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WORKING PAPER NO. 688

DEFENSE SPENDING REDUCTIONS AND THE CALIFORNIA ECONOMY: A COMPUTABLE GENERAL EQUILIBRIUM MODEL

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Abstract

This study uses a multisector, computable general equilibrium model to analyze the impact of cutbacks in federal defense expenditures on the California economy. Growth in government expenditures at all levels was clearly one of the driving forces behind the rapid economic growth of the state in the past, and the decline in such expenditures has been a major contributing factor to the slowdown of the state economy. The results indicate that the California economy is sensitive to cutbacks in federal defense expenditures, and increasingly so as state labor and capital markets are linked to national markets. Assuming both labor and capital are mobile, the model yields defense-GSP (gross state product) expenditure multipliers of 4–5. Assuming only labor is mobile yields a multiplier of around one. In this case, defense cutbacks of 40–60 percent lead to significant migration of skilled labor categories out of the state (2–9 percent) and to decreases in state product of 2–3 percent. These results indicate that labor and capital mobility are very important to the state economy. Policies that make the state more desirable to investors and labor will significantly lower the negative impact of reductions in defense and other government expenditures.

Funding for this project was provided by the California Energy Commission. The views expressed in this paper are those of the authors and do not necessarily represent the views or policies of the funding institution. This report is also available as a final report to the California Energy Commission, Contract No. 300-91-010, Computable General Equilibrium Models of California and the Los Angeles Basin, Volume 1: Defense Spending Reductions and the California Economy (May 1994). The authors would like to thank Michael Dardia (Rand Corporation), David Henry (U.S. Department of Commerce), and William Thomas (Congressional Budget Office) for generously sharing their experience studying the economic role of defense contracting in the United States. We especially thank David Henry for sharing sectoral data on national defense expenditures. Any errors or omissions are solely the responsibility of the authors.

Summary

During the 1980s, the United States experienced a defense build-up comparable to that of previous wars. Between 1980 and 1986, national defense outlays increased 49%, to a level just slightly less (in real terms) than outlays at the peak of the Vietnam War. Since the mid-1980s national defense cuts have paralleled previous post-war experience. By 1991, national defense budget authority was 20% below its 1985 peak and cuts in defense expenditures are expected to continue through most of the 1990s.

By FY1999, under the Clinton FY1995 budget proposal, defense spending is expected to fall 32% from 1990 levels. According to the Congressional Budget Office, procurement spending is expected to fall through 1995 and then increase throughout the remainder of the decade. By 1999, national defense procurement outlays are expected to be 43% below 1990 levels. In the wake of the end of the cold war, Congress also called for three rounds of base closures (1991, 1993, 1995). The 1991 and 1993 rounds are expected to eliminate 120,700 of the 2,115,645 Department of Defense (DoD) jobs that existed nationwide in FY1990.

The California economy benefitted significantly from the defense build-up of the 1980s. According to one study (Kroll 1993), defense-related employment is credited with more than half the net increase in manufacturing jobs between 1982 and 1987. Similarly, the reductions in defense spending are credited with contributing significantly to the downturn in the California economy since 1990 (Gov. 1994). The value of prime defense contracts awarded to California firms rose 47% from 1981 to 1984 and fell 30% from 1985 to 1992. This decline was comparable to the decline between 1969 and 1971, following the Vietnam war. The California Governor's Office translates national cuts in defense expenditures to a 60% cut in defense spending in California (Gov. 1994).

The California economy is more dependent on defense spending than the nation as a whole. California receives a larger proportion of U.S. defense spending than any other state (19.3% of 1992 U.S. defense outlays). But it also has the largest state economy in the nation — 14% of 1990 U.S. GDP (Gross Domestic Product). The share of federal defense spending in California GSP (Gross State Product) is higher than that in the national economy as a whole (6.7% of California GSP compared to 5.7% of U.S. GDP). These expenditures are concentrated in a few important manufacturing and service sectors (planes, ships, space, instruments, and public administration).

Several studies have examined the impact of defense cuts on the U.S. economy. A major Department of Defense study used the DEIMS model, a relatively straightforward application of an input-output model. Two other major studies by the Congressional Budget Office and the national Defense Conversion Commission have used the INFORUM model, which integrates an input-output model with a macroeconomic model. These studies both conclude from long-run, comparative dynamic experiments that the defense cuts will have a significant negative impact on national employment and GDP. This negative shock can be mitigated, however, by channelling the savings into private or public investment, especially investment that increases productivity.

This study uses a multi-sector, computable general equilibrium model of the California economy (CA-CGE model) to investigate the range of impacts defense cuts may have on the state economy. The results indicate that the magnitude of the effect of defense cuts on California is highly sensitive to the degree to which the state economy is linked to national factor markets. In the longer run, assuming both labor and capital mobility between the state and the rest of the country, results show a defense expenditure-GSP multiplier of 4 to 5. A cut of one billion dollars in federal defense expenditures in California lowers California GSP by $4-5 billion. In this case, defense cutbacks create a ripple effect throughout the state economy, leading to large declines spread across all sectors. In the medium run, with only labor markets linked nationally, the multiplier is around 1. In this long-run case, defense cuts of 40% to 60% lead to significant migration of skilled labor out of the state (2-9%) and to decreases in GSP of 2% to 3%.

The impacts of defense cuts vary widely by sector. CBO's short-run national study projects that, under a 42% defense spending cut, defense demand for guided missiles nationally will fall 38% from 1992 to 1998, and demand for engineering and scientific instruments will fall by 52%. In the CBO projections, 56% of 4 national industrial sectors change by less than 1% in either direction. In the CA-CGE model, assuming only labor is mobile, a 40% defense cut results in a 14% to 47% decrease in sectoral value added in California for highly defense-dependent sectors (planes, ships, space, and instruments). Most other sectors decline less than 5%. When both labor and capital are mobile, the income multiplier effect dominates the sectoral effect, spreading the impact of defense cuts across the entire state economy. Under a 40% cut in defense spending, most California industrial sectors decline 10% to 15%. Planes are more heavily affected, declining 23%.

Job loss involves an adjustment for both employee and employer. A good indicator of the disruption caused by defense cuts is the number of jobs lost, even assuming that the displaced workers find alternative employment. In the CA-CGE model variant where only labor is mobile, a 20% cut in defense spending leads to gross job-loss of 291,000 in California, while a 40% cut leads to a loss of 516,000 jobs (from a 1990 base employment of 16,540,000). Assuming both capital and labor mobile, a 40% cut leads to loss of 1,679,000 jobs, or about 10% of base employment. Results from other analyses fall within the range found using the CA-CGE model.

The CA-CGE model results indicate that the California economy is sensitive to cutbacks in federal defense expenditures. They also indicate the importance of government spending in general. Growth in government expenditures at all levels was one of the driving forces behind the rapid growth in California during the 1980s, and the decline in these expenditures has been a major contributing factor to the slowdown of the state economy. The fact that the negative impacts of defense cutbacks are much worse the more closely California factor markets are linked to national markets also has significant policy relevance. If California wishes to lessen the impact on the state economy of defense cutbacks, it is important to pursue policies that encourage capital and labor to remain in the state. Policies that make the state economy more desirable to investors and labor will significantly lower the negative multipliers associated with defense and other government expenditure reductions.

Introduction

The California economy entered a significant downturn in 1990. California non-farm wage and salary employment has dropped steadily since mid-1990 at a rate of roughly 1 to 2 percent per year (Gov. 1994). This is the longest continuing decline in California employment since 1939.[1] In his 1994 budget proposal, Governor Wilson claimed that, "there is no question that [the] defense [build-down] is by far the leading cause of the state's economic distress. With the full impact of the Clinton cuts yet to be felt, recovery through much of this decade will be jeopardized absent concerted action at all levels of government" (Gov. 1994 p. 14).

California reaped substantial gains from expansion in U.S. military spending through the mid-1980s — an expansion comparable to that experienced in previous wars. Between 1982 and the peak in 1984, prime defense procurement contract awards to firms in California rose 47% from a level that in 1982 already exceeded prime contract awards at the height of the Vietnam War (DoD Prime Contract Awards various years). Nationwide, this expansion ended in 1986. By 1994, national defense outlays had fallen roughly 20% from their 1986 level in real terms (Thomas 1994).

This study discusses the role defense spending has played in California's economy and the role reduction in defense spending is playing in the state's current recession. It uses a computable general equilibrium (CGE) model to analyze the potential impacts of these cuts on the California economy. Section 1 discusses defense spending's role in the U.S. economy and reviews proposed reductions in defense spending cuts at the national level. Section 2 describes the role defense spending has played in state economies, particularly California. Section 3 reviews models which have been used to analyze the impact of defense cuts nation-wide. Section 4 presents a multisectoral, computable general equilibrium (CGE) model of California. Finally, section 5 discusses the results of an analysis using this model to study the impact of defense spending cuts.

1. The National Picture

1.1 Defense Spending in the National Economy

The United States has undergone five major military expansions and contractions in this century: four associated with major wars and a fifth with the recent Reagan defense build-up (Figure 1). The country has experienced slowed economic activity during these disarmament periods. Between 1945 and 1946, defense spending fell by $57.3 billion or 27% of 1945 GNP. Nominal GNP fell $22.8 billion or 10.3% (18% in real terms) from a peak in 1945 to a post-war recession trough in 1946. Real GNP did not recover fully until the end of 1952 (Garfinkel 1990).

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[1]California has been remarkably fortunate to have had almost continuous statewide growth in non-farm wage and salary employment since the Great Depression. The period since 1990 is the first time since 1939 that California non-farm wage and salary employment has dropped in more than one consecutive year (CDF 1993).

After the Korean War the defense budget was cut by $7.4 billion or 2% of 1953 GNP. Real GNP fell 3.2% from a peak in mid-1953 to a trough in mid-1954. By the beginning of 1955, it again exceeded its 1953 level (Garfinkel 1990). A significant trough followed the end of the Vietnam War. It is unclear whether it was caused by defense reductions or by the world oil shocks in the early 1970s.

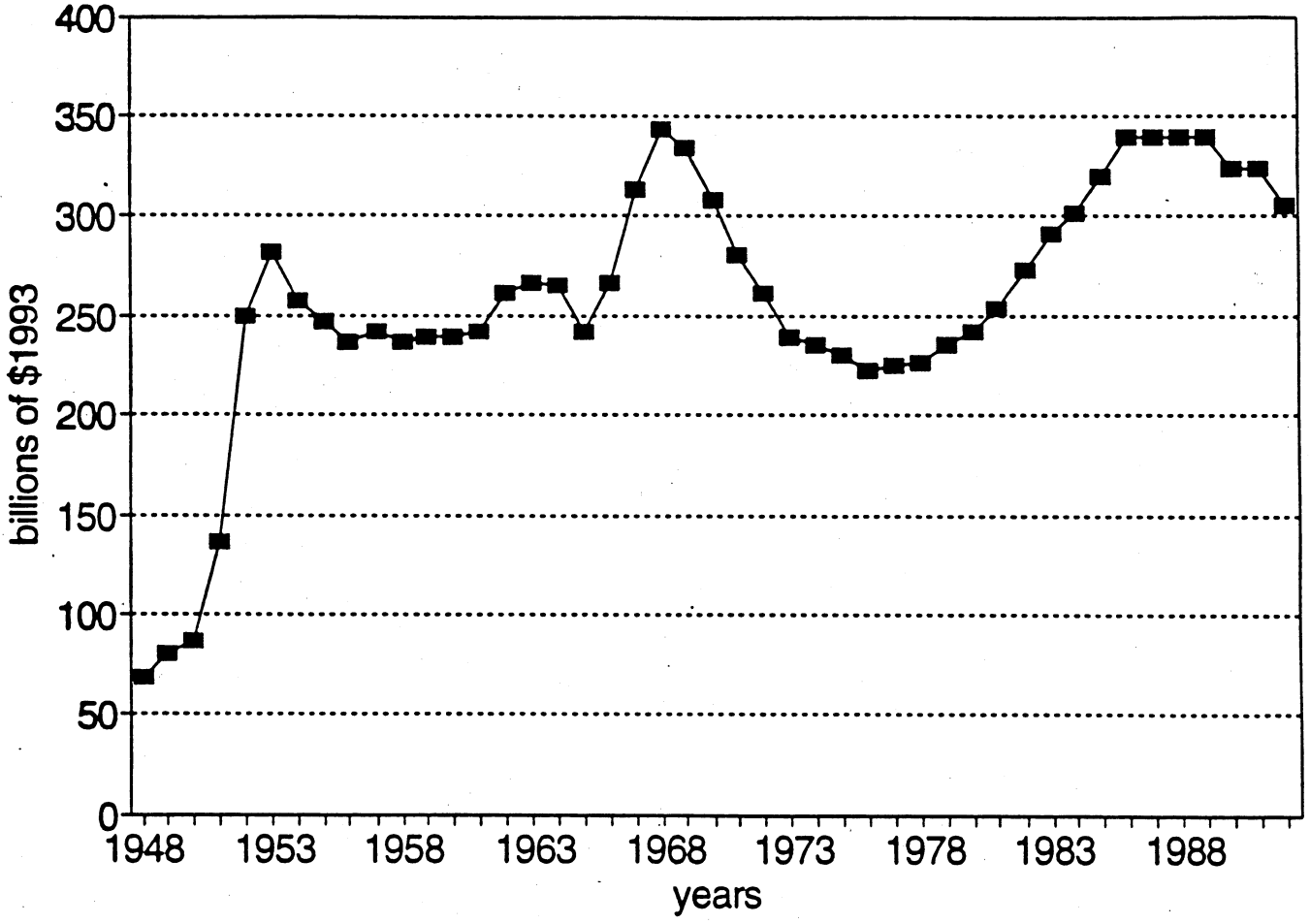
The Reagan defense build-up was massive in absolute terms. Between 1976 and 1986, U.S. defense expenditures increased from $230 billion to almost $350 billion (1992 dollars) (CBO 1992). The national defense budget authority increased about 5% annually in real terms from 1980 to 1986 (Garfinkel 1990, Jayne 1988). By 1986, it was 49% higher in real terms than in it was in 1980 (CBO 1992).[2] In real terms, the 1986 spending level was only slightly less than that at the height of the Vietnam War.

Relative to other economic activities, the build-up was not as massive. Since the early 1950s, defense has accounted for a progressively smaller proportion of U.S. GNP. When the Reagan build-up peaked in 1986, defense spending accounted for 6.6% of GNP. This was less than the post World War II average of 7.4% (Wynne 1991). By 1990 it had fallen to 5.8% of GNP. By 1995, defense spending will account for less than 4% of GNP, a historic post-World-War-II low (CBO 1993). Analysis of the 1990s defense budgets often cite this figure with alarm, yet it is part of a secular decline, due more to an absolute increase in U.S. GNP than reductions in defense spending (Figure 2).

