D(I) to D(MIL)	6.92**	2.33	2.73***
D(MIL) to D(PI)	4.78**	1.82	1.21
D(PI) to D(MIL)	6.72**	2.24	2.77***
D(MIL) to D(FI)	2.24	1.46	0.97
D(FI) to D(MIL)	2.66	1.53	1.47
D(MIL) to D(INV)	5.93**	2.21	1.64
D(INV) to D(MIL)	12.12*	3.74**	4.90**

Notes: * significant at the 1% level
 ** significant at the 5% level
 *** significant at the 10% level

Sources: See Table V.1.

capital, compared to what the latter would have been in an environment of lower military outlays. His alternative hypothesis was that the expansion of the military would be borne by reduced public and private consumption. Based upon his econometric results, Smith concluded that it was investment, not consumption, which bore the burden of military outlays; he suggested that political processes in OECD economies maintained total consumption shares but did not provide such protection for investment.

Conversely, both Boulding (1973) and Edelstein (1990) found that in the United States, the investment to output ratio was stable in the long-run, despite substantial changes in the share of output going to the military. They both concluded that it was the consumption share which fluctuated in response to military spending changes; Edelstein suggested that this shift occurred through an increase in the tax burden on wage and salary income.

Given the results reported above, indicating the absence of a long-run link between investment and military spending, I examined data on consumption and military spending. The level and the log of total consumption, TC, defined as private consumption plus civilian government consumption outlays¹⁰, both tested as $I(1)$, in contrast to the log and level of military spending which tested as $I(0)$ (Table V.5). The ratio

10. Civilian government consumption was calculated as total government outlays less military outlays and civilian government investment outlays.

of total consumption to GNP, TC/GNP, tested as $I(0)$ with a significant time trend, suggesting a trend stationary process. Following Perman (1991 pp. 11-12), who recommends removing time trends from trend-stationary series prior to further testing, I de-trended the TC/GNP series; the de-trended series $R(\text{TC/GNP})$, tests as $I(1)$.¹¹

As a next step, I estimated a possible cointegrating relationship between $R(\text{TC/GNP})$ and MIL/GNP (Table V.8). The ADF test statistic is significant at the 1% level with the absence of autocorrelation, suggesting the residuals from the cointegration regression are stationary.

One interpretation of a cointegrating regression is that it identifies an error-correction mechanism (ECM) in a long-run equilibrium relationship (Engle and Granger, 1987; Korösi, Mátyás and Székely, 1992 pp. 106-109). An example of an ECM is:

$$\text{V.6a)} \quad X_t = a + b_1 Z_t + b_2 X_{t-1} + b_3 Z_{t-1} + \epsilon_t.$$

If X and Z are in long-run equilibrium, their difference ($X_t - Z_t$) should be constant. If their difference fluctuates but is stationary, this can be interpreted as a measure of the movements to regain equilibrium. Re-writing V.6a (see Kennedy, 1992 pp. 250-252, 264):

11. The de-trended series is a time series of the residuals from the equation: $(\text{TC/GNP})_t = a + b(\text{TIME})_t + \epsilon_t$

$$V.6b) \quad D(X)_t = a + b_1 D(Z)_t + (b_3 - 1)(X_{t-1} - Z_{t-1}) + \epsilon_t.$$

The term $(X_{t-1} - Z_{t-1})$ is the one-period lagged residuals from the cointegrating regression, which were found to be stationary, while the coefficient of $D(Z)_t$ is a measure of the long-run equilibrium relationship. All of the variables entering V.6b are $I(0)$. The results (Table V.8) suggest a long-term trade-off between the military and consumption shares of GNP of -0.54. The ECM equation tests as being free of autocorrelation and heteroskedasticity, and stable over the sample period.

The estimates of both the cointegrating and ECM equations do not, of course, provide multi-variate structural estimates, nor do they delineate the channels through which changes in military spending have effects on consumption. A structural model would also have to explain the time trend in the TC/GNP series. In addition, they are subject to some of the same problems of interpretation as noted above with spending to gross output ratios, although the ECM estimates are derived from stationary variables and test as being free of heteroskedasticity. These estimates are, however, consistent with the absence of a long-run military spending-investment trade-off, and with the earlier results reported by Boulding and Edelstein.