1.2 Defense Cuts at the National Level

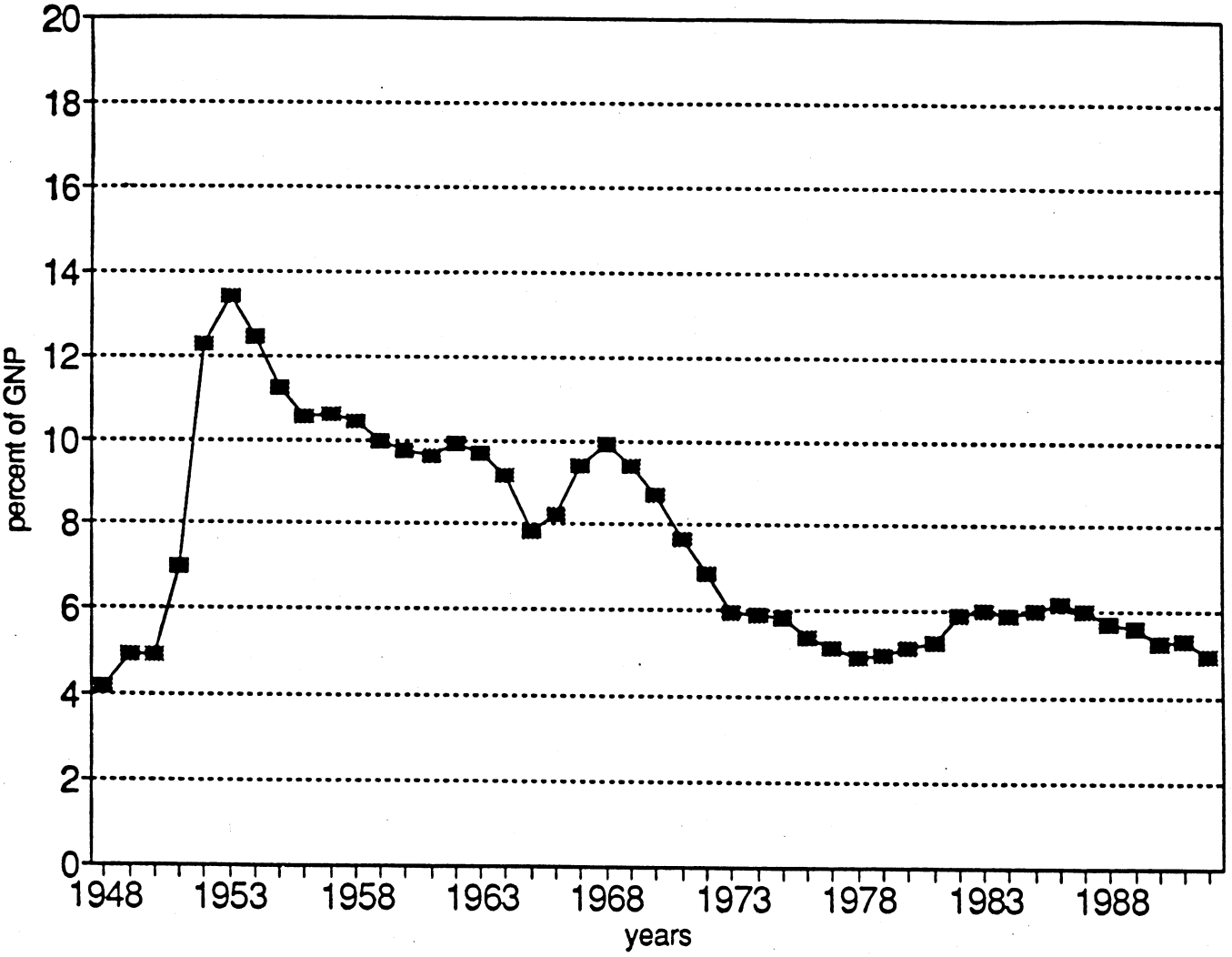
Beginning in 1986, Congress failed to increase annual defense appropriations substantially, in effect cutting them in real terms by 2% annually between 1986 and 1991. Defense budget authority fell from $317.5 billion in 1986 to $278.3 billion in 1991 (1990 dollars) (Commerce 1993a). By 1991, the national defense budget authority was already 20% below its 1985 peak in real terms (CBO 1992). Defense spending became a major issue in the 1990 budget summit and consequent Omnibus Budget Reduction Act of 1990 (OBRA) (CBO 1992). OBRA mandated that 36% ($180 billion) of the reduction in the federal deficit planned for 1991-1995 come from defense; in effect capping 1995 defense expenditures at $350 billion (Table A). Consistent with this mandate, the Bush FY1991 budget proposed a 2% real annual decrease in DoD's budget for FY1991 to FY1995 (CBO 1992). The Bush FY1992 budget reduced real annual defense outlays 20% by 1997 (CBO 1992) (Figure 3).

[2]Defense budget authority here refers to Congressional authorization for Department of Defense (DOD) spending. Actual spending (DOD outlays) lag spending authorization by periods of several months to several years depending on the type of expenditure.



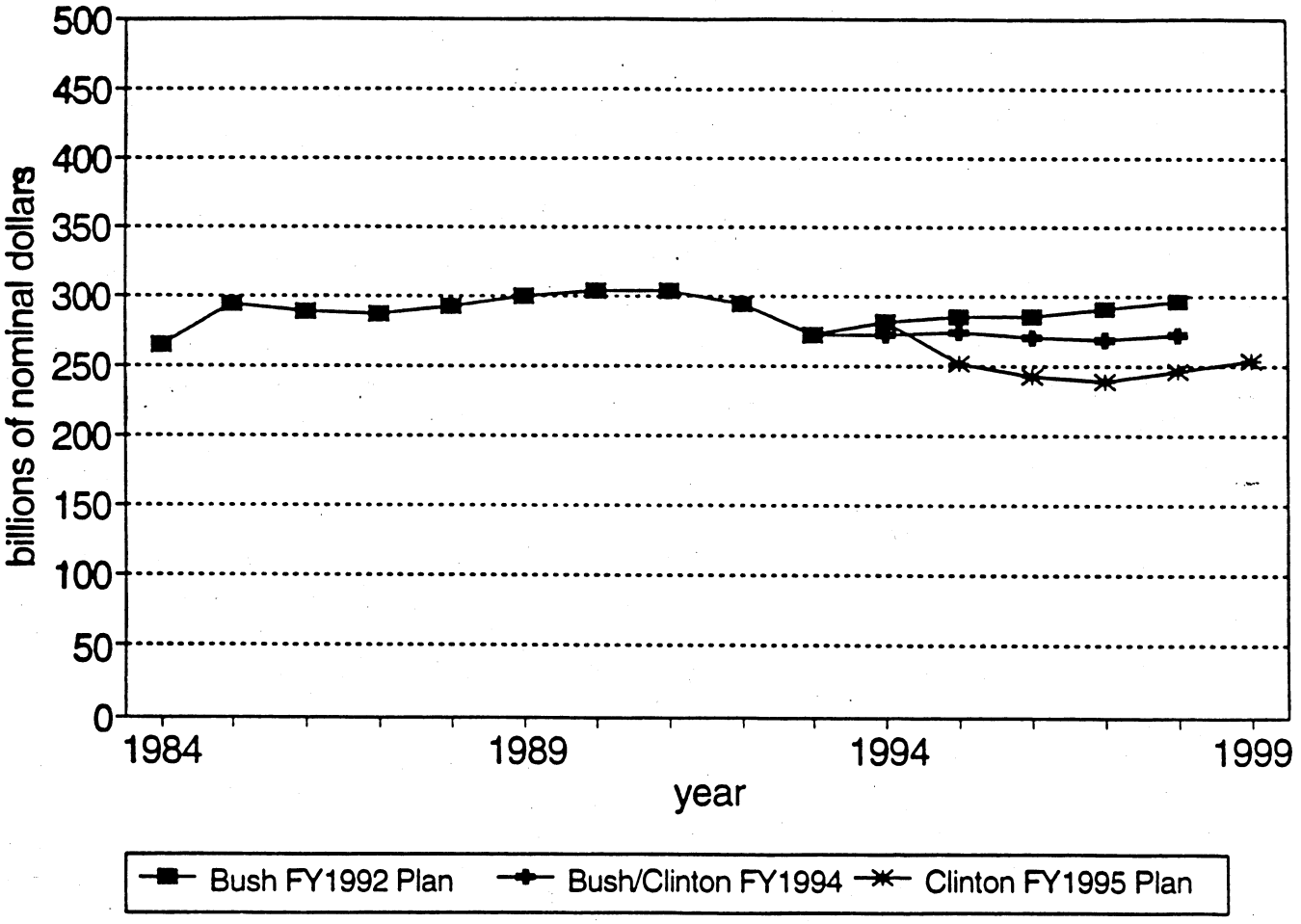
Source: U.S. Council of Economic Advisers, *Economic Report of the President* (various years).

Figure 1. U.S. Defense Outlays (1948-92)



Source: U.S. Council of Economic Advisers, *Economic Report of the President* (various years).

Figure 2. U.S. Defense Outlays as a Percent of GNP (1948-92)



Source: Congressional Budget Office, (CBO) *Effects of Alternative Defense Budgets on Employment* (1992); CBO, *Planning for Defense: Affordability and Capability of the Administration's Program* (1994).

Figure 3. Actual and Alternative Defense Authority (1984-99)

The Clinton FY1994 budget proposal closely followed the expected Bush FY1993 budget, reducing projected FY1997 defense outlays from $273 billion to $215 billion (1993 dollars) (CSF 1993). This proposal would have reduced national defense outlays by $131 billion between 1994 and 1998 (CSF 1993) (Figure 3). At the same time, President Clinton announced initiation of a "bottom up review" of defense budgetary requirements (CBO 1994). The review, completed in October 1993, focused on the need for conventional weapons and forces. A second review of strategic forces is under way which may recommend cuts affecting California's missiles and space sector.

The Clinton FY1995 budget proposal reflects national defense plans developed in the Joint Chief of Staffs "bottom-up review" (CBO 1994). The FY1995 proposal provides $104 billion (1994 dollars) less funding for defense between 1995 and 1999 than did the FY1994 budget. Under the FY1995 budget proposal, 1999 defense spending would be 32% below 1990 levels. CBO estimates that under this proposal defense spending would fall from 4.2% of GDP in 1994 and to 2.9% by 1999. These proposed spending levels push the discretionary spending caps established under the Budget Enforcement Act of 1990 extended by Omnibus Budget Reconcilliation Act of 1993 (OBRA-1993). Further, Secretary of Defense Perry has stated that the FY1995 budget falls $20 billion short of the funding needed to maintain the forces called for in the "bottom up review" (CBO 1994).

The Clinton FY1995 proposal hits procurement harder than other areas of defense expenditure (Table 1). In 1990, defense procurement budget authority stood at $94 billion (1995 dollars) (DoD Prime Contract Awards 1990). Under the FY1995 budget it drops 54% to $43 billion (1995 dollars) by 1995. During the remainder of the decade it will rise slightly, with 1999 levels 43% below those in 1990 (CBO 1994). Procurement spending is expected to increase further during the first decade of the next century. Defense analysts maintain that the current "holiday" from procurement spending was only made possible by the extraordinarily high level of procurement of advanced weapons systems during the 1980s (CBO 1994). This leaves open the possibility that California could enter another boom and bust cycle in the early part of the next century. The instability these cycles introduces into the state's economy may be amplified in the future. As generations of weapons have become successively more expensive, variation between peaks and troughs in defense spending cycles appears to be increasing.

Table 1. Trends in National Defense Budget Authority by Budget Category Under Clinton Administration FY1995 Proposed Budget

	Budget Authority (billions of 1995 dollars)						Change from 1990 Level (in percent)	
	Fiscal Year							
Category	1990	1995	1996	1997	1998	1999	1995	1999
Dept. of Defense								
Military Personnel	$ 91	$ 70	$ 65	$ 63	$ 62	$ 61	–23%	–33%
Operation and Maintenance	103	93	86	83	81	81	–10	–21
Procurement	94	43	47	47	52	53	–54	–43
Research development, test, and evaluation	42	36	34	30	28	27	–14	–36
Military construction	6	5	8	5	4	4	–15	–38
Family housing	4	3	4	3	3	3	–9	–5
Other	0	1	–5	–4	–4	–3	N/A	N/A
Subtotal	339	252	237	228	227	227	–26	–33
Other Agencies	12	12	12	11	11	11	–8	–8
TOTAL	351	264	249	239	238	238	–25	–32

Source: Congressional Budget Office, *Planning for Defense: Affordability and Capability of the Administration's Program* (1994).

Notes: Budget authority proposed in the Clinton FY1995 budget. DoD price index was used to express values in constant 1995 dollars.

N/A = not available.

In 1991, at the same time that proposals were being made to cut defense expenditures significantly, Congress called for further realignment of U.S. military bases. The 1991 National Defense Authorization Act called for the Base Closure and Realignment Commission to reconvene in 1991, 1993, and 1995 to reassess military needs and recommend additional facilities for closure or realignment (CBO 1992).

The 1991 round of base closures led to a direct net loss of 30,600 military and 27,800 civilian jobs nationwide. In total, national military personnel payroll decreased from $75.6 billion in 1990 to $72.8 billion (1990 dollars) in 1992 (DoD Atlas various years). In the 1993 round, the Base Closure Commission recommended closing 130 bases and realigning 43 bases nationally (BRAC 1993). The 1993 round of base closures will result in a net loss of 20,700 military and 41,600 civilian jobs nationwide (DoD 1993a). These actions are expected to result net savings of $3.8 billion (BRAC 1993). Recommendations of further cuts are expected from the 1995 meeting of the Base Closure Commission.

2. The State Picture

2.1 Geographic Distribution of Defense Industries

The United States has a long history of regional specialization in defense-related industries. Defense spending has shifted between regions as military demand and technology have changed (Malecki 1984). In the 1950s and 1960s, as military expenditures shifted to aircraft and missiles, they shifted geographically away from the Great Lakes states (centers of auto and conventional munitions manufacture) to California and the Pacific northwest, where space and climate provided a cost advantage in testing and building aircraft (Crump 1989). The presence of top universities further favored the development of defense-related electronics and aerospace industries in California and the Northeast during the 1960s, 1970s, and 1980s by providing research facilities and a highly skilled labor pool (Malecki and Stark 1988). Recently, Texas, Arizona, Florida, and Georgia have emerged as areas of concentrated defense activity involving space and aviation (Malecki and Stark 1988).[3]

California has shown a remarkable ability to remain a center for defense industries, even with major changes in the nature of weapons systems. California has remained among the top ten recipients of defense spending since World War II (Table 2). In 1992, California continued to lead the nation in direct and indirect defense spending (CBO 1993). Although its share of national prime contract awards has dropped since the 1960s, California still received 19.3% of direct U.S. defense outlays in 1992 (CBO 1993, Crump 1989, DoD Prime Contract Awards various years).

[3]Personal communication with Michael Dardia, Rand Corporation, March/April 1994.

Table 2. Average Prime Contract Awards by State, World War II-1990s (Percentage of U.S. total)

Rank	World War II	% of U.S.	Korean War	% of U.S.
1	New York	10.5%	New York	15.3%
2	Michigan	10.5	California	13.6
3	California	9.1	Michigan	9.5
4	Ohio	8.3	Ohio	6.3
5	Pennsylvania	6.8	New Jersey	5.3
6	Illinois	6.4	Illinois	5.0
7	New Jersey	6.3	Pennsylvania	4.5
8	Indiana	4.8	Indiana	4.5
9	Connecticut	3.8	Connecticut	4.2
10	Texas	3.8	Washington	4.0
Percent Accounted for:		70.3		72.2

Rank	1960s	% of U.S.	1980s	% of U.S.	1990s	% of U.S.
1	California	23.9%	California	22.0%	California	19.7%
2	New York	11.4	New York	7.8	Texas	7.8
3	Massachusetts	5.1	Texas	6.9	Virginia	6.0
4	New Jersey	4.9	Massachusetts	5.4	Massachusetts	5.8
5	Texas	4.8	Missouri	5.1	New York	5.3
6	Connecticut	4.5	Connecticut	4.8	Missouri	4.5
7	Ohio	4.4	Virginia	4.5	Florida	4.2
8	Pennsylvania	3.6	Florida	3.7	Maryland	3.5
9	Washington	3.4	Maryland	3.1	Connecticut	3.4
10	Michigan	2.8	Ohio	2.8	Ohio	3.4
Percent Accounted for:		68.8		66.1		63.5

Source: E. Malecki and L. Stark, "Regional and Industrial Variation in Defense Spending: Some American Evidence," in *Defence Expenditure and Regional Development* (1988) and DoD, *Prime Contract Awards by Region and States*, Fiscal Years (various years).

Table 2 also shows that defense spending is remarkably concentrated geographically. There is obvious political advantage to spreading defense spending broadly among jurisdictions, yet for the past 50 years ten states have captured more than 60 percent of the prime procurement contract awards (Malecki and Stark 1988). This concentration, however, has declined over the past 40 years. This decline, rather than competition from other major recipient states, appears to account for California's decreasing share of national contract awards.

Defense procurement is also regionally specialized at an industry level (Table 3). Several states have large contract shares in only one or two industries. For example, between 1989 and 1991 Ohio received an average of 39.4% of prime contracts for aircraft engines, but only 6.8% of total aircraft prime contracts (DoD Prime Contract Awards various years). Only a handful of states have large shares in several categories. In the 1980's, these included California and Texas. These states' diversification within defense may reflect agglomeration economies associated with geographic proximity (see Krugman 1991, Porter 1990, and Glaeser 1992).[4] Our model results, described below, are consistent with the comments of several defense analysts that even among these states there is a great deal of intra-industry specialization and subsectoral trading between states (Malecki 1984).[5]

2.2 Defense Spending in California

During the 1980s, California gained considerably from the up-side of the defense market. The Commission on State Finance contends that the Reagan build-up contributed significantly to California's recovery from the 1982 recession (CSF, 1992). Defense-related employment has been credited for more than "half the net increase in manufacturing jobs between 1982 and 1987 (still a relatively small share of total job growth during this period)" (Kroll 1993 p.2). Between 1981 and 1986 (the national peak of the 1980's prime contract awards), prime contract awards to California rose 47%. During this period, California accumulated $74 billion (1990 dollars) in excess of its average annual prime contract awards for the period 1960 through 1979 (DoD Prime Contract Awards various years). At the peak of defense outlays under the Reagan defense build up, California received more than $60 billion (1992 dollars), over $10 billion (1990 dollars) more than it received at the height of the Vietnam War (CSF 1992). In real terms, prime contract awards have still not fallen below their peak during the Vietnam War (Figure 4).

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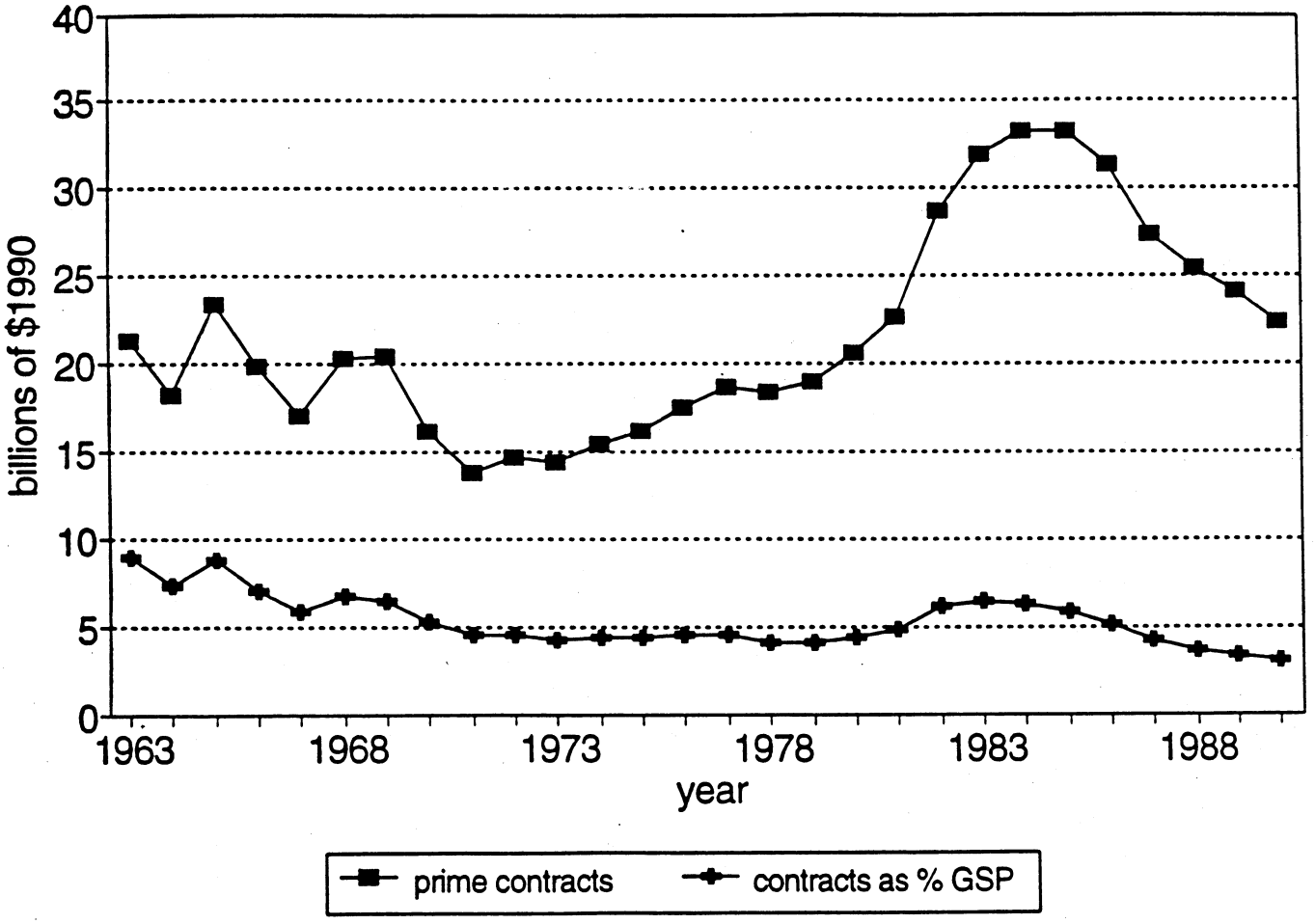
[4]The regional distribution of subcontracts from the recipients of prime contracts may also have a significant effect on the concentration of defense spending and on the impact of defense cuts on a state or regional economy. A survey of studies of subcontracting patterns concluded that little net geographic dispersion of DoD funds occurs because of subcontracting. (Malecki and Stark 1988). For a more complete discussion of the geographic distribution of subcontracting see Hoffmann (1994).

[5]Personal communication with Michael Dardia, Rand Corporation, March/April 1994.

Table 3. Geographic Distribution of Defense Prime Contract Awards by Industrial Sector

	Fiscal Year 1989-1991		
	Rank	State	% of U.S. Total
Aircraft and Parts	1	California	17.9%
	2	Missouri	16.1
	3	Texas	15.3
	4	Connecticut	8.8
	5	New York	7.6
		Total	65.7
Missile and Space	1	California	33.9
	2	Massachusetts	13.1
	3	Colorado	10.1
	4	Texas	7.3
	5	Missouri	3.8
		Total	68.2
Ships	1	Connecticut	18.3
	2	Virginia	17.4
	3	Mississippi	9.7
	4	New York	9.1
	5	California	8.4
		Total	62.9
Electronics	1	California	19.7
	2	Massachusetts	11.7
	3	New York	9.0
	4	Virginia	7.2
	5	Maryland	6.1
		Total	53.7
Services	1	California	17.4
	2	Virginia	13.3
	3	Massachusetts	7.5
	4	Maryland	6.7
	5	Dist. of Columbia	5.0
		Total	49.9

Source: DoD, *Prime Contract Awards by Region and States* (various years).



Source: Department of Defense, *Prime Contract Awards by Region and State* (various years); California Department of Finance, *California Statistical Abstract* (1993).

Figure 4. Defense Prime Contracts Over $25,000 Awarded to California Firms

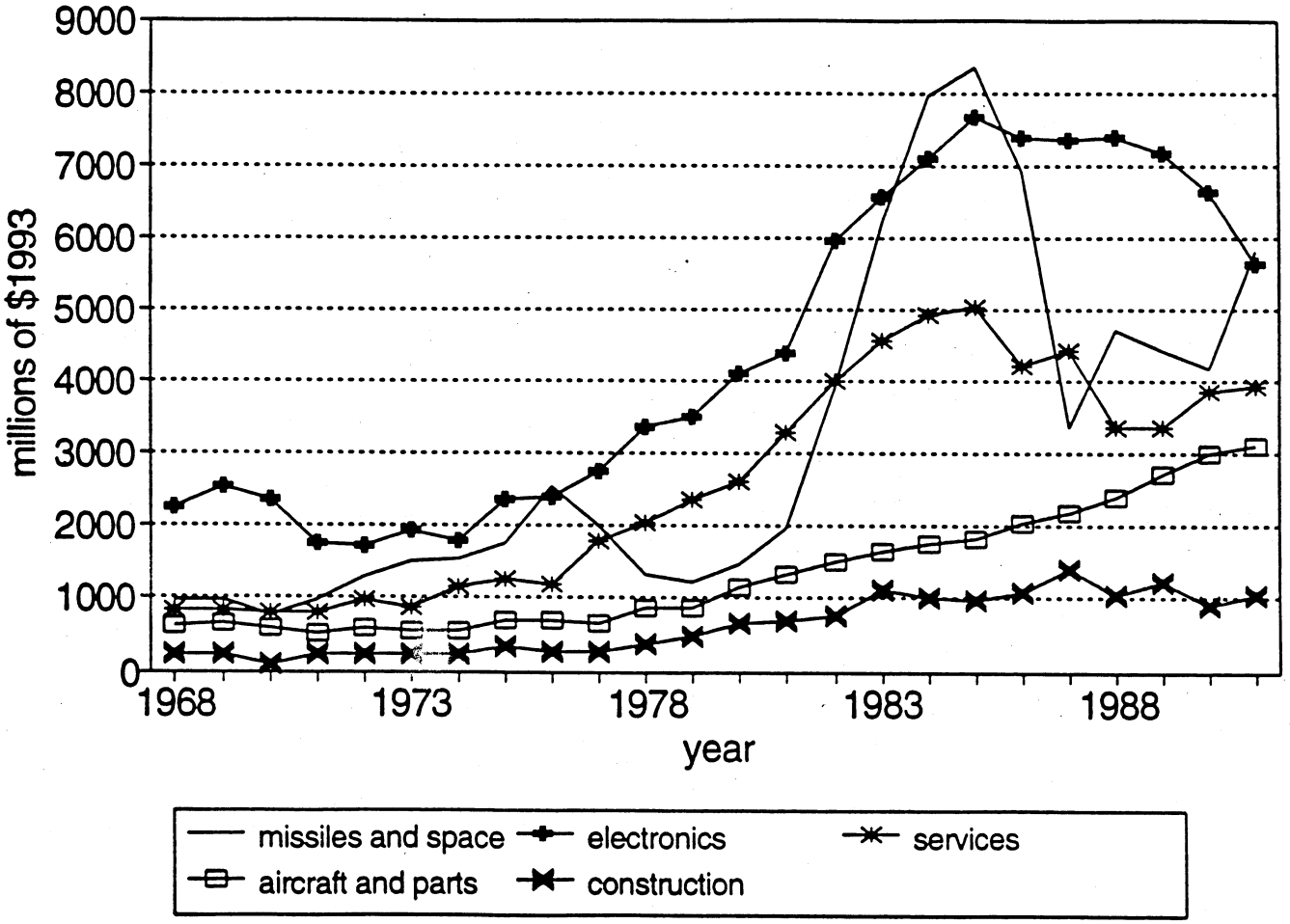
State government analysts also argue that declines in defense spending have contributed significantly to California's current recession (CSF 1992, Gov. 1994). Between 1984 (the peak of 1980s contract awards to California) and 1992, defense prime contracts to California firms decreased 30%. This decline compares with a 32% drop from 1969 to 1971, in the wake of the Vietnam War.[6]

On the other hand, the California Commission on State Finance (CSF) maintains that the state is less dependent on defense spending and better positioned to sustain the current build down than it was during the build-down after the Vietnam War. They estimate that defense expenditures accounted for almost 14% of Gross State Product (GSP) at the height of Vietnam War-related spending, but only 8.6% of GSP at the height of the Reagan era build up.[7] Data on actual outlays are unavailable at a state level and must be estimated from national outlay data and state shares of defense contract awards. Defense prime contract awards have averaged 4.6% of California GSP during the past 20 years (1972 though 1991). In 1984 (the height of the Reagan build up), prime contract awards represented 6.5% of GSP compared to 6.6% at the height of the Vietnam War build up. By 1990, they had fallen to 2.97% (compared to 4.05% at the bottom of the post-Vietnam War trough). This is a historic low. California's defense-related industries appear no less dependent on defense than in the past.

For the past 20 years, aircraft, missiles and space, and electronics and communications have been California's largest source of prime contract awards (Figure 5). California received roughly twice as much in prime contracts in these industries in the mid-1980s as it did at the beginning of the decade. California received $1,975 million in aircraft prime contract awards in 1981, $8,347 million (1992 dollars) in 1985. It received $4,376 million missiles and space contracts in 1981, and $7,679 (1992 dollars) in 1985. Similarly in electronics and communications California received $5038 million in 1985, $3300 (1992 dollars) million in 1981. Contract awards to these industries fell in the late 1980s, but in 1991 they all still received markedly more in real terms than a decade earlier. Contracts for services, including engineering and design, tripled through steady growth from 1980 to 1991.

[6]In real terms, prime contract awards grew 20% in California, 48% nationally, during Vietnam War build up (DoD Prime Contract Awards, various years).

[7]Gross State Product (GSP) at the state level is analogous to Gross Domestic Product (GDP) at the state level.



Source: Department of Defense, *Prime Contract Awards by Region and State* (various years).

Figure 5. Defense Prime Contracts Over $25,000 Awarded to California Firms by Sector

There is considerable variation in trends in national prime contract shares among California's major defense-related industries (Figure 6). Missiles and space have been losing share of national defense contracts relatively steadily over the past 25 years dropping from 45.9% in 1979 to 31.3% of national contract awards in 1991 (DoD Prime Contract Awards, various years). This represents a movement of the missiles and space industry out of California to Texas and southeastern states. The electronics and communications industry lost national contract share steadily from 27.4% in 1978 to 17.4% in 1989. Since then it has climbed steadily to 22.4%. This may represent a change of direction for this industry. California's share of aircraft and parts appears roughly to follow major swings in total defense spending. In the last decade, it peaked at 25.1% of national contracts in 1984, fell to 11.4% in 1987, and recently has increased to 26.3%. While this measure does not describe these industry's defense dependence, it does give a better picture of which California industries will be most affected by federal defense cuts.

Employees of defense related industries will bear and have borne a significant share of the costs of this adjustment. Using our state model, we explore the extent to which workers move between industries as a result of defense cuts. During the past ten years the most significant trend in the California labor market has been the sharp increase in service employment and the lack of growth, and recently downturn, in manufacturing jobs (Figure 7).

2.3 Defense Cuts in California

The Commission on State Finance has estimated that defense expenditures in California fell from $56 billion in 1990 to $51 billion in 1992 (1992 dollars) (CSF 1992). Based on the Clinton FY1993 budget proposal, they projected that it would fall an additional 22% to $37 billion by 1997. In 1993, they revised this estimate downward to $33 billion (1993 dollars) based on the FY1994 proposed budget and the 1993 round of base closures (CSF 1993). They estimated that a total of 126,000 California defense-related jobs were lost between 1988 and 1992 (107,000 aerospace, 19,000 from military bases); and that 22% of California's total job loss between 1990 and 1992 (810,000 jobs) was defense-related (CSF 1992).[8] CSF projected that an additional 81,000 jobs would be lost between 1993 and 1997 (60,000 aerospace, 21,000 from bases). They based these estimates on experience in the 1970s which showed that defense firms responded quickly to expectations about future defense expenditures (CSF 1992).

In part because defense spending in California is concentrated in weapons procurement (73% of total defense spending) and in part because California's aerospace industry is heavily defense-related (65% of industry output), CSF maintained that defense cuts would primarily affect California's aerospace industry (CSF 1992). They estimated that this industry lost 107,000 jobs between 1988 and August 1992 and would lose an additional 60,000 jobs by 1997.