Table V.8. Cointegration and ECM Regressions
(annual data; 1949-1988)

A: The cointegrating regression

Dependent variable: $R(TC/GNP)$

<u>variable</u>	<u>coefficient</u>	<u>t-statistic</u>	<u>CRDW</u>
constant	0.02	3.12	0.717
MIL/GNP	-0.26	-3.34	

B: ADF test on residuals

Dependent variable: $D(\epsilon_t)$

<u>variable</u>	<u>coefficient</u>	<u>t-statistic</u>	<u>critical value</u>
ϵ_{t-1}	-0.68	-4.69*	-4.20

C: ECM regression

Dependent variable: $D(R(TC/GNP))$

<u>variable</u>	<u>coefficient</u>	<u>t-statistic</u>
constant	-0.002	-1.29
$D(MIL/GNP)$	-0.54	-4.79*
ϵ_{t-1}	-0.53	-5.13*

Summary statistics:

N	= 39
R^2_{adj}	= 0.59
D. W.	= 1.71
LM(1)	= 0.42
LM(2)	= 0.65
Chow test	= 0.57
White test	= 0.74

Notes: * significant at the 1% level
The ECM equation covers 1950-1988, due to lags

Sources: See Table V.1.

Conclusions

The empirical results reported above suggest some possible interpretations of the defense-investment trade-off issue. The conclusions are as follows:

First, to the extent a defense spending-investment trade-off exists in the United States, it has not been consistent over the post-World War II period as a whole. The trade-off is confined to the years between 1949 and 1971. It seems reasonable to suggest that the rapid military expenditure growth experienced at the beginning of the Korean and Vietnam Wars, and the substantial declines in military outlays at the conclusion, or winding down, of those conflicts, is a major source of the measured defense-investment trade-offs.

Second, there does not appear to be a long-run trade-off between military spending and total investment spending. Military spending and investment, whether expressed as shares of GNP, levels of spending or natural logs of spending levels, are not integrated of the same order, indicating the absence of a consistently-acting, long-run mechanism linking the two.

Third, there does appear to be a trade-off that is short-run in nature, being measured in first differences of the spending variables. A short-run trade-off would be consistent with the interpretation that the investment trade-off is largely a result of substantial military spending changes in the context of an economy operating at high and/or growing levels of resource utilization. Moreover, short-run trade-

offs are, by definition, not long lasting. In addition, the time path of military spending also suggests that they have been reversible; each of the major buildups have been followed by a substantial build-down suggesting that the investment resources lost in the expansion phase of military outlays are regained in the contraction phase. Indeed, the logic of the empirical results, in that the response of investment to changes in military spending are assumed to be symmetrical, lead to this conclusion. Thus, the opportunity costs of military spending, in terms of foregone physical capital formation, are likely to have been minor.

Fourth, evidence presented above suggests that there is a long-term trade-off between military spending and consumption. When the two are measured as shares of GNP, and when the consumption share is taken as the residual from a time trend, a cointegrating vector was found, enabling the estimation of an equation embodying both a long-run equilibrium relationship between the two, and a error-correction mechanism to adjust towards the equilibrium.

Chapter VI

Conclusions

The issue investigated in this dissertation is whether military spending has occurred at the expense of spending on physical capital formation in the United States in the period after World War II.

This issue has been investigated, and debated, as part of the broader issue of how military spending affects economic growth and other measures of aggregate economic performance. This debate has frequently concentrated on the effects of military spending and military programs on investment, research and development, innovation and productivity. The effects of military spending on investment is thought to be particularly important, since new investment is a determinant of the quantity and quality of the future stock of productive capital and is, therefore, a determinant of the growth of gross output over time. Thus, if higher levels of military spending occurs at the expense of investment outlays, a case could be made that the presence of the military has a high opportunity cost in terms of foregone future growth in living standards.

The economic literature on the impact of military spending on aggregate economic performance in the United States initially appears to support the conclusion that military spending leads to lower rates of economic growth, higher rates of unemployment and higher rates of inflation.

However, a closer look at the literature, as presented in Chapter II, does not support this conclusion.

The first main conclusion of this dissertation is that the evidence and arguments regarding the aggregate impacts of military spending, either in terms of the United States alone or when comparing the United States with other developed economies, does not support a strongly negative role, or even a large role, for military spending in effecting the main indicators of aggregate economic performance.

A substantial amount of research has also been conducted on the relation between military spending and investment spending, and a major conclusion from this research is that a strong negative relation exists between the two. This research is analyzed in Chapter III. Many of the arguments are *a priori* in nature, and supported only by casual or anecdotal evidence. In addition, the studies that have yielded the strongest statistical evidence supporting a trade-off between military spending and investment spending are cross-national, and not devoted to the United States alone. Evidence for the United States alone indicates a negative trade-off, but one that is smaller than is found in cross-national studies. Further, even when various studies are in broad agreement regarding evidence, they do not agree, and often do not even investigate, how the negative military spending-investment linkages occur. The explanations offered are themselves either assumptions or hypotheses. It is

difficult to interpret results that appear similar but are based upon differing assumptions and explanations.