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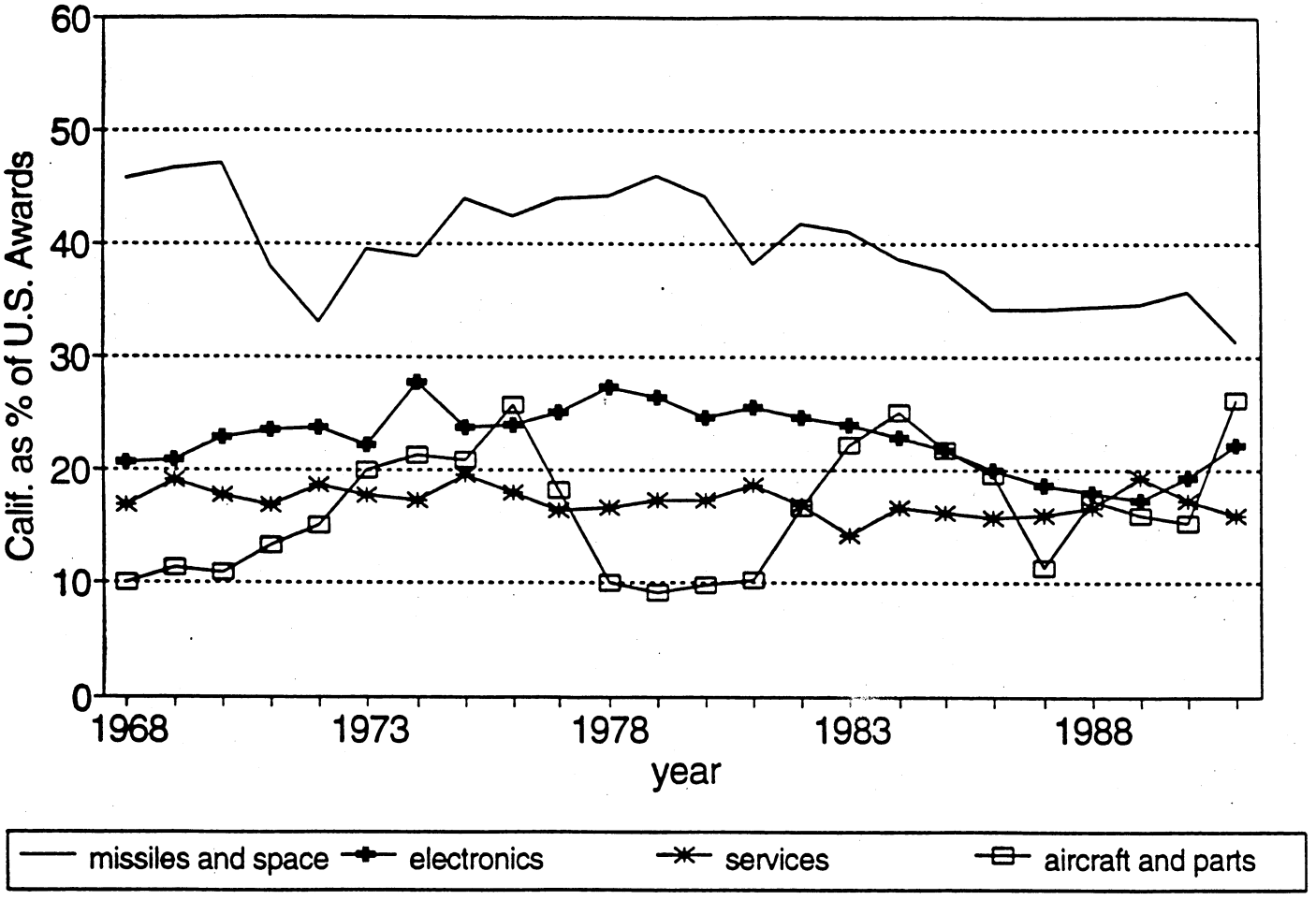
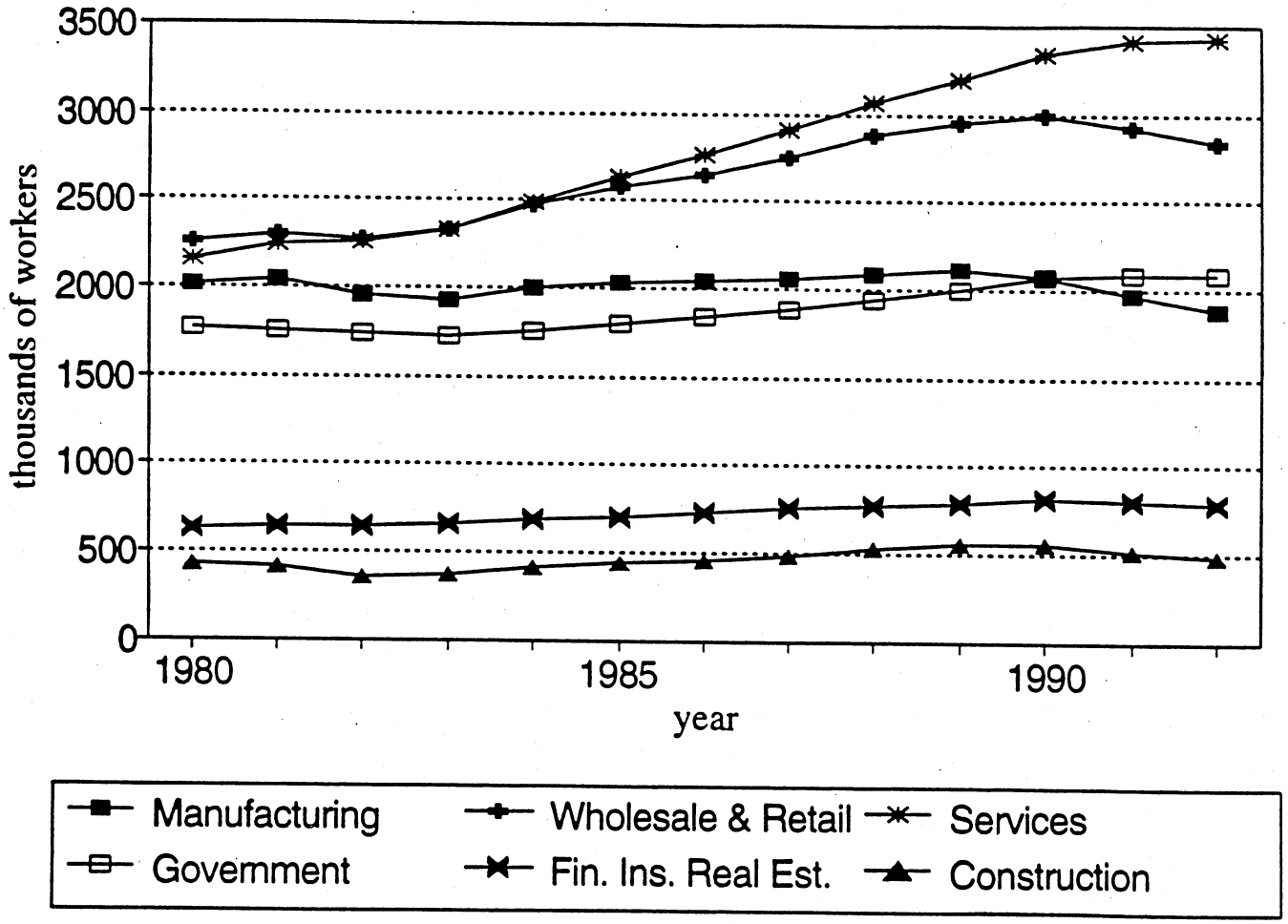
[8]In 1990 13,846,000 people were employed in California. By 1992 this had dropped to 31,805,000. But during these years, labor force growth outpaced employment growth and California's unemployment rate increased from 5.6% to 9.1% (CDF 1993).



Source: Department of Defense, *Prime Contract Awards by Region and State* (various years).

Figure 6. Defense Prime Contracts Over $25,000 Awarded to California Firms as % of U.S. Awards by Sector



Source: California Department of Finance, *California Statistical Abstract* (1993).

Figure 7. California Wage and Salary Employment by Major Industry, 1980-1992

Defense cuts have already affected some areas of the state more than others. At the peak of the 1980s defense boom, 79.3% of the state's 1988 aircraft employment, 59.2% of its missile employment, and 72.5% of the state's employment in producing search and navigation equipment took place in Los Angeles or Orange County (Kroll 1993). Between January of 1988 and August of 1992, Los Angeles, Orange, and San Diego counties lost 89,000 of the 107,000 aerospace jobs lost statewide (CSF 1992).[9]

On the other hand, base closures, which are spread across the state, have also already affected California, and will continue to do so throughout the 1990s. In 1991, 305,732 people living in California were on DoD payroll. The 1991 round of base closures cut 10% of these positions. In 1990, 14.7% of DoD direct employment (292,995 jobs) was located in California (Commerce 1993a, Table 546; DoD Atlas FY1991). California absorbed 54% of the national net loss of military jobs (16,500) and 55% of the national net loss of civilian jobs (15,200). California military payroll dropped from $10.2 billion in 1990 to $9.7 billion in 1992 (1990 dollars) (DoD Atlas various years). In the 1993 round, 10 of the 130 base closings and 3 of the realignments the Base Closure Commission recommended nationally are in California (BRAC 1993, DoD 1993a). The Department of Defense expects California to experience a net loss of 15,523 military jobs (75% of U.S. net loss) and 14,160 civilian jobs (34% of U.S. net loss) (DoD 1993a).

In April 1994 Governor Wilson included an analysis of the impact of defense cuts in his annual budget proposal.

> Pres. Clinton's $188 billion cuts (FY1994 budget) over the next five years are two and one-half times larger than those in Pres. Bush's last budget proposal. . . . As adopted by Congress in 1993, the five-year budget plan will, by 1998, cut real national defense outlays by 40% from peak 1989-88 levels. The cuts will fall disproportionately on equipment purchases, which are slated to drop twice as much as payroll costs. . . . Compared to the nation's 40% cut in real defense outlays, California will see real spending slashed by as much as 60% by 1998. . . . Using traditional economic analysis, it is possible to trace roughly half the state's 850,000-plus recession job loss [1990-1993] to the direct and indirect effects of the defense cuts. The direct and indirect effects of defense cuts to date account for at least 60 percent of the decline in real economic activity. . . . Since 1988, the state has lost 162,000 aerospace manufacturing jobs — 43 percent of the industry — due mainly to defense cuts; a significant portion of the 72,000 electronics industry job losses may also be traced to the drop in defense purchases.

[9]See Appendix 4 for a review of studies of regional impacts within California.

(Gov. 1994, p. 13).[10]

3. Measuring the Impact of the Defense Build-Down

3.1 National Models

Efforts to model regional economic impacts of defense spending have relied heavily on national efforts, both for data development and for basic modeling approach. In a sense a national economy can be viewed as a regional economy within a larger global economy. It is not surprising that many of the same modeling questions arise in both settings. Regional or national economic models must address three basic questions. How will the model capture indirect (multiplier) effects flowing from the initial direct impact? How will the model address substitution effects — *i.e.* the fact that outside events can change prices and producers can change their input mix to respond to these price changes? How will the model incorporate macroeconomic phenomenon like savings, capital flows, and imports and exports?

A large class of input-output based models have been developed to address these questions (Dervis, de Melo, and Robinson, 1982). The earliest attempts, simple input-output models, focused solely on capturing multiplier effects. These are very short-run models which assume no substitution effects and no need to account for capital flows or international or interregional trade. They give some idea of the direct and indirect effect of an external shock or policy change, but by ignoring substitution, they can overstate the total effect. One modeling advance has been to combine input-output models with macroeconomic models to account for savings, interest rates, capital flows, and unemployment. The DRI input-output models with macroeconomic drivers and the Interindustry Forecasting at the University of Maryland (INFORUM) model are both examples of this subclass of models which have been used to analyze the impact of defense cuts nationally (Almon 1991).

Another modeling advance has been to move from input-output models to full, non-linear, computable general equilibrium (CGE) models. The data base for these models starts from an input-output table and then adds accounts for other economic actors and traces the full "circular flow" of income and expenditure. The resulting Social Accounting Matrix (SAM) integrates the input-output accounts with the national income and product accounts. The SAM traces the flows of goods, services, and income flows through the private and public sectors. CGE models have been used to analyze the national impact of cuts in defense spending (Roland-Holst, Robinson, and Tyson, 1988). Our study uses a state-level CGE model to analyze the impact of defense cuts on the California economy.

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[10]The Governor's office attributed the cause of 868,000 job losses from 1990 to 1993 to: direct defense cuts, 222,000 (25.6%); indirect defense cuts, 193,000 (22.2%); direct construction decline, 201,000 (23.2%); indirect from construction, 143,000 (17.2%); and all other, 103,000 (11.9%).

The Department of Defense, Congressional Budget Office, and Defense Conversion Commission have each used input-output based models to analyze the direct and indirect national impacts of defense cuts (CBO 1992, CBO 1993, DoD 1991, DCC 1993a). The DoD's Defense Economic Impact Measurement System (DEIMS) model uses a simple national level input-output model to project direct and indirect defense expenditures resulting from Congressionally approved budget authority (DEIMS 1985). The CBO and Defense Conversion Commission (DCC) have used INFORUM to model the impact of defense cuts nationally (CBO 1993, DCC 1993a). These studies are widely viewed as the most complete efforts currently used to model national impacts of defense spending.

The DEIMS model is a straightforward application of an input-output model. The INFORUM model requires more explanation. INFORUM is a dynamic model with macroeconomic linkages which uses an input-output table and regression analysis of the behavior of economic decision makers (Almon 1991). As used in modeling the impact of defense spending, INFORUM applies the Department of Commerce input-output table to the DEIMS vector of final DoD demand to generate estimates of total industry supply (CBO 1993, DCC 1993a). INFORUM estimates national level macroeconomic changes resulting from defense cutbacks using the Long-Term Interindustry Forecasting Tool (LIFT) model. LIFT uses an I/O table to estimate intermediate demand from a given vector of final demand for 83 industrial sectors. Total sector output is the sum of final and intermediate demand. LIFT combines these input-output results with a macroeconomic model to estimate hours of employment, wage rates, and number of employees for each industry.[11]

These major national studies use two basic approaches to economic modeling: comparative statics and comparative dynamics. Comparative static experiments ask how a system changes in response to a shock, holding all other exogenous factors fixed. The idea is to use the model to do controlled experiments, determining how the economy is affected by particular changes. Comparative dynamics starts with a dynamic model that explicitly includes time. A base run is generated for some period. Then experiments are done to determine how the time path of the economy changes in response to a shock. Both approaches are valuable. The data requirements and size of dynamic models makes the comparative dynamic approach more difficult to implement, but it has the advantage of explicitly spelling out the time path of variables of interest. Static models usually require less data and are smaller, but cannot provide information about the amount of time the economy requires to adjust to shocks.

Both the CBO 1993 and the Defense Conversion Commission 1993 studies included partially dynamic analysis to examine the effect of alternative uses of national savings expected from defense cuts. They include, in a simple manner, the link between changes in investment financed by savings from defense reductions and later increases in the capital stock. They both conclude that either private or public investment of these savings in productive activities would

[11]The DEIMS construction of a final, national demand vector is described more fully in Hoffmann (1994). CBO and DoD use similar methods based on state prime contract shares to determine state level defense demand and supply (Hoffmann 1994). Appendix 3 describes construction of the defense demand vector used in this study.

significantly lessen the expected job losses and decline in GDP due to the impact effect of cuts in defense spending.[12] National CGE models have been used to conduct a partially dynamic analysis of the impact of cuts in defense expenditure on the U.S. economy (Roland-Holst, Robinson, and Tyson 1991). The analysis below uses a static model of California, and so ignores potential links between defense cuts and aggregate investment.

3.2 National Model Results

The 1993 CBO study contains an analysis of a short-run impact which is in essence a comparative static exercise. It is also based on defense reduction scenarios which remain reasonable under the Clinton FY1995 budget proposal and, therefore, are used as the basis for the defense cut experiments examined below.

The 1993 CBO paper, *Effects of Alternative Defense Budgets on Employment*, used the Bush FY1993 budget proposal as its base scenario. It examined three alternative scenarios which reduced the projected Bush FY1998 defense budget of $293 billion by $25 billion, $50 billion and $100 billion (1998 dollars) (CBO April 1993). These respectively represent 24%, 30%, and 42% cuts in defense spending between 1992 and 1998. The Clinton FY1995 budget falls between the $50 billion and $100 billion reduction scenarios (Table 4). CBO projects that the Clinton budget would reduce defense outlays by over 30% by 1998, by roughly 40% by 2000 (Thomas April 1984).

All of three cut scenarios slowed GDP growth in the short run.[13] "In the short run, cuts in defense spending —indeed, cuts in any type of federal spending— reduce the demand for goods and services if used to trim the deficit" (CBO 1993, p. 8) The 24% defense reduction led to 1.8% GDP growth in 1998. The 42% defense reduction led to 1% GDP growth by 1998 (CBO 1993). In the long run, they could lead to lower interest rates and permanently higher levels of GDP if properly invested (CBO 1993).

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[12]The discussion below focuses on the results of CBO's 1993 study of the impact of defense cuts on the nation's economy.

[13]CBO used the Bush FY 1993 defense budget as a base for comparison. That budget led to real GDP growth of 2.8% in 1993 and 3.0% in 1994 (CBO 1993). Real GDP growth was projected to slow during the remainder of the decade, reaching 2% by 1998. The unemployment rate was forecasted to drop from 7.1% in 1993, to 6.6% in 1994, to 5.7% by 1998.

Table 4. Alternatives for Reducing the Defense Budget (By fiscal year, in billions of current U.S. dollars)

	Fiscal Year								
	1990	1993	1994 (est.)	1995 (est.)	1996 (est.)	1997 (est.)	1998 (est.)	1999 (est.)	Total
									1994-98 (est.)
			Base: Bush Administration's 1992 Plan[a]						
Budget Authority	$ 304	$ 273[a]	$ 282	$ 284	$ 286	$ 291	$ 296[b]		$ 1438
Outlays[c]	299	293	282	283	286	290	293		1434
			Alternative A: Cut $25 Billion from Base 1998 Budget						
Budget Authority	304	273	277	277	274	273	171		1371
Outlays[c]	299	293	279	277	277	275	271		1378
			Alternative B: Cut $50 Billion from Base 1998 Budget						
Budget Authority	304	273	273	269	261	255	245		1304
Outlays[c]	299	293	277	272	267	260	249		1324
			Alternative C: Cut $100 Billion from Base 1998 Budget						
Budget Authority	304	273	267	253	235	219	195		1169
Outlays[c]	299	293	274	261	247	230	205		1216
			Clinton Administration FY1995 Budget Proposal Based on "Bottom Up Review"						1995-99 (est.)
Budget Authority	304	273		252	243	240	247	253	1236

Sources: CBO, *Effects of Alternative Defense Budgets on Employment* (1993). CBO, *Planning for Defense: Affordability and Capability of the Administration's Program* (1994). U.S. Dept. of Commerce; Bureau of the Census, *Statistical Abstract of the Unted States*, 1993.

Notes: [a] Adjusted for Congressional action in 1993.
[b] Projected by the Congressional Budget Office assuming the same real decline in budget authority as in 1977.
[c] Outlays estimated after enactment of the fiscal year 1993 budget using economic and spendout assumptions consistent with the Bush Administration's plan.

CBO estimated that private sector defense-related employment would fall by 610,000 jobs (22.8%) from the 1992 base of 2,670,000 jobs nationwide under the Bush plan; by 780,000 (29.2%) with a 24% reduction, and by 1,260,000 jobs (47.2%) with the 42% reduction (CBO 1993, Table 10). Cuts in DoD direct employment by 1998 ranged from 865,000 (under the Bush 1992 plan) out of 5,455,000 jobs nationwide in 1992, to 2,495,000 under the 42% reduction. The aerospace industry was projected to lose 45,000 defense-related jobs between 1992 and 1998 under the Bush Plan. Communications equipment was projected to lose 85,000 jobs.[14]

In the short run, all levels of cuts result in significant national decreases in defense-related supply industries. CBO projected that, under the Bush plan, output in the guided missile would decline 3% over 1992-1998, aircraft and parts and communications equipment would decline nearly 13%, and engineering and scientific instruments would decline 27% (CBO 1993, Appendix A). Most sectors changed little. In CBO's analysis with the 417-sector INFORUM model, 56% of the sectors changed by less than 1% in either direction, even under the largest cut scenario, and 28% of the sectors actually increase output by 1% or more (CBO 1993). For those industries highly dependent on defense, obviously the larger the cut the larger the impact. Under the 42% cut, defense output of guided missiles fell 38% from 1992 to 1998, aircraft fell 34% to 41%, and engineering and scientific instruments fell 52% (CBO 1993, Appendix A).

At a state level, CBO estimated that, for California, a 42% cut in national defense expenditure represents state expenditure cuts amounting to 3-3.9% of gross state product (GSP) (CBO 1993, Figures 2 and 7). CBO also estimated that California GSP would fall by 0.5% or less by 1998 under a 24% cut and by 1-1.9% by 1998 under a 42% cut (CBO 1993, Figures 4 and 8).

4. The California CGE Model

To estimate the impact on the California economy of the decrease in federal military expenditures in the state, we developed a multisectoral, computable general equilibrium (CGE) model of the state economy — the CA-CGE model. The model is in the tradition of CGE models that have been applied to a number of countries to explore issues of structural adjustment.[15] The CA-CGE model has a number of special features to capture the fact that the

[14]In terms of defense dependence, California industries are generally better positioned than other major defense related industries. While 80% of guided missile output was defense related in 1992, only 27% to 37% of aircraft and parts industries outputs were defense related, as was 41% of communications equipment. In contrast 56% to 68% of ammunition, ordnance, shipbuilding, and tank production was defense related in 1992. (CBO 1993).

[15]See Robinson (1989) for a survey of CGE models. Devarajan, Lewis, and Robinson (1991) describe the structure and properties of trade-focused CGE models. There has been one earlier state CGE model that focused on issues of energy (Despotakis and Fisher 1988).

state economy is imbedded in a larger national economy, with linked capital, labor, and product markets.

4.1 Model Summary

This subsection summarizes the technical specification of the CA-CGE model. Table 5 lists the equations of a simplified version of the model. The model is implemented in a modeling language called GAMS (General Algebraic Modeling System).[16] This simplified presentation focuses on production technology and the treatment of government demand, and ignores international trade, income distribution, and macroeconomic aggregates such as savings, investment, the balance of trade, and the government deficit.

Figure 8 shows the nested structure of the sectoral production functions, which are given in Equations 1 to 3. At the top level, sectoral output is a constant-elasticity-of-substitution (CES) function of real value added and intermediate inputs. Real value added is a Cobb-Douglas (CD) function of capital and three types of labor. Capital refers to physical capital stock —plant and equipment. Intermediate inputs are demanded according to fixed input-output coefficients. Intermediates, in turn, are made up of domestically produced and imported goods.

Equations 4 to 6 define cost functions for final products, value added, and intermediate inputs. Equations 7 and 8 are factor demand equations derived from the first-order conditions for profit maximization. Equation 9 defines the numeraire price index, which is held fixed. In essence, the aggregate price level in California (measure by the consumer price index) is assumed to be linked to the national price level. Equations 10 to 13 map the circular flow from factor income to product demand, while equations 14 to 16 provide market-clearing conditions. Finally, equations 17 to 20 bring together a number of revenue-expenditure identities arising from the homogeneity of the various underlying functions. These identities are implied by the other equations, given homogeneity, and are hence not independent equations. The simplified model has $(9 \cdot i + i \cdot j + 6)$ endogenous variables and, assuming all constraints are binding, $(9 \cdot i + i \cdot j + 6)$ equations. The model, however, satisfies Walras' Law (*i.e.* the supply-demand balance equations sum to zero) and therefore has only $(9 \cdot i + i \cdot j + 5)$ independent equations.

The model in Table 5 follows a standard neoclassical specification. The CES and Cobb-Douglas functions for output and real value added yield well-behaved first-order conditions for profit maximization (equations 7 and 8). The consumption demand system (Equation 13) has fixed expenditure shares. Consumption demand can be viewed as coming from a representative household with a Cobb-Douglas utility function. A CGE simulation model with this specification will generally have a unique solution that satisfies all the non-linear first-order conditions, with all factor and product prices strictly positive and all constraints satisfied.

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[16] The GAMS software is described in Brooke, Kendrick, and Meeraus (1992). The full CA-CGE model equations in the GAMS language are presented in Appendix 1. Appendix 2 describes the data base and the aggregation scheme.

Table 5. Equations of a Simplified California CGE Model

	Production	
1.	$X_i = \text{CES}_i(V_i, INT_i)$	CES production function.
2.	$V_i = \text{CD}_i(K_i, L_i)$	Cobb-Douglas value added function.
3.	$X_{ij} = \text{LIN}_{ij}(INT_j)$	Linear intermediate inputs function.
	Prices and Factor Demand	
4.	$(1 - t_i^X) \cdot P_i^X = \text{CES}_i(P_i^V, P_i^{INT})$	Production cost function.
5.	$P_i^V = \text{CD}_i(W^K, W^L)$	Value added cost funciton.
6.	$P_i^{INT} = \text{LIN}_i(P_{ji}; j)$	Intermediate input cost function.
7.	$W^K = \frac{\partial V_i}{\partial K_i} P_i^V$	Demand for capital stock.
8.	$W^L = \frac{\partial V_i}{\partial L_i} P_i^V$	Demand for labor.
9.	$\bar{P} = \sum_i \beta_i \cdot P_i^X$	Numeraire price index.
	Income and Final Demand	
10.	$Y = \sum_i P_i^V \cdot V_i$	Aggregate income.
11.	$Y^G = \sum_i t_i^X \cdot P_i^X \cdot X_i + T^Y \cdot Y$	Government revenue.
12.	$\sum_i P_i^X \cdot \left(\bar{G}_i^D + \bar{G}_i^{ND} \right) = Y^G$	Government demand.
13.	$P_i^X \cdot C_i = \beta_i \cdot Y \cdot (1 - T^Y)$	Consumption demand.
	Supply-Demand Balances	
14.	$X_i = \sum_j X_{ij} + C_i + \bar{G}_i^D + \bar{G}_i^{ND}$	Product supply-demand.
15.	$\bar{L} = \sum_i L_i + \Delta \bar{L}^{mig}$	Labor supply-demand.
16.	$\bar{K} = \sum_i K_i + \Delta \bar{K}^{mig}$	Capital stock supply-demand.

Identities

17.	$(1 - t_i^X) \cdot P_i^X \cdot X_i = P_i^V \cdot V_i + P_i^{INT} \cdot INT_i$	Sales/income.
18.	$P_i^V \cdot V_i = W^K \cdot K_i + W^L \cdot L_i$	Value-added/factor payments.
19.	$P_i^{INT} \cdot INT_i = \sum_j P_{ji}^X \cdot X_{ji}$	Intermediate input expenditure.
20.	$\sum_i P_i^X \cdot C_i = Y \cdot (1 - T^Y)$	Income/expenditure.

Variables and Parameters

Variables

X_i	Output
V_i	Real value added
INT_i	Aggregate intermediate input use
K_i	Capital stock input
L_i	Labor input
X_{ji}	Intermediate input from sector j to sector i
P_i^X	Output market price
P_i^V	Value added price
P_i^{INT}	Aggregate intermediate input price
W^K	Rental rate of capital stock (exogenous if capital stock migration is endogenous)
W^L	Wage of labor (exogenous if labor migration is endogenous)
Y	Aggregate income
Y^G	Government revenue
C_i	Consumption demand
T^Y	Lump-sum tax rate

In total, there are $9 \cdot i + i \cdot j + 5$ variables and $9 \cdot i + i \cdot j + 6$ equations. Given that the system satisfies Walras' Law, there are $9 \cdot i + i \cdot j + 5$ independent equations.

Parameters

t_i^X	Indirect tax rate (or subsidy, if negative)
β_i	Consumption expenditure shares
$\bar{L}$	Aggregate supply of labor
$\bar{K}$	Aggregate supply of capital stock
$\bar{G}_i^D$	Government demand for defense goods and services
$\bar{G}_i^{ND}$	Government demand for non-defense goods and services
$\Delta\bar{K}^{mig}$	Capital stock migration (endogenous if W^K is fixed)
$\Delta\bar{L}^{mig}$	Labor migration (endogenous if W^L is fixed)

Notation

LIN	Linear function
CD	Cobb-Douglas function
CES	Constant elasticity of substitution function

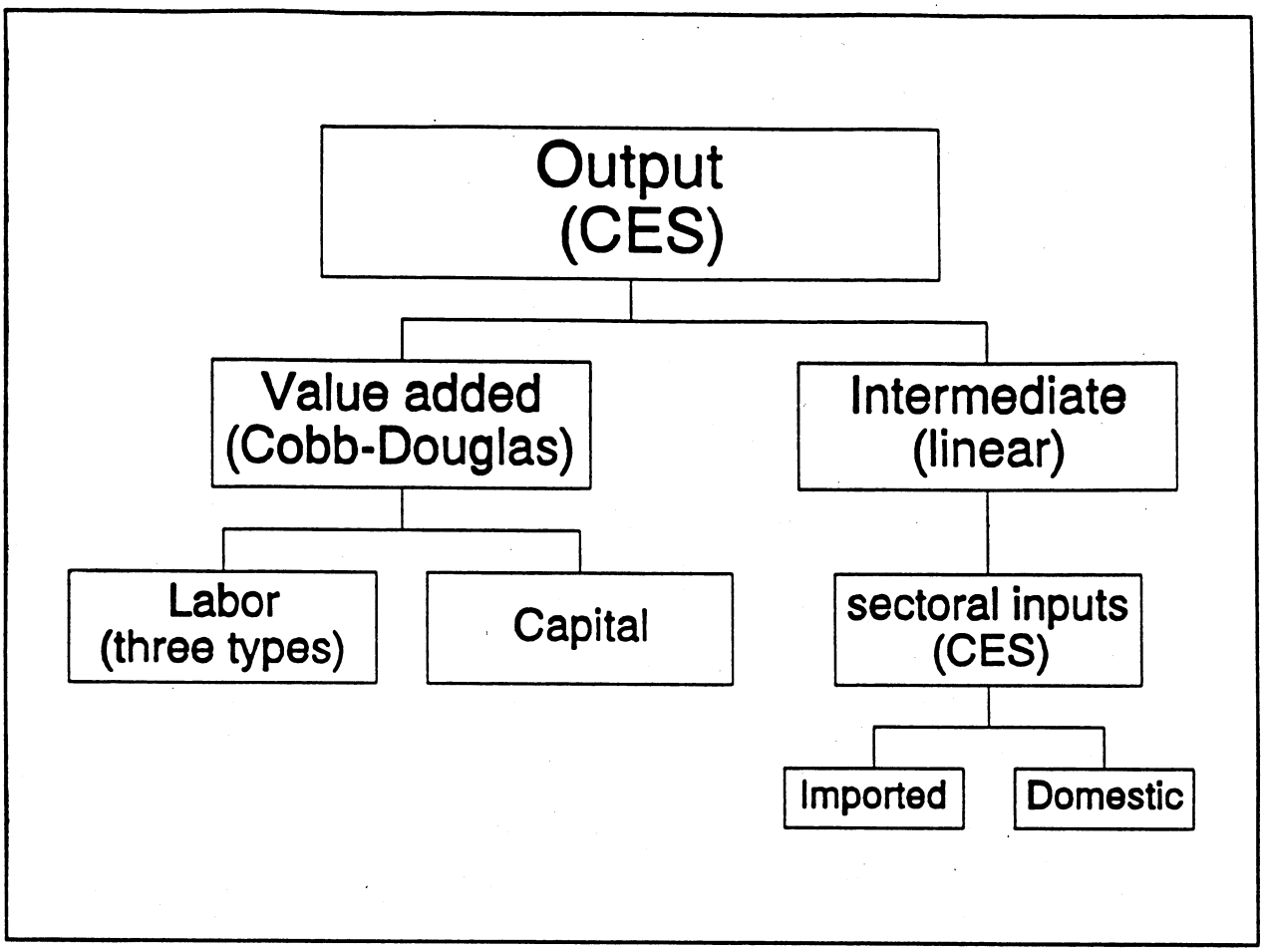

Figure 8. Sectoral Production Functions

4.2 Factor Markets

The simplified model in Table 5 has only one labor category. The full model has three labor types, each with a separate wage and market-clearing equation: high-skilled service workers, other service workers, and industrial workers.[17] High-skilled service workers work in the engineering and professional services sector (which includes engineers, managers, and workers in financial, insurance, legal, and business services). Other-service workers are in the other, generally less-well-paid, service sectors. Industrial workers include all other labor, including those in agriculture and state and federal government (including federal defense employees). The intent is to segment the labor market into non-competitive labor categories. Workers are assumed to be able to work in any sector in which their category works, but cannot change categories. The fundamental assumption is that high-skilled workers constitute a special labor market and are liable to migrate rather than accept a lower wage within California. Most government workers, on the other hand, are part of the general labor market, with alternative employment opportunities in industry.

A typical CGE model of a national economy assumes that the aggregate supplies of factors of production are fixed (or, perhaps, have specified aggregate supply functions) and will solve for market-clearing wages and capital rentals endogenously. In a regional or state model, however, it is perhaps more appropriate to assume that the state factor markets are embedded in larger, national markets. In this case, one might assume that the wage is set at the national level and that the California labor markets clear at the prevailing national wages. If labor demand in California falls, labor will migrate out of the state instead of the wage falling to clear the market. In making this assumption, we are not asserting that California wages equal the average national wage, only that there is fixed relationship between California wages and those in the rest of the nation. The California economy is assumed not to be large enough to affect the prevailing national wages, which are then taken as given.

A fundamental factor in determining how California will respond to a change in national defense spending is the degree to which California is economically integrated into the rest of the U.S. economy. By economic integration we mean the degree to which labor, capital, and products can move between regions. High tariffs or high transportation costs may prevent product markets from being integrated. Immigration laws may prevent labor markets from being integrated. It is not correct to assume that states within a nation are economically perfectly integrated. For example, if workers expect to be recalled after a lay-off, they may well remain within California, even though wages there are falling relative to the rest of the country. Any factor which diminishes the mobility of factors or products reduces the level of economic integration. In the CA-CGE model, we assume that California's product market is integrated with the outside world, given assumptions about imperfect substitutability in demand and supply (discussed below). We then consider variants of the model which allow us to explore the role of economic integration of factor markets in the impact of national policy on the state.

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[17]The sectoral aggregation is described in Appendix 2.