The second main conclusion of this dissertation is that the existence of a sizeable, negative trade-off between military spending and investment in the United States since World War II has not been satisfactorily established in the existing body of empirical research.

Looking more closely at the military spending-investment linkage, econometric work for the years 1949-1988, presented in Chapter IV, supports the existence of a trade-off between military spending and investment in the United States, albeit one that is smaller than found in previous studies. However, the relationship between military spending and investment spending appears to have undergone a structural shift. To the extent a trade-off has been present, it appears to have been confined to the period from 1949 to 1971, a period that contains two major military buildups and subsequent build-downs, and a period when the aggregate economy was operating, on average, close to capacity.

The third major conclusion, then, is that a military spending-investment trade-off is confined to the years prior to 1972, and that it may be the result of large and rapid rises and declines of military purchases in the context of capacity ceilings, rather than any inherent characteristics of military spending.

Chapter V extends the econometric analysis of the military spending-investment relationship. Using

cointegration techniques, there does not appear to be a consistent long-run relationship between military spending and total investment in postwar United States annual data. A short-run relationship is indicated, with a trade-off between the two. The short-run trade-off is also confined to the period from 1949 to 1971, again suggesting a trade-off derived from the wartime expansions and contractions of military spending. If this is the source of the trade-off observed in Chapter IV, it also implies that the loss of investment spending is relatively short-lived and reversible, since the major buildups were succeeded by buildddowns of similar size and speed.

The fourth main conclusion is that the trade-off observed in previous studies is short-term in nature, and that the evidence presented here does not support the existence of a long-term military spending-investment trade-off.

Cointegration techniques were also applied to the relation between military spending and total consumption. The main finding is that there does appear to be a long-term negative relationship between military spending and consumption, and it can be modelled with an error-correction mechanism.

The fifth main conclusion of this dissertation is that changes in the military burden over the postwar period in the United States appear to have had their primary effect on the resources allocated to aggregate consumption spending, and not on investment. If this conclusion is correct, the main

opportunity cost of military spending is on current living standards, and not necessarily on those in the future.

Bibliography

Aben, Jacques and Smith, Ron P. "Defence and Employment in the UK and France: A Comparative Study of the Existing Results," in Christian Schmidt and Frank Blackaby, eds., **Peace Defense and Economic Analysis**. New York: St. Martin's Press, 1987, pp. 384-398.

Adams, Gordon. **The B-1 Bomber: An Analysis of Its Strategic Utility, Cost, Constituency and Economic Impact**. New York: Council on Economic Priorities, 1976.

Adams, Gordon. "Disarming the Military Subgovernment." **Harvard Journal on Legislation**, 3 April 1977, 14 (3), pp. 459-503.

Adams, Gordon. "Defense Policy-Making, Weapons Procurement, and the Reproduction of State-Industry Relations," paper presented at the annual meeting of the American Political Science Association, Washington, D.C., August 1980.

Adams, Gordon. **The Politics of Defense Contracting: The Iron Triangle**. New Brunswick and London: Transaction Books, 1982a.

Adams, Gordon. **A Bomber for All Seasons**. New York: Council on Economic Priorities Newsletter, 1982b.

Adams, Gordon. **Controlling Weapons Costs: Can the Pentagon's Reforms Work?** New York: Council on Economic Priorities, 1983.

Adams, G. and Gold, D.A. "The Economics of Military Spending: Is the Military Dollar Really Different," in Christian Schmidt and Frank Blackaby, eds., **Peace Defense and Economic Analysis**. New York: St. Martin's Press, 1987a, pp. 266-300.

Adams, Gordon and Gold, David. **Defense Spending and the Economy: Does the Defense Dollar Make a Difference?** Washington, D.C.: Defense Budget Project, 1987b.

Anderson, James. **Bankrupting America: The Tax Burden and Expenditures of the Pentagon by Congressional District**, Lansing, MI: Employment Research Associates, 1982.

Anderson, Marion. **Neither Jobs Nor Security**. Lansing, MI: Employment Research Associates, 1982a.

Anderson, Marion. **The Empty Pork Barrel**. Lansing, MI: Employment Research Associates, 1982b.

Baldwin, William L. **The Structure of the Defense Market**. Durham, NC: Duke University Press, 1967.

Baumol, William J. "Productivity, Growth, Convergence and Welfare: What the Long-run Data Show." **American Economic Review**, 1986, December 76 (5), pp. 1072-1085.

Baumol, William J. "A Modest Decline Isn't All That Bad." **New York Times**, February 15, 1987.

Baumol, William J., Blackman, S.A.B. and Wolff, Edward. **Productivity and American Leadership: The Long View**. Cambridge, MA: The MIT Press, 1989.