The CA-CGE model allows model variants in which the markets for labor and capital clear by quantity adjustments rather than by wage/rental adjustments. For each labor category that we assume is integrated with the national economy, we specify that the wage in California is determined by the fixed national wage of that category. The model then solves for migration rather than the wage. Similarly, we can assume that the average rental rate for real capital is fixed at the national level (*i.e.* that physical capital is mobile or, at least, can change location through investment and depreciation) and that capital will leave or enter California until the average rate of return in California equals the national average. In the experiments described below, we use three model variants: (1) a "within-state" variant in which capital and labor can relocate across sectors within the state, but do not migrate; (2) a "partial-integration" variant in which labor can migrate and capital can be reallocated across sectors within the state, but does not migrate; and (3) a "full-integration" variant in which all factors can migrate. These three variants, with their varying degrees of factor mobility, should generate empirical estimates that provide lower and upper bounds on the extent of expected adjustment to the defense cuts.

The full-integration variant is extreme in that a change in profitability due to a shift in exogenous government demand is assumed to be permanent by both workers and investors, who then migrate or shift their capital stock into or out of the state. In effect, in this model variant all factor prices in California are fixed at national levels, and the model behaves like a fixed-price, Leontief/Keynesian multiplier model in which changes in exogenous demand lead to accommodating changes in supply and larger changes in income.[18]

Which model variant is more "realistic" depends on how producers and labor view the defense cutbacks. If they are seen as temporary or transitory, then producers and labor will remain in the state, rather than bear the adjustment costs of moving to another state. They will bear temporary cuts in wages and profits, on the assumption that the state economy will turn around soon. In this case, variant 1 seems reasonable. On the other hand, the more permanent the cuts are seen, the more relevant are variants 2 and 3. An additional complication is that the model assumes that the rest of the economy is independent of California, and that changes in the California economy are not associated with changes elsewhere. It may be, for example, that defense cutbacks in California lead to unemployment, but if this also occurs in the rest of the economy, California labor will not be tempted to migrate just because wages in California fall. In this case, variant 1 is more applicable. Recent history, however, indicates that the California economy has lagged the rest of the economy, both in the onset and turning point of the recession.

[18]In the Keynesian multiplier model there are no supply constraints. A change in aggregate demand results directly in a change in aggregate supply. Labor market clear by unemployment, not by changes in the wage.

4.3 External Trade

The CA-CGE model is structured like most trade-focused CGE models in that it differentiates domestic and traded commodities.[19] We specify that goods of the same sectoral classification produced in California are different from goods produced elsewhere.[20] By doing so we are able to model the possibility that there is significant regional subsector specialization. This phenomena has become familiar in the automotive industry where parts are sourced from a wide range of locations. Highly integrated economies are characterized by high levels of regional specialization. In the analysis below, we in fact see a high level of two-way trade within sectors such as "planes" (*i.e.* "aircraft and parts"), which indicates that there is subsector specialization and likely substantial trade in parts between regions. In our modeling framework we assume that within a sector goods produced in California are imperfect substitutes for goods made elsewhere.

We capture product differentiation by using trade-aggregation functions. In demand, California goods are assumed to be combined with imported goods according to a constant elasticity of substitution (CES) import-aggregation function, with sectorally specific elasticities of substitution. Similarly, sectoral output produced in California is assumed to be differentiated by destination: the California market or a "foreign" market. The transformation of goods for delivery to the different markets is according to a constant elasticity of transformation (CET) function for each sector. The result is that the structure of domestic prices within California are closely, but not perfectly, linked to external prices.

In addition, the CA-CGE model includes a category of "non-competitive" imports; that is, goods which are imported into California but which have no local sectoral counterpart. These non-competitive imports are determined by fixed coefficients, with different coefficients by demand categories: intermediate use and final demand by government, investment, and private consumption.

Many trade-focused CGE models assume that the balance of trade is given exogenously, and solve for a real exchange rate that equilibrates the aggregate supply of exports with aggregate demand for imports. For a state economy, such an assumption is unrealistic. We instead assume that California is part of a monetary union with the rest of the United States, and so has a fixed exchange rate of one. We also assume that the relationship between the aggregate price level (measured by a consumer price index) in California and that of the rest of the U.S. is fixed. In

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[19]For a discussion of the treatment of exports and imports in trade-focused CGE models, see Devarajan, Lewis, and Robinson (1991).

[20]For California, "elsewhere" includes both the rest of the United States and the rest of the world —we do not distinguish between U.S. and international trade. It is extremely difficult within the United States to determine a single state's exports to ports outside the United States. U.S. export data are maintained by customs district, and custom districts generally do not conform to state boundaries. For example, the port of San Diego includes exports not only from southern California, but also from Arizona.

effect, we choose the consumer price index as numeraire in the model and fix the real, price level-deflated exchange rate. The balance of trade for California is then solved endogenously, given the sectoral export-supply and import-demand functions.

4.4 Government Demand and Revenue

Government expenditure on goods and services is broken into two categories: defense and non-defense. Defense expenditure is only by the federal government, while non-defense expenditure includes federal, state, and local. We distinguish government demand by type of expenditure rather than level of government. This aggregation makes it possible to determine whether the impact of defense cuts differs noticeably from cuts in other government spending. Government employees are treated as employees of the "public administration" sector, whose output is demanded by the government. Federal defense expenditure on public administration includes both military and civilian personnel.

Both categories of government expenditure are fixed exogenously by sector. The experiments below consider the impact of variations in the levels of these expenditures. The model also includes a number of taxes, both indirect and direct. It does not distinguish among state, local, or federal taxes.[21] Thus, the model solves for the aggregate government budget deficit, but cannot distinguish by level of government. Any deficit or surplus is assumed to be financed by borrowing from the loanable funds market and is treated as a use of savings in the model economy.

4.5 Macroeconomic Balances

The model includes the major macro balances: balance of trade, private savings and investment, and aggregate government deficit. Aggregate investment is fixed exogenously. Government savings is determined residually, as the difference between government revenue and expenditure. "Foreign" savings —the state balance of trade in goods and non-factor services— is determined endogenously, given the fixed real exchange rate. Private savings is generated by assuming average savings-rate parameters for enterprises and households. In order to achieve savings-investment balance, the average savings rate out of aggregate income is assumed to adjust endogenously. This macroeconomic "closure" of the model is called Johansen closure, after Lief Johansen who used it in the first CGE model (Johansen 1960).

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[21]There is, of course, a long tradition of public finance CGE models (Shoven and Whalley 1984). It is certainly feasible to extend the CA-CGE model to include a more realistic representation of federal, state, and local government fiscal systems.

5. Defense Expenditure Reduction Scenarios

5.1 Structure of the Economy

The data base for the CA-CGE model is described in Appendices 2 and 3. The base year for the model is 1990. The core data are a set of input-output accounts, which indicate intermediate flows, combined with income accounts for the various economic actors in the model. The result is a Social Accounting Matrix (or SAM) for the state economy. We have used a combination of U.S. government (the IMpact of PLANning, or IMPLAN, data base maintained by the U.S. Forest Service), state, and national data sources to construct a 1990 SAM for California (IMPLAN 1993). From IMPLAN, we obtained a 528-sector 1990 California input-output table, the commodity row and activity column of a 1990 California SAM with three household income levels, and federal expenditures divided between military and nonmilitary expenditures. The Forest Service updates the state input-output tables every five to seven years. California tables are available for 1982 and 1990.

Table 6 presents the state product accounts. It shows that California is a large economy that is highly integrated with the rest of the nation and the world. California gross state product (GSP) was $741.0 billion in 1990, which was about 14% of U.S. GDP in 1990 ($5,522.2 billion) (Commerce 1993a, Table 690).[22] In 1989, California had the largest GSP of any state in the country — over twice that of the next largest state, Texas (Commerce 1993a, Table 694). If viewed as a separate country, California would have ranked seventh in GSP in 1990, behind the United Kingdom and ahead of Canada. California's import and export shares are very high (43.3% and 46.1% respectively). The import and export shares for the U.S. as a whole in 1990 were less than 10% (slightly less than Japan's); Canada's were around 25%, Germany's around 30%, the Netherlands around 55%, and Belgium's more than 70% (Commerce 1993a, Table 1392; World Bank 1993).

Table 6 also shows that defense spending, and government spending as a whole, account for a higher share of California GSP than for the U.S. In 1990, government expenditure was 19.7% of California GSP and 18.9% of U.S. GDP (CEA 1993). For the same year, federal defense purchases of goods and services was 6.7% of California GSP, compared to 5.7% of U.S. GDP (CEA 1993). California state officials have stated frequently in the past few years that California is being hit disproportionately by defense cuts. While the we have already seen that California is receives a large proportion of federal defense spending, these figures show another part of the picture, that defense spending plays a larger role in California's economy than in the nation's as a whole.

[22]The California Department of Finance reports that 1990 California GSP was $744.7 billion (1990 dollars) (CDF 1994), which is close to the value reported by IMPLAN.

Table 6. California Gross State Product (GSP), 1990

	$ billion	Shares (%)
Consumption	$ 458.8	61.9%
Investment	116.2	15.7
Government	145.8	19.7
Federal military	50.0	6.7
Federal non-military	19.6	2.6
State and local	76.2	10.3
Exports	336.7	45.4
Imports	–316.5	–42.7
GSP	741.0	100.0

Sources: U.S. Department of Agriculture, Forest Service, *IMPLAN: California Aggregate Input/Output Table for 1990* (1990); Henry, David," 1990 U.S. Defense Bill of Goods," at U.S. Department of Commerce, Economics and Statistics Administration (1993).

Table 7 shows selected sectoral data for California. While defense expenditures represent only 3.4 percent of aggregate gross demand (including demand for intermediate goods), a number of sectors are highly dependent on federal defense demand. Sectors where defense demand accounts for more than 10 percent of sectoral supply include: planes, ships, space and missiles, instruments, engineering services, and public administration. This dependence pattern suggests that cuts in either procurement or defense operations (reflected in federal defense employment in the public administration sector) could have a significant impact on the state.

Table 7 also shows very high levels of two-way trade across almost all non-service sectors. For example, mining, ships, and space (which includes missiles) export more than 90 percent of production, and import more than 90 percent of total state demand. Eight sectors have export and import shares both greater than 50 percent. High-levels of two way trade indicate a high level of subsectoral regional specialization. This pattern is characteristic of economies which are highly integrated with other regions.

Table 8 shows sectoral employment by the four labor categories used in the model. With over two million workers in public administration, government is clearly an important player in the state. There are also 2.69 million workers classified as professionals or high-skilled service sector workers, which includes managers and engineers as well workers in the finance sector. This labor category is sensitive to changes in defense spending because of the links through intermediate inputs between these sectors and defense industries.

5.2 Model Experiments

CGE models make possible controlled comparative static experiments in a general equilibrium setting. They allow one to examine how an economy as a whole responds to a shock, all other factors held constant.[23] We did a series of five experiments, reducing federal military expenditures uniformly across all sectors in 20 percent steps. CBO estimates that there was a 17% decline in defense outlays between 1990 and the end of 1993 (Thomas 1994). The first experiment, a 20% cut, roughly represents cuts in real defense outlays from 1990 to 1994. The second experiment, a 40% cut, falls between CBO alternatives B and C discussed above. It reflects the CBO's thinking on the likely fall in defense spending between 1990 and the year 2000 (Thomas 1994, CBO 1993, CBO 1994). The final experiment eliminates all military expenditure in the state. It, and the 60% and 80% cuts, were included to provide an indication of the dependence of the California economy on defense spending.

[23]For example, simply comparing the change in GDP with the change in defense spending over a given historical period will not provide an accurate estimate of the defense multiplier. Many changes other than a change in defense spending will have affected GDP during the period. CGE models allow the researcher in effect to hold these other factors constant.

Table 7. Selected Sectoral Data for California, 1990

Sector	Value added	Output	Supply	Exports/ output	Imports/ supply	Govt[a]/ supply	Defense[b]/ supply
		$ billions			Percent		
Agriculture	$ 7.50	$ 25.69	$ 20.62	56.9%	46.3%	–2.3%	1.7%
Mining	16.06	23.33	48.32	93.6	96.9	–0.1	0.1
Construction	41.17	99.46	102.20	0.2	2.9	12.3	3.0
Food Manufacturing	13.23	39.69	43.25	61.4	64.6	4.0	0.6
Textiles	4.50	11.35	19.13	27.6	57.0	0.6	0.1
Wood	15.82	34.73	46.09	45.2	58.7	5.0	0.1
Chemicals	18.42	59.72	60.96	39.8	41.0	4.5	1.5
Metal	11.82	28.49	38.77	85.2	89.1	1.7	1.0
Electric	14.91	31.87	25.16	38.4	22.0	5.4	4.0
Machinery	13.49	29.23	30.75	64.2	65.9	9.4	6.8
Cars	1.81	6.14	20.24	74.2	92.2	3.0	0.1
Planes	12.76	24.62	14.97	87.3	79.1	34.7	30.0
Ships	0.68	1.15	1.41	94.2	95.3	25.9	10.7
Space	7.09	12.31	11.26	92.8	92.2	50.9	22.0
Instruments	16.47	28.10	21.38	63.3	51.8	16.7	11.4
Misc.	6.98	14.12	16.44	32.9	42.3	–0.8	0.5
Transportation Services	38.14	58.29	56.75	10.4	8.0	7.8	3.1
Utilities	11.86	29.01	31.00	24.2	29.0	6.2	0.4
Trade	107.33	128.18	107.66	18.4	2.8	–1.3	0.6
Housing	66.23	85.54	58.25	31.9	0.0	0.9	0.0
Professional Services	79.59	117.68	104.19	15.1	4.1	3.0	0.9
Engineering Services	26.59	42.02	33.58	20.1	0.0	23.2	14.9
Other Services	125.81	202.36	190.64	13.2	7.8	1.8	0.4
Public Administration	82.78	82.78	82.78	0.0	0.0	100.0	17.4
TOTAL/AVERAGE	741.03	1,215.85	1,185.78	27.9	25.9	11.1	3.4

Sources: U.S. Department of Agriculture, Forest Service, *IMPLAN: California Aggregate Input/Output Table for 1990* (1990); Henry, David," 1990 U.S. Defense Bill of Goods," at U.S. Department of Commerce, Economics and Statistics Administration (1993).

Notes: "Value added" is at market prices. Total value added = GSP.
"Supply" is domestic production + imports – exports.
[a] Govt/supply is government demand as percent of sector supply. Government demand includes state, local and federal demand.
[b] Defense/supply is defense demand as percent of sector supply.

Table 8. California Sectoral Employment

Sector	Industrial labor	Low-skilled services	High-skilled services
		Millions	
Agriculture	0.53	0.0	0.0
Mining	0.05	0.0	0.0
Construction	1.11	0.0	0.0
Food Manufacturing	0.19	0.0	0.0
Textiles	0.18	0.0	0.0
Wood	0.36	0.0	0.0
Chemicals	0.18	0.0	0.0
Metal	0.24	0.0	0.0
Electric	0.25	0.0	0.0
Machinery	0.25	0.0	0.0
Cars	0.03	0.0	0.0
Planes	0.18	0.0	0.0
Ships	0.01	0.0	0.0
Space	0.06	0.0	0.0
Instruments	0.22	0.0	0.0
Miscellaneous	0.12	0.0	0.0
Transportion Services	0.61	0.0	0.0
Utilities	0.09	0.0	0.0
Trade	0.0	3.42	0.0
Housing	0.55	0.0	0.0
Professional Services	0.0	0.0	1.96
Engineering Services	0.0	0.0	0.73
Other Services	0.0	3.10	0.0
Public Administration	2.11	0.0	0.0
TOTAL	7.33	6.52	2.69

Note: Labor is millions of workers.

Since public administration is included as a sector in our input-output table, the experiments reduce both procurement and employment of personnel. In order to explore the impact on the labor market of closing military bases, we also did a separate set of experiments in which we only reduced the demand for defense-related public administration.

All the experiments were repeated for three model variants: (1) a "within state" model with no migration of factors into or out of the state, solving for market-clearing wages within the state; (2) a "partial integration" model that allows labor migration, and hence assumes fixed wages, but assumes no movement of capital; and (3) a "full integration" model in which all factors can migrate, with wages and the capital rental rate assumed fixed to the national level.

5.3 Experiment Results

Table 9 provides aggregate results for defense reduction scenarios ranging from -20% to -100% under the three model variants. The defense multiplier (the ratio of change in GSP to change in defense spending) is largely invariant to the size of the defense cut. But as expected, the level of impact for each level of expenditure reduction turns significantly on assumptions made regarding the level of factor market integration. The impact increases as the level of economic integration increases.