Bezdek, Roger. "The 1980 Economic Impact -- Regional and Occupational -- of Compensated Shifts in Defense Spending." **Journal of Regional Science**, August 1975, 15 (2), pp. 183-198.

Block, Fred. **The Origins of International Economic Disorder**. Berkeley, CA: University of California Press, 1977.

Borras, Michael, Millstein, James E. and Zysman, John. "Trade and Development in the Semiconductor Industry," in John Zysman and Laura Tyson, eds., **American Industry in International Competition**. Ithaca, NY: Cornell University Press, 1983, pp. 142-248.

Boulding, Kenneth. "The Impact of the Defense Industry on the Structure of the American Economy," in Bernard Udis, ed., **The Economic Consequences of Reduced Military Spending**. Lexington, MA: Lexington Books, 1973, pp. 225-252.

Brancato, Cathryn Kay, and Le Grande, Linda. "Impact on Employment of Defense versus Non-Defense Government Spending." **Congressional Research Service Issue Brief MB82246**. Washington, D.C.: Library of Congress, 1984.

Buck, David, Hartley, Keith and Hooper, Nick. "Defence Research and Development, Crowding-Out and the Peace Dividend." **Defence Economics**, 1993, 4 (2), pp. 161-178.

Bureau of Economic Analysis (BEA). United States Department of Commerce. **Fixed Reproducible Tangible Wealth in the United States**. Washington, D.C.: U. S. Government Printing Office, 1985.

Bureau of Economic Analysis (BEA). United States Department of Commerce. **The National Income and Product Accounts of the United States, 1929-82**. Washington, D.C.: U. S. Government Printing Office, 1986.

Bureau of Economic Analysis (BEA). United States Department of Commerce. "Summary Fixed Reproducible Tangible Wealth Series, 1925-87." **Survey of Current Business**, October 1988, 68 (10), pp. 35-36.

Bureau of Economic Analysis (BEA). United States Department of Commerce. **Survey of Current Business**. Washington, D.C.: U. S. Government Printing Office, monthly issues.

Cappelin, Adne, Gleditsch, Nils Petter and Bjerkholt, Olav. "Military Spending and Economic Growth in the OECD Countries." **Journal of Peace Research**, 1984, 21 (4), pp. 361-373.

Cater, Douglas. **Power in Washington**. New York: Random House, 1964.

Chan, Steve. "The Impact of Defense Spending on Economic Performance: A Survey of Evidence and Problems." **Orbis**, Summer 1985, 29 (2), pp. 403-434.

Chase Econometric Associates. **Economic Impact of the B-1 Program on the US Economy**. Bala Cynwyd, PA: Chase Econometrics, 1975.

Clark, Peter K. "Investment in the 1970s: Theory, Performance, and Prediction." **Brookings Papers on Economic Activity**, 1979, (1), pp. 73-113.

Collins, John. **US-Soviet Military Balance: Concepts and Capabilities**. New York: McGraw-Hill, 1980.

Committee for National Security. **Spending for a Sound Defense: Alternative to the Reagan Military Budget**. Washington, D.C.: Committee for National Security, 1985.

Compa, Lance. "Labor and the Military - A History," in Gordon, Suzanne and McFadden, Dave, eds., **Economic Conversion: Revitalizing America's Economy**. Cambridge, MA: Ballinger, 1984, p. 33-43.

Congressional Budget Office (CBO). United States Congress. **Defense Spending and the Economy**. Washington, D.C.: U. S. Government Printing Office, 1983.

Congressional Budget Office (CBO). United States Congress. **The Economic and Budget Outlook, Fiscal Years 1986-1990 (Part I)**. Washington, D.C.: U. S. Government Printing Office, February 1985.

Congressional Budget Office (CBO). United States Congress. **The Economic and Budget Outlook, Fiscal Years 1988-1992 (Part I)**. Washington, D.C.: U. S. Government Printing Office, January 1987.

Council of Economic Advisers (CEA). **Economic Report of the President**. Washington, D. C.: U. S. Government Printing Office, 1990.

Cuff, Robert D. **The War Industries Board: Business-Government Relations During World War I.** Baltimore, MD: Johns Hopkins Press, 1973.

Cypher, James. "The Basic Economics of Rearming America." **Monthly Review**, November 1981, 33 (6), pp. 11-27.

Cypher, James. "Review of DeGrasse." **Journal of Economic Issues**, 1985, 19 (1), pp. 227-232.

Defense Budget Project. **Nuts and Bolts at the Pentagon: A Spare Parts Catalog.** Washington, D.C.: Defense Budget Project, 1984.

Defense Budget Project. **The FY 1986 Defense Budget: The Weapons Buildup Continues.** Washington, D.C.: Defense Budget Project, 1985.

Deger, Saadet. **Military Expenditure in Third World Countries: The Economic Effects.** London: Routledge & Kegan Paul, 1986.

DeGrasse, Robert W. Jr. **Military Expansion Economic Decline.** Armonk, NY: M.E. Sharpe, 1983.

Denison, Edward F. **Trends in American Economic Growth 1929-1982.** Washington, D.C.: The Brookings Institution, 1985.

Department of Defense (DOD). **Symposium on the Impact of Higher Levels of Defense Expenditures on the United States Economy in the 1980s.** Washington, D.C.: Department of Defense, 1980.

Department of Defense (DOD). **FY 1983 Report of the Secretary of Defense.** Washington, D.C.: Department of Defense, 1982.

Department of Defense (DOD). **Atlas/State Data Abstract for the United States, Fiscal Year 1984.** Washington, D.C.: Department of Defense, 1985.

Domke, William K., Eichenberg, Richard C., and Kelleher, Catherine M. "The Illusion of Choice: Defense and Welfare in Advanced Industrial Economies 1948-1978." **American Political Science Review**, March 1983, 77 (1), pp. 19-35.

Drifte, Reinhard. **Arms Production in Japan: The Military Application of Civilian Technology.** Boulder, CO: Westview Press, 1986.

Duchin, Faye. "Economic Consequences of Military Spending." **Journal of Economic Issues**, June 1983, XVII (2), pp. 543-553.

DuBoff, Richard B. "What Military Spending Really Costs." **Challenge**, September-October, 1989, 32 (5), pp. 4-10.

Dumas, Lloyd J. "Military Spending and Economic Decay," in Lloyd J. Dumas, ed., **The Political Economy of Arms Reduction**. Boulder, CO: Westview Press, 1982, pp. 1-26.

Dumas, Lloyd J. **The Overburdened Economy**. Berkeley and Los Angeles: University of California Press, 1986.

Dunne, Paul and Smith, Ron. "Military Expenditure and Unemployment in the OECD." **Defence Economics**, 1990, 1 (1), pp. 57-73.

Edelstein, Michael. "What Price Cold War?" **Cambridge Journal of Economics**, December 1990, 14 (4), pp. 421-437.

Edelstein, Michael. "The Economics of 20th Century Wars," unpublished manuscript, Department of Economics, Queens College, City University of New York, 1994.

Engle, Robert F. and Granger, C. W. J. "Cointegration and Error-Correction: Representation, Estimation and Testing," **Econometrica**, March 1987, 55 (2), pp. 251-276.

Eisner, Robert. **How Real is the Federal Deficit?** New York: The Free Press, 1986.

Epstein, Gerald. "The Triple Debt Crisis." **World Policy Journal**, Fall 1985, II (4), pp. 625-657.

Evans, Paul. "Do Deficits Produce High Interest Rates?" **American Economic Review**, March 1985, 75 (1), pp. 68-87.

Fitzgerald, Arthur Ernest. **The High Priests of Waste**. New York: Norton, 1972.

Folk, Hugh. **The Shortage of Scientists and Engineers**. Lexington, MA: D.C. Heath and Company, 1970.

Fox, J. Ronald. **Arming America: How the US Buys Weapons**. Boston: Harvard School of Business Administration, 1974.

Freeman, John Lieper. **The Political Process**. Garden City, NY: Doubleday, 1955.

Freeman, Richard. "A Cobweb Model of the Supply and Starting Salary of New Engineers." **Industrial and Labor Relations Review**, 1976, 29 (2), pp. 236-248.

Gansler, Jacques. **The Defense Industry**. Cambridge, MA: The MIT Press, 1980.

Ginzberg, Eli. "Scientific and Engineering Personnel: Lessons and Policy Directions," in National Research Council, **The Impact of Defense Spending on Non-defense Engineering Labor Markets: A Report to the National Academy of Engineering**. Washington, D.C.: National Academy Press, 1986, pp. 25-41.

Gold, David. **The Impact of Defense Spending on Investment, Productivity and Economic Growth**. Washington, D.C.: Defense Budget Project, 1990.

Gold, David. "Military Spending and Investment in the United States," in Jurgen Brauer and Manas Chatterji, eds., **Economic Issues of Disarmament**. New York: New York University Press, 1993, pp. 288-303.

Gold, David and Adams, Gordon. "Defence Spending and the American Economy." **Defence Economics**, 1990, 1 (4), pp. 275-293.

Gold, David and De Grasse, Robert Jr. "Economic Recovery vs. Defense Spending." **New York Times**, February 20, 1981.