In variant 1, where no factor migration is allowed, the impact on California GSP is constrained to be small. Since factors used to meet defense demand cannot leave the state, they relocate to another sector. Since this variant also assumes that factor markets clear through wage adjustments, there is no unemployment. As a result, GSP is affected little. When defense spending is eliminated, GSP actually rises slightly, indicating that capital, labor, or both have moved to more productive sectors within the state. Within the more realistic reduction levels, 20% and 40%, GSP does not change at all. There is some change in the structure of wages. Both industrial labor and professional services are directly affected by defense cuts, since the defense sectors are intensive in their use of these labor categories.[24] As a result of decreased defense demand, industrial and professional services wages fall. Return to capital increases as the capital/labor price ratio increases.

[24]All DoD employees and many defense-related industry employees are included in industrial labor. Engineering and business services are included in professional services.

Table 9. **Procurement Cuts and Base Closures: Impact of Total Defense Reductions of 20-100% on Selected California Variables, Three Model Variants**

	Exp. 1 –20%	Exp. 2 –40%	Exp. 3 –60%	Exp. 4 –80%	Exp. 5 –100%
	Percent change from base solution				
Variant 1: no migration					
GSP	0.0%	0.0%	0.0%	0.1%	0.2%
Wages					
Capital stock	0.5	1.1	1.5	2.0	2.5
Industrial labor	–0.6	–1.1	–1.4	–1.6	–1.6
Services labor	0.6	1.3	1.9	2.4	2.9
Professional labor	–1.0	–2.1	–3.1	–4.2	–5.4
Variant 2: labor migration					
GSP	–1.1	–2.0	–2.8	–3.5	–4.3
Wage of capital	–0.8	–1.3	–1.7	–2.1	–2.5
Aggregate employment					
Capital stock	0.0	0.0	0.0	0.0	0.0
Industrial labor	–3.6	–6.2	–8.6	–10.8	–13.0
Services labor	1.4	2.4	3.2	3.9	4.5
Professional labor	–0.8	–1.7	–2.6	–3.7	–4.7
Variant 3: all migration					
GSP	–5.1	–10.1	–15.1	–20.2	–25.2
Aggregate employment					
Capital stock	–5.2	–10.4	–15.5	–20.6	–25.8
Industrial labor	–4.3	–8.6	–12.8	–17.1	–21.3
Services labor	–5.6	–11.3	–16.9	–22.5	–28.1
Professional labor	–5.8	–11.6	–17.4	–23.2	–28.9
	Change in GSP/Change in defense spending				
Defense multiplier					
Variant 1	0.0	0.0	0.0	0.0	0.0
Variant 2	1.0	0.9	0.8	0.8	0.8
Variant 3	4.7	4.7	4.7	4.6	4.6

Notes: "GSP" is gross state product. GSP is in billions of $US 1990.
Wage is total return to factors reported in trillions of $US 1990.
Labor is millions of workers.
Capital stock aggregate employment is in trillions of $US 1990.

The picture changes, however, in the "partial integration" variant where California's wages are set in national labor markets and labor markets clear through workers migrating out of state. Capital is still assumed to be immobile. In this environment, with a 40% defense cut, 6.2 percent of the industrial labor force and 1.7 percent of professionals leave the state. This out-migration is partly offset by an in-migration of service sector workers, amounting to 2.3 percent of that labor category. These in-migrants, however, are both fewer and less productive than the out-migrants, and the net result is a 2.0 percent decline in GSP. The defense-GSP multiplier, which is defined as the change in GSP divided by the change in defense expenditures, equals 0.9. A billion dollar reduction in federal defense expenditures in the state reduces GSP by $900 million. The results of this model suggest that California may have already seen roughly half of this level of impact between 1990 and 1994. Under either the 20% or 40% cut scenario there is significant impact on GSP (a 1% to 2% reduction).

The picture is even more bleak under variant 3, "full economic integration," in which all wages and the rental rate of capital are fixed and all factors can migrate. The assumptions essentially lead to a fixed-price multiplier model. As discussed, these are extreme assumptions regarding integration, even for a state economy. The result, under the 40% reduction experiment, is a dramatic out-migration of 9 to 12 percent of labor and capital, and a corresponding fall in GSP (of 10.1%). The defense-GSP multiplier in this model equals 4.7, which is high but within the range of medium-run Keynesian multipliers generated in macro models. In this variant, the effects on the major macro variables are roughly linear in the size of the reduction across the full range of the reduction. This result provides a rough rule of thumb for the policy maker.

Experiment 5, 100% reduction, gives an outer bound on California's dependence on defense spending. A comparison of experiment 5 under variants 2 and 3 underscores the impact of the loss of capital stock on labor productivity and GSP.

Table 10 presents the level of sectoral job losses or capital losses, on average, associated with each scenario. The table indicates the amount of disruption in factor markets due to the various defense-cutback scenarios. Even with an assumption of no economic integration and full employment, the results from variant 1 indicate a significant amount of job loss. Workers and capital move between sectors within California as defense demand is cut. Variant 2, which allows labor migration, yields larger disruptions, especially in the services sectors. Comparing Tables 8 and 9, it is clear that there are some sectoral job gains for some labor categories. In fact, the service sector gains jobs. People leaving industrial or professional labor categories either move into less skilled jobs or leave the state. There is a fair amount of sectoral capital turnover as well, even without capital migration. This points to a good deal of sectoral restructuring. Under the extreme integration assumptions of variant 3, there are no sectoral job gains —all sectors lose. All who lose work due to defense cuts leave the state. While the assumption of perfect labor and capital mobility is extreme, the variant is useful in tracing out the potential size of multiplier linkages.

Table 10. Procurement Cuts and Base Closures: Impact of Total Defense Reductions of 20-100% on Sectoral Job Loss in California, Three Model Variants

Average sectoral decline in factor employment	Exp. 1 –20%	Exp. 2 –40%	Exp. 3 –60%	Exp. 4 –80%	Exp. 5 –100%
	Percent of base factor supply				
Variant 1: no migration					
Capital stock	0.3%	0.7%	1.1%	1.5%	2.0%
Industrial labor	1.0	2.0	3.0	4.1	5.3
Services labor	0.0	0.1	0.2	0.2	0.3
Professional labor	0.7	1.4	2.2	2.9	3.7
Variant 2: labor migration					
Capital stock	1.4	2.2	3.0	3.6	4.2
Industrial labor	3.6	6.3	8.7	10.9	13.0
Services labor	0.0	0.0	0.0	0.0	0.0
Professional labor	1.0	2.0	3.0	4.0	5.0
Variant 3: all migration					
Capital stock	5.2	10.4	15.5	20.6	25.8
Industrial labor	4.3	8.6	12.8	17.1	21.3
Services labor	5.6	11.3	16.9	22.5	28.1
Professional labor	5.8	11.6	17.4	23.2	28.9

Notes: Sectoral job losses is the sum across sectors of job losses (for both labor and capital) in declining sectors divided by aggregate base factor supply.
Capital stock employment is in trillions of $US 1990.
Labor is millions of workers.

IMPLAN data shows 16,540,000 Californians employed in 1990.[25] With a 20% cut in defense expenditures (roughly that experience between 1990 and 1994) the CA-CGE model estimates loss of between 92,130 and 836,300 of these jobs. Under variant 2, a 20% defense reduction leads to loss of 290,780 jobs. The model projects loss of between 190,780 and 1,679,180 jobs under a 40% defense cut (the anticipated cut between 1990 and 2000). Under variant 2, a 40% cut results in loss of 515,590 defense-related jobs.

Tables 11 to 13 show the detailed sectoral results from the various scenarios for all three model variants. Variant 1, the full-employment model, yields odd results. The release of skilled labor from the public administration and professional services sectors causes wages to fall. Manufacturing sectors pick up the released labor and expand, largely by exporting. In particular, the manufacturing sectors which are most defense dependent (planes, ships, space, and instruments) nonetheless expand, because they gain from reduced costs and make up the decline in state demand by expanding exports. The underlying assumption is that "foreign" demand (demand in the rest of the U.S. or the rest of the world) remains strong and that they can sell as much as they wish at fixed external prices. This assumption is unlikely to be reasonable for these sectors, since the fall in demand in California is part of a general cutback nationwide. While civilian demand is a large share of total demand in these sectors, it is unlikely to be able to take up the slack. These sectoral results indicate that model variant 1 is probably unrealistic.

The sectoral results from model variant 2 (Table 12) are more reasonable. For example, a 40% decline in military demand leads to output declines of 15–47% in the most defense-dependent manufacturing sectors. Non-defense sectors are not greatly affected. In variant 3 (Table 13), the decline in defense-dependent sectors is large, but the large defense-GSP multiplier leads to a general decline in demand spread across all sectors. While in model variants 1 and 2, there are both winners and losers across the sectors, in variant 3 all sectors lose.

Table 14 gives the macro results from the "base closing" scenarios in which we lowered the number of DoD employees by decreasing defense-related demand for public administration, but left the demand for the output of other sectors unchanged. In the no-integration/full-employment variant, this scenario actually leads to increases in GSP. The released labor finds more-productive, higher-wage employment in other sectors. While the full-employment assumption is suspect, these results do contain a germ of truth. The resources devoted to military bases may well have more productive alternative uses in the civilian economy. Not only the released labor, but the land and capital may be employed more productively in other uses. Note also that the same results would occur from reductions in state employment, say through cutbacks in any civil service employment —a result similar to that found in the CBO study.

[25]California state data sources estimate 13,846,000 people were employed in the state in 1990 (CDF 1993a).

Table 11. Changes in California Sectoral Value Added: Defense Expenditure Reductions, Model Variant 1 (No migration of factors)

Sector	Base value	Exp. 1 –20%	Exp. 2 –40%	Exp. 3 –60%	Exp. 4 –80%	Exp. 5 –100%
	$ billion	Percent change from base solution				
Agriculture	$ 7.50	1.0%	1.6%	2.0%	2.0%	1.5%
Mining	16.06	0.0	0.0	0.0	0.0	0.0
Construction	41.17	–0.3	–0.7	–1.1	–1.5	–2.0
Food Manufacturing	13.23	0.9	1.7	2.1	2.3	2.2
Textiles	4.50	1.4	2.7	3.9	5.0	5.8
Wood	15.82	1.3	2.5	3.5	4.3	4.9
Chemicals	18.42	0.2	0.4	0.5	0.4	0.2
Metal	11.82	5.4	10.6	15.1	18.6	20.8
Electric	14.91	0.4	0.8	1.0	1.2	1.2
Machinery	13.49	1.2	2.2	3.0	3.4	3.6
Cars	1.81	1.7	3.1	4.3	5.1	5.5
Planes	12.76	9.1	21.8	39.9	65.1	98.1
Ships	0.68	12.8	26.4	39.0	47.7	50.1
Space	7.09	1.6	1.5	–1.2	–7.5	–17.3
Instruments	16.47	0.1	0.3	0.5	0.8	1.2
Miscellaneous	6.98	0.7	1.4	1.9	2.3	2.6
Transportation Services	38.14	0.0	–0.1	–0.2	–0.4	–0.7
Utilities	11.86	0.7	1.3	1.9	2.4	2.7
Trade	107.33	-0.1	-0.1	-0.2	-0.3	-0.3
Housing	66.23	0.1	0.2	0.2	0.2	0.1
Professional Services	79.59	0.5	1.0	1.5	1.9	2.4
Engingeering Services	26.59	–3.1	–6.2	–9.3	–12.4	–15.6
Other Services	125.81	0.2	0.3	0.5	0.6	0.7
Public Administration	82.78	–3.5	–6.9	–10.4	–13.9	–17.4
GSP	741.03	0.0	0.0	0.1	0.1	0.2

Notes: "GSP" is gross state product. GSP is in billions of $US 1990.
"Value added" is at market prices. Total value added = GSP.

Table 12. Changes in California Sectoral Value Added: Defense Expenditure Reductions, Model Variant 2 (Labor migrates)

Sector	Base value	Exp. 1 –20%	Exp. 2 –40%	Exp. 3 –60%	Exp. 4 –80%	Exp. 5 –100%
	$ billion	Percent change from base				
Agriculture	$ 7.50	–0.7%	–1.4%	–2.1%	–2.9%	–3.6%
Mining	16.06	0.0	0.0	0.0	0.0	0.0
Construction	41.17	–0.8	–1.6	–2.3	–3.0	–3.7
Food Manufacturing	13.23	0.6	1.0	1.2	1.4	1.5
Textiles	4.50	0.4	0.6	0.8	1.0	1.1
Wood	15.82	–1.4	–2.3	–3.2	–4.0	–4.7
Chemicals	18.42	–0.1	–0.3	–0.5	–0.7	–1.0
Metal	11.82	–10.6	–16.8	–21.8	–25.9	–29.6
Electric	14.91	–5.2	–8.8	–12.0	–14.9	–17.6
Machinery	13.49	–6.2	–10.4	–14.1	–17.4	–20.6
Cars	1.81	–0.9	–1.5	–2.0	–2.5	–3.0
Planes	12.76	–31.3	–47.2	–58.9	–68.3	–76.2
Ships	0.68	–20.9	–31.4	–38.9	–44.9	–49.9
Space	7.09	–20.2	–32.2	–41.6	–49.6	–56.6
Instruments	16.47	–8.6	–14.6	–19.7	–24.4	–28.8
Miscellaneous	6.98	0.8	1.4	1.8	2.1	2.4
Transportation Services	38.14	–0.6	–1.2	–1.8	–2.4	–3.1
Utilities	11.86	0.2	0.3	0.4	0.5	0.5
Trade	107.33	1.4	2.3	3.0	3.7	4.3
Housing	66.23	2.0	3.3	4.4	5.4	6.3
Professional Services	79.59	0.6	0.8	1.0	1.1	1.1
Engineering Services	26.59	–3.6	–7.1	–10.7	–14.2	–17.8
Other Services	125.81	2.0	3.3	4.4	5.4	6.3
Public Administration	82.78	–3.5	–6.9	–10.4	–13.9	–17.4
GSP	741.03	–1.1	–2.0	–2.8	–3.5	–4.2

Notes: "GSP" is gross state product. GSP is in billions of $US 1990.
"Value added" is at market prices. Total value added = GSP.

Table 13. Changes in California Sectoral Value Added: Defense Expenditure Reductions, Model Variant 3 (Labor and capital migrate)

Sector	Base value	Exp. 1 –20%	Exp. 2 –40%	Exp. 3 –60%	Exp. 4 –80%	Exp. 5 –100%
	$ billion	Percent change from base				
Agriculture	$ 7.50	–6.3%	–12.5%	–18.7%	–24.9%	–31.1%
Mining	16.06	0.0	0.0	0.0	0.0	0.0
Construction	41.17	–1.6	–3.1	–4.7	–6.2	–7.8
Food Manufacturing	13.23	–5.7	–11.3	–17.0	–22.6	–28.2
Textiles	4.50	–5.7	–11.4	–17.1	–22.8	–28.4
Wood	15.82	–4.3	–8.5	–12.7	–16.9	–21.1
Chemicals	18.42	–5.0	–9.9	–14.8	–19.7	–24.6
Metal	11.82	–3.6	–7.1	–10.6	–14.1	–17.6
Electric	14.91	–3.7	–7.3	–11.0	–14.6	–18.2
Machinery	13.49	–4.4	–8.7	–13.0	–17.3	–21.6
Cars	1.81	–5.6	–11.2	–16.8	–22.3	–27.8
Planes	12.76	–11.7	–23.4	–34.9	–46.4	–57.8
Ships	0.68	–5.9	–11.8	–17.5	–23.2	–28.9
Space	7.09	–7.6	–15.2	–22.6	–29.9	–37.2
Instruments	16.47	–6.0	–12.0	–18.0	–23.9	–29.9
Miscellaneous	6.98	–5.6	–11.2	–16.7	–22.2	–27.7
Transportation Services	38.14	–5.5	–10.9	–16.4	–21.8	–27.2
Utilities	11.86	–5.2	–10.3	–15.4	–20.6	–25.7
Trade	107.33	–5.5	–11.0	–16.4	–21.8	–27.2
Housing	66.23	–5.4	–10.8	–16.2	–21.6	–26.9
Professional Services	79.59	–5.7	–11.3	–17.0	–22.6	–28.2
Engineering Services	26.59	–6.2	–12.4	–18.6	–24.8	–30.9
Other Services	125.81	–5.8	–11.6	–17.4	–23.2	–29.0
Public Administration	82.78	–3.5	–6.9	–10.4	–13.9	–17.4
GSP	741.03	–5.1	–10.1	–15.1	–20.2	–25.2

Notes: "GSP" is gross state product. GSP is in billions of $US 1990.
"Value added" is at market prices. Total value added = GSP.