Gold, David, Paine, Christopher and Shields, Gail. **Misguided Expenditure: An Analysis of the Proposed MX Missile System**. New York: Council on Economic Priorities, 1981.

Gordon, Robert J. **Macroeconomics** (Fifth Edition). Glenview, IL: Scott, Foresman, 1990.

Gordon, Robert J. and Veitch, John M. "Fixed Investment in the American Business Cycle, 1919-85." Working Paper No. 1426, Cambridge, MA: National Bureau of Economic Research, 1984.

Griffin, Larry J., Wallace, Michael and Devine, Joel A. "The Political Economy of Military Spending: Evidence from the United States." **Cambridge Journal of Economics**, March 1982, 6 (1), pp. 1-14.

Griliches, Zvi. "Productivity Puzzles and R&D: Another Non-explanation." **Journal of Economic Perspectives**, Fall 1988, 2 (4), pp. 9-22.

Hartung, William D., DeGrasse, Robert W. Jr., Rosy Nimroody and Stephen Daggett **The Strategic Defense Initiative: Costs, Contractors and Consequences**. New York: Council on Economic Priorities, 1985.

Hayes, Michael T. "The Semi-Sovereign Pressure Groups: A Critique of Current Theory and Alternative Typology." **Journal of Politics**, February 1978, 40 (1) pp. 134-61.

Henry, David K. and Oliver, Richard P. "The Defense Buildup, 1977-85: Effects on Production and Employment." **Monthly Labor Review**, August 1987, 110 (8), pp. 3-11.

Holzman, Franklyn D. "Are the Soviets Really Outspending the US on Defense?" **International Security**, Spring 1980, 4 (4), pp. 86-104.

Hong, Byung Yoo. **Inflation Under Cost Pass-Along Management**. New York: Praeger Publishers, 1979.

Joint Economic Committee (JEC). United States Congress. Subcommittee on Economic Goals and Intergovernmental Policy. **The Defense Buildup and the Economy**. Washington, D.C.: U.S. Government Printing Office, 1982.

Kaldor, Mary. **The Baroque Arsenal**. New York: Hill & Wang, 1981.

Kaldor, Mary, Sharp, Margaret, and Walker, William. "Industrial Competitiveness and Britain's Defense." **Lloyds Bank Review**, October 1986, No. 162, pp. 31-49.

Kaufman, Richard. **The War Profiteers**. Garden City, NY: Doubleday/Anchor Books, 1972.

Kennedy, Gavin. **Defence Economics**. New York: St. Martin's Press, 1983.

Kennedy, Paul. **The Rise and Fall of the Great Powers: Economic Change and Military Conflict from 1500 to 2000**. New York: Random House, 1987.

Kennedy, Peter. **A Guide to Econometrics** (Third Edition). Cambridge, MA: The MIT Press, 1992.

Koistinen, Paul A.C. **The Military Industrial Complex: A Historical Perspective**. New York: Praeger, 1980.

Korösi, Gábor, Mátyas, László and Székely, István P. **Practical Econometrics**. Aldershot, England: Avebury, 1992.

Lee, Maw Lin. "The Relationship of New Orders to Shipments of Defense Products," in United States Congress, Joint Economic Committee. **Economic Effect of Vietnam Spending** (Volume II). Hearings, Ninetieth Congress, First Session, Washington, D. C.: U. S. Government Printing Office, 1967 pp. 678-684.

Leontief, Wassily. "Statement," in United States Congress, Joint Economic Committee. **Economic Effect of Vietnam Spending** (Volume I). Hearings, Ninetieth Congress, First Session, Washington, D.C.: U.S. Government Printing Office, 1967.

Leontief, Wassily and Duchin, Faye. **Military Spending: Facts and Figures, Worldwide Implications and Future Outlook.** New York and Oxford: Oxford University Press, 1983.

Levin, Senator Carl. **The Other Side of the Story,** Washington, D.C.: Office of Senator Carl Levin, May 1983.

Lindgren, Goran. "Review Essay: Armaments and Economic Performance in Industrialized Economies." **Journal of Peace Research**, 1984, 21 (4), pp. 375-387.

Maddison, Angus. "Growth and Slowdown in Advanced Capitalist Economies: Techniques of Quantitative Assessment." **Journal of Economic Literature**, June 1987, 25 (2), pp. 649-698.

Markusen, Ann R. "Defense Spending and the Geography of High Tech Industries." Working Paper No. 423, University of California, Berkeley: Institute of Urban and Regional Development, 1984a.

Markusen, Ann R. "Defense Spending: A Successful Industrial Policy?" Working Paper no. 424, University of California, Berkeley: Institute of Urban and Regional Development, 1984b.

Martin, Stephen, Smith, Ron P. and Fontanel, Jacques. "Time-series Estimates of the Macroeconomic Impact of Defence Spending in France and the UK," in Christian Schmidt and Frank Blackaby, eds., **Peace, Defense and Economic Analysis.** New York: St. Martin's Press, 1987, pp. 384-398.

McConnell, Grant. **Private Power and American Democracy.** New York: Knopf, 1967.

McPherson, Michael S. "Modelling the Supply of Scientists and Engineers," in National Research Council, **The Impact of Defense Spending on Nondefense Engineering Labor Markets.** Washington D.C.: National Academy Press, 1986, pp. 43-51.

Melman, Seymour. **Our Depleted Society.** New York: Dell, 1965.

Melman, Seymour. **Pentagon Capitalism.** New York: McGraw-Hill, 1970.

Melman, Seymour. **The Permanent War Economy: American Capitalism in Decline.** New York: Simon & Schuster, 1974.

Melman, Seymour. **Profits Without Production.** New York: Alfred Knopf, 1983.

Mintz, Alex. "Guns versus Butter: A Disaggregated Analysis." **American Political Science Review**, December 1989, 83 (4), pp. 1285-1293.

Mintz, Alex and Huang, Chi. "Defense Expenditures, Economic Growth and the Peace Dividend." **American Political Science Review**, December 1990, 84 (4), pp. 1283-1293.

Mosley, Hugh. **The Arms Race: Economic and Social Consequences**. Lexington, MA: Lexington Books, 1985.

Mowery, David C. and Rosenberg, Nathan. **Technology and the Pursuit of Economic Growth**. Cambridge: Cambridge University Press, 1989.

Moynihan, Senator Daniel Patrick. **New York State and the Federal Fisc: IX**, Washington, D.C.: Office of Senator Moynihan, 1985.

National Research Council (NRC). **The Impact of Defense Spending on Nondefense Engineering Labor Markets: A Report to the National Academy of Engineering**. Washington, D.C.: National Academy Press, 1986.

National Science Board (NSB). **Science and Engineering Indicators - 1993**. Washington, D.C.: United States Government Printing Office, 1993.

National Science Foundation (NSF). **National Patterns of Science and Technology Resources**. Washington, D.C.: National Science Foundation, annual volumes.

Neustadt, Richard. **Presidential Power**. New York: Wiley, 1976.

Noble, David F. **Forces of Production: A Social History of Industrial Automation**. New York and Oxford: Oxford University Press, 1984.

North-east-Mid-west Institute. **The Pentagon Tilt: Regional Biases in Defense Spending and Strategy**. Washington, D.C.: North-east-Mid-west Institute, 1984.

O'Connor, James. **The Fiscal Crisis of the State**. New York: St. Martin's Press, 1973.

Oden, Michael Dee. **Military Spending, Military Power, and U.S. Postwar Economic Performance**. Unpublished doctoral dissertation, New School for Social Research, 1992.

Office of Management and Budget (OMB). **Budget of the United States Government, FY 1989: Historical Tables**. Washington, D.C.: U.S. Government Printing Office, 1988.

Office of Management and Budget (OMB). **Budget of the United States Government FY 1992: Historical Tables**. Washington, D.C.: U.S. Government Printing Office, 1991.

Organization for Economic Cooperation and Development (OECD). **Historical Statistics**. Paris: Organization for Economic Cooperation and Development, 1987.

Ozawa, Terutomo. "Technology Transfer and Japanese Economic Growth in the Postwar Period," in R.G. Hawkins and A.J. Prasad, eds., **Research in International Business and Finance** (Volume 2). Greenwich, CT: JAI Press, 1981.

Peck, Merton J. and Scherer, Frederic M. **The Weapons Acquisition Process: An Economic Analysis**. Boston, MA: Harvard School of Business Administration, 1962.

Perman, Roger. "Cointegration: An Introduction to the Literature." **Journal of Economic Studies**, 1991, 18 (3), pp. 3-30.

Pindyck, Robert S. and Rubinfeld, Daniel L. **Econometric Models and Economic Forecasts** (Third Edition). New York: McGraw-Hill, 1991.

President's Private Sector Survey on Cost Control, 1983. **Task Force Report on the Office of the Secretary of Defense; Task Force Report on the Department of the Army; Task Force Report on the Department of the Navy; Task Force Report on the Department of the Air Force**. Washington, D.C.: Department of Commerce, 1983.

Ramo, Simon. **America's Technology Slip**. New York: John Wiley and Sons, 1980.

Rasler, Karen and Thompson, William R. "Defense Burdens, Capital Formation, and Economic Growth: The Systemic Leader Case." **Journal of Conflict Resolution**, March 1988, 32 (1), pp. 61-86.

Reppy, Judith. "Long Term Consequences of Military Spending." Paper presented at the annual meeting of the International Studies Association, Washington, D.C., March 1985.

Riddell, Tom. "The Employment Effects of Military Spending." Paper presented at the annual meeting of the Allied Social Sciences Association, Dallas, TX, December 1984.

Rosenberg, Nathan. **Perspectives on Technology**. New York: Cambridge University Press, 1976.

Rothschild, Kurt W. "Military Expenditure, Exports and Growth." **Kyklos**, 1973, XXVI (4), pp. 804-814.

Russett, Bruce. "Defense Expenditures and National Well-Being." **American Political Science Review**, December 1982, 76 (4), pp. 767-777.

Sapolsky, Harvey M. **The Polaris System Development: Bureaucratic and Programmatic Success in Government.** Boston, MA: Harvard University Press, 1972.

Schattschneider, Elmer Eric. **The Semi-Sovereign People** (Second Edition). Hinsdale, IL: Dryden Press, 1975.

Schmidt, Christian and Blackaby, Frank, editors. **Peace, Defense and Economic Analysis.** New York: St Martin's Press, 1987.

Seidman, Harold. **Politics, Position and Power.** New York: Oxford University Press, 1970.

Smith, R. P. "Military Expenditures and Capitalism." **Cambridge Journal of Economics**, March 1977, 1 (1), pp. 61-76.

Smith, R. P. "Military Expenditure and Capitalism: A Reply." **Cambridge Journal of Economics**, September 1978, 2 (3), pp. 299-304.

Smith, Ronald P. "Military Expenditure and Investment in OECD Countries, 1954-1973." **Journal of Comparative Economics**, March 1980, 4 (1), pp. 19-32.

Smith, Ron and Smith, Dan. "Military Expenditures, Resources and Development." Unpublished study prepared for the United Nations, 1980.

Starr, Harvey, Hoole, Francis W., Hart, Jeffrey A., and Freeman, John R. "The Relationship Between Defense Spending and Inflation." **Journal of Conflict Resolution**, March 1984, 28 (1), pp. 103-122.

Stevens, Robert Warren. **Vain Hopes, Grim Realities: The Economic Consequences of the Vietnam War.** New York: New Viewpoints, 1976.

Stubbing, R. "The Imaginary Defense Gap: We Already Outspend Them." **Washington Post**, 14 February, 1982.

Sveikauskas, Leo. "The Contribution of R&D to Productivity Growth." **Monthly Labor Review**, March 1986, 109 (3), pp. 16-20.

Szymanski, Al. "Military Spending and Economic Stagnation." **American Journal of Sociology**, July 1973, 79 (1), pp. 1-14.

Thurow, Lester. "How to Wreck the Economy." **New York Review of Books**, May 14, 1981.

Trebilcock, Clive. "Spin-off in British Economic History: Armaments and Industry, 1760-1914." **Economic History Review**, December 1969, 22 (3), pp. 474-490.

United Nations Centre for Disarmament. **Economic and Social Consequences of Military Spending**. New York: United Nations, 1978.

Vitaliano, Donald F. "Defense Spending and Inflation: An Empirical Analysis." **Quarterly Review of Economics and Business**, Spring 1984, 24 (1) pp. 22-32.

Walker, John F. and Vatter, Harold G. "Why has the United States Operated Below Potential Since World War II?" **Journal of Post Keynesian Economics**, Spring 1989, XI (3), pp. 327-346.

Weidenbaum, Murray L. "The Economic Impact of the Government Spending Process," in United States Congress, Joint Economic Committee. **Economic Effect of Vietnam Spending** (Volume II). Hearings, Ninetieth Congress, First Session, Washington, D. C.: U. S. Government Printing Office, 1967, pp. 603-661.

Weidenbaum, Murray, L. **Economics of Peacetime Defense**. New York: Praeger Publishers, 1974.

Wolff, Edward. "The Magnitude and Causes of the Recent Productivity Slowdown in the United States." in William J. Baumol and Kenneth McLennan, eds., **Productivity Growth and US Competitiveness**. New York and Oxford: Oxford University Press, 1985, pp. 29-57.

Wolff, Edward. **Growth, Accumulation and Unproductive Activity**. Cambridge and New York: Cambridge University Press, 1987a.

Wolff, Edward. "Review of **Post-War Economic Growth Revisited** by G. Bombach." **Journal of Economic Literature**, March 1987b, XXV (1), pp. 140-142

Zeigler, H., and Peak, W.G. **Interest Groups in American Society** (Second Edition). Englewood Cliffs, NJ: Prentice Hall, 1972.