Table 14. Base Closures: Impact of Reductions of 20-100% in Defense Demand for Labor in California on Selected Variables, Three Model Variants

	Exp. 1 –20%	Exp. 2 –40%	Exp. 3 –60%	Exp. 4 –80%	Exp. 5 –100%
	Percent change from base solution				
Variant 1: no migration					
GSP	0.0%	0.1%	0.2%	0.2%	0.3%
Wages					
Capital	0.4	0.8	1.1	1.4	1.9
Industrial labor	–0.2	–0.4	–0.5	–0.6	–0.6
Services labor	–0.2	–0.4	–0.7	–0.9	–1.2
Professional labor	0.1	0.2	0.3	0.4	0.5
Variant 2: labor migration					
GSP	–0.6	–1.1	–1.7	–2.2	–2.7
Wage of capital	–0.3	–0.5	–0.7	–0.8	–1.0
Aggregate employment					
Capital	0.0	0.0	0.0	0.0	0.0
Industrial labor	–1.8	–3.3	–4.9	–6.3	–7.8
Services labor	0.2	0.3	0.4	0.4	0.5
Professional labor	0.0	0.0	–0.1	–0.1	–0.2
Variant 3: all migration					
GSP	–1.4	–2.8	–4.1	–5.5	–6.9
Aggregate employment					
Capital	–1.2	–2.3	–3.5	–4.6	–5.8
Industrial labor	–1.6	–3.2	–4.8	–6.5	–8.1
Services labor	–1.5	–3.0	–4.5	–6.0	–7.5
Professional labor	–1.2	–2.3	–3.4	–4.6	–5.6
	Change in GSP/Change in Defense Spending				
Defense multiplier					
Variant 1	–0.1	–0.1	–0.1	–0.2	–0.2
Variant 2	1.7	1.6	1.6	1.6	1.5
Variant 3	4.0	4.0	4.0	4.0	4.0

Notes: "GSP" is gross state product. GSP is in billions of $US 1990.
Wage is total return to factors reported in trillions of $US 1990.
Labor is millions of workers.
Capital stock aggregate employment is in trillions of $US 1990.

The results for model variant 2 indicate that the defense-GSP multiplier for this category of defense expenditure is approximately double that of economywide defense expenditure. In model variant 3, however, the multipliers are somewhat smaller. This comparison supports theoretical predictions. More damage is done to the state by decreasing labor demand than by decreasing procurement demand. This is because the state economy can make up for declining state demand for products through increased exports. Decreased demand for labor within the state cannot be compensated for by export demand. Finally, in all variants, as expected, the absolute macroeconomic effects are smaller for base closures alone because the cutbacks are much smaller. The results indicate, however, that the relative effects are significant. A 40% cut in defense public administration expenditure leads to a cut in GSP of 1.1 percent in variant 2, and a 2.8% cut in variant 3.

Conclusion

The California economy benefitted significantly from the defense build-up of the 1980s. Defense-related employment is credited with more than half the net increase in manufacturing jobs between 1982 and 1987 (Kroll 1993). Defense spending is also credited with contributing significantly to the downturn in the California economy since 1990 (Gov. 1994). The value of prime defense contracts awarded to California firms rose 47% from 1981 to 1986 and fell 30% from 1984 to 1992. This decline was comparable to the decline between 1969 and 1971, as the Vietnam war wound down. The Congressional Budget Office (CBO) projected a 40% decrease in national defense spending during the 1990s. The California Governor's Office translates this to a 60% cut in defense spending in California (Gov. 1994).

California receives a larger proportion of U.S. defense spending than any other state (19.3% of 1992 U.S. defense outlays). It also is the largest state economy in the nation (14% of 1990 U.S. Gross Domestic Product, or GDP). The share of federal defense spending in California Gross State Product (GSP) is higher than that in the national economy as a whole (6.7% of California GSP compared to 5.7% of U.S. GDP). These expenditures, however, are concentrated in a few important manufacturing and service sectors (planes, ships, space, and instruments). These data suggest that California is as, or more, sensitive to defense spending than the nation as a whole.

This study uses a multisector, computable general equilibrium model of the California economy (CA-CGE model) to investigate the range of impacts defense cuts may have on the state economy. The results indicate that the magnitude of the effect of defense cuts on California is highly sensitive to the degree to which the state economy is linked to national factor markets. In the longer run, assuming both labor and capital mobility between California and the rest of the country, results show a defense expenditure-GSP multiplier of 4 to 5. A cut of one billion dollars in federal defense expenditures in California lowers California GSP by $4-5 billion. In this case, defense cutbacks create a ripple effect throughout the state economy, leading to large declines spread across all sectors. In the medium run, with only labor markets linked nationally,

the multiplier is around 1. In this case, defense cuts of 40% to 60% lead to significant migration of skilled labor out of the state (2-9%) and to decreases in GSP of 2% to 3%. The more linked is California with the rest of the economy, the more pervasive is the impact of defense cutbacks on the state economy.

The impact of defense cuts varies widely by sector. When only labor is mobile, a 40% defense cut results in a 14% to 47% decrease in sectoral value added for highly defense-dependent sectors (planes, ships, space, and instruments). Most other sectors decline less than 5%. When both labor and capital are mobile, the income multiplier effect dominates the sectoral effect, spreading the impact of defense cuts across the entire state economy. Under a 40% cut in defense spending with full factor mobility most industrial sectors decline 10% to 15%, although some sectors such as planes are more heavily affected (declining 23.4%).

Job loss provides an direct measure of adjustment costs associated with a major economic shock. Existing estimates of job losses associated with defense cutbacks fall within the range of results from this study. The California Governor's Office estimated that 430,000 defense-related jobs were lost between 1990 and 1993 (Gov. 1994). CSF estimated that in the aerospace industry alone, 176,000 defense-related jobs were lost between 1990 and 1992 (CSF 1992). With a 20% cut in defense expenditures (roughly that experience between 1990 and 1994), the CA-CGE model generates a loss of between 92,130 and 836,300 jobs. Job losses under model variant 2 (labor mobile and capital immobile) falls between the CSF and governor's estimates, with 290,780 jobs lost as a result of a 20% defense cut. CSF anticipates that an additional 81,000 defense-related jobs will be lost between 1993 and 1997, or a total of 207,000 jobs between 1988 and 1997. The CA-CGE model projects a loss of between 190,780 and 1,6[illegible],180 jobs under a 40% defense cut (the anticipated decrease between 1990 and 2000). A 40% cut leads to loss of 515,590 defense-related jobs under variant 2.

The results indicate that the California economy is sensitive to cutbac n federal defense expenditures. They also indicate the importance of government spending in eral. The growth in government expenditures at all levels was clear one of the driving for behind the rapid growth of the state in the 1980s, and the decline in these expenditures has been a major contributing factor to the slowdown of the state economy. California led the rest of the economy in the boom period, and has lagged the country in the recovery. In such an environment, one would expect more movement of factors into the state in the boom period and out of the state during the down phase. The fact that the negative impacts of defense cutbacks are much worse the more closely California factor markets are linked to national markets also has significant policy relevance. If California wishes to lessen the impact on the state economy of defense cutbacks, it is important to pursue policies that encourage capital and labor to remain in the state.

Policies that make the state economy more desirable to investors and labor will significantly lower the negative multiplier associated with defense and other government expenditure reductions. Labor and capital mobility are sensitive to investment in people and infrastructure. State support for education and training, at all levels, has been in the past, and

continues to be, very important to workers. In addition, the state economy would benefit from policies that encourage unemployed workers to remain and seek alternative employment in the state. Unemployment insurance and support for retraining and additional education are important. Finally, the investment climate is important. Enterprises and investors need active encouragement to remain in the state and wait out the recession. Policies to maintain and expand the state's physical infrastructure are also important in maintaining a hospitable investment climate.

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Appendix 1:
The California Computable General Equilibrium (CA-CGE) Model

Introduction

This appendix presents the equations of the California CA-CGE model in the format of the software in which the program was written, GAMS. GAMS is the acronym for "General Algebraic Modeling System," and the software is described in Brooke, Kendrick, and Meeraus (1988). For ease of exposition, only the sets, parameters, variables, and equations are presented here. Data, parameter initialization, and table printing code are omitted.

GAMS statements are case insensitive. However, we use a few notation conventions to improve readability:

- variables are all in upper case.
- variable names with a suffix 0 represent base-year values and are specified as parameters in the model.
- parameters are all in lower case.
- sets are all in lower case.

In the GAMS language:

- parameters are treated as constants in the model and are defined in separate PARAMETER statements.
- SUM is the summation operator, sigma.
- PROD is the product operator, pi.
- LOG is the natural logarithm operator.
- $ introduces a conditional "if" statement.
- the suffix, .FX, indicates a fixed variable.
- the suffix, .L, indicates the level or solution value of a variable.
- the suffix, .LO, indicates the lower bound of a variable.
- the suffix, .UP, indicates the upper bound of a variable.
- an asterisk (*) in column one indicates a comment. Some alternative treatments are shown commented out.
- a subset is denoted by the subset name followed by the name of the larger set in parentheses. In statements, the subset name is used by itself.
- a semicolon (;) terminates a GAMS statement.
- items between slashes (/) are data.

```
*California CEC model for analyzing impact of defense reductions
*Programed 3/94 by Sherman Robinson
*Program structure based on USDA/ERS gdp Version, June 1989
*Original programming by: S. Robinson, K. Hanson, and M. Kilkenny.
*Adaptati   for Indonesia with nested functions by Jeffrey D. Lewis

*########  ############ SET DECLARATION ##############################

SETS

i sectors/
     agric          agriculture
     mining         mining and oil
     const          construction
     food           food mfg
     text           textiles and clothing
     wood           wood and products
     chem           chemicals
     metal          metal and products
     elect          electrical machinery
     mach           other machinery
     cars           cars and trucks
     plane          airplanes
     ship           ship building
     space          missles and space
     instr          instruments
     misc           miscellaneous
     trans          transportation services
     util           utilities
     trade          wholesale and retail trade
     house          real estate
     prsvc          professional services
     engsvc         engineering and management
     svc            other services
     pubad          public administration
/

 f    factors of production / capital    capital
                              lmanuf     industrial labor
                              lsvl       service sector low skill
                              lsvh       service sector high skill /

 hh   households             / hhall      single household /

 ins  non-labor institutions / corp       corporate income   /

 gt        govt by type      / state      state and local govt
                               fnonmil    federal non-military
                               fmil       federal military     /

 iint(i)   sectors using intermediate inputs
 iintn(i)  sectors without intermediate inputs

 ie(i)     export sectors
 ien(i)    non export sectors

 im(i)     import sectors
 imn(i)    non import sectors
 ivat(i)   value added tax sectors
 ioil(i)   mining                /mining /
 noil(i)   non-mining sectors

 ikap(f)   capital / capital /
 ilab(f)   labor categories  ;
```

```
  ilab(f)         = not ikap(f)  ;
  ivat(i)         = no;
  noil(i)         = not ioil(i) ;

 ALIAS (i,j)
 ALIAS (ivat,jvat);
 ALIAS (iint,jint);
 ALIAS (h,hh);


*######################### PARAMETER DECLARATION ######################

 PARAMETERS

*### READ IN PARAMETERS

*## READ IN FOR INITIALIZATION OF VARIABLES
 CORSAV0      CORPORATE SAVINGS
 CORTAX0      CORPORATE TAXES
 DEPR0        depreciation
 E0(i)        EXPORTS
 EXR0         EXCHANGE RATE
 FHT0         corp to hh transfer
 GOVCON0      TOTAL VOLUME OF GOVERNMENT CONSUMPTION
 GTCOR0       govt to corp transfer
 GHT0         govt to hh transfer
 HHSAV0       HOUSEHOLD SAVINGS
 HHTAX0       HOUSEHOLD TAX REVENUE
 INVT0        TOTAL INVESTMENT
 GDPVA0       Nominal gdp
 M0(i)        IMPORTS
 MPS0(hh)     HOUSEHOLD MARGINAL PROPENSITY TO SAVE
 NCIMP0       Non Comp Imports
 PD0(i)       DOMESTIC GOODS PRICE
 PE0(i)       DOMESTIC PRICE OF EXPORTS
 PM0(i)       DOMESTIC PRICE OF IMPORTS
 PNC(i)       PRICE OF NONCOMPETITIVE IMPORTS
 PQ0(i)       PRICE OF COMPOSITE GOOD
 PV0(i)       VALUE ADDED PRICE BY SECTOR
 PX0(i)       AVERAGE OUTPUT PRICE
 PINDEX0      CPI DEFLATOR
 PINDOM0      DOMESTIC PRICE DEFLATOR
 GOVSAV0      Govt Savings
 INDTAX0      indirect tax
 SSTAX0       soc security tax
 X0(i)        DOMESTIC OUTPUT
 CD0(i)       Private consumption
 GD20(i,gt)   Govt consumption by type

*## READ IN PARAMETERS AS RATES, SHARES, ELASTICITIES
 csav         savings rate for corporations
 ctax         tax rate for corporate income
 inv(i)       ratio of inventory investment to gross output
 rfxd0        ratio of fixed investment to gdpva
 gg(i)        government consumption shares
 rhoc(i)      armington function exponent
 rhot(i)      cet function exponent
 rhov(i)      value added function exponent
 rhox(i)      production function exponent
 sst          social security tax rate
 te(i)        export tax rates
 tm(i)        tariff rates on imports
 tx(i)        indirect tax rates
 tr(i)        indirect tax rate inc exports
 th(hh)       household tax rate
```

```
*# READ IN TABLE OF PARAMETERS (NEED NOT BE DECLARED)
* TABLE aa(i,j)           INPUT-OUTPUT COEFFICIENTS
  bb(i)                  investment coefficients
* TABLE cc(i,hh)          HOUSEHOLD CONSUMPTION SHARES
* TABLE lfactohh(hh,f)    HOUSEHOLD SHARES IN LABOR FACTOR INCOME
* TABLE emptohh(hh,f)     HOUSEHOLD SHARES IN LABOR EMPLOYMENT
* TABLE kfactohh(hh,ins) HOUSEHOLD SHARES IN NON-LABOR FACTOR INCOME

*## COMPUTED PARAMETERS FOR INITIALIZATION OF VARIABLES
 CURACT0        CURRENT ACCOUNT
 D0(i)          DOMESTIC SALES VOLUME
 FXDINV0        FIXED CAPITAL INVESTMENT
 ID0(i)         Sectoral investment
 FD0(f)         FACTOR DEMAND AGGREGATE
 FS0(f)         FACTOR SUPPLY AGGREGATE
 GR0            GOVERNMENT REVENUE
 INT0(i)        INTERMEDIATE INPUT DEMAND
 N0(i)          COMPOSITE INTERMEDIATE INPUT
 PN0(i)         INTERMEDIATE INPUT PRICE BY SECTOR
 PWM(i)         WORLD MARKET PRICE OF IMPORTS (IN DOLLARS)
 PWE(i)         WORLD PRICE OF EXPORTS
 PWE0(i)        Base year price of exports
 Q0(i)          COMPOSITE GOOD SUPPLY VOLUME
 V0(i)          VALUE ADDED
 VAR0(i)        VALUE ADDED RATE BY SECTOR
 WFDIST0(i,f)   FACTOR PRICE SECTORAL PROPORTIONALITY CONSTANTS
 WF0(f)         FACTOR PRICE AGGREGATE AVERAGE
 YF0(f)         FACTOR INCOME SUMMED OVER SECTOR
 YFSECT0(i)     FACTOR INCOME BY SECTOR
 YINST0(ins)    NON-LABOR INSTITUTIONAL INCOME
 YH0(hh)        HOUSEHOLD INCOME
 YCORP0         CORPORATE INCOME

*## COMPUTED PARAMETERS AS RATES, SHARES
 ac(i)          armington function shift parameter
 at(i)          cet function shift parameter
 av(i)          value added function shift parameter
 ax(i)          production function shift parameter
 bc(i)          armington function share parameter
 bt(i)          cet function share parameter
 bv(i,f)        factor share parameter for value added function
 bx(i)          production function share parameter
 nc(i)          noncompetitive imports share
 ncg            noncomp import share for govt
 nch(hh)        noncomp import share for hh
 qd(i)          dummy variable for computing av(i) and bv(i)
 rmd(i)         ratio of imports to domestic sales
 tmreal(i)      real tariff rate
 wtd(i)         domestic price index weights
 wtq(i)         composite price index weights
 ;

*#########################################################################

 VARIABLES

*#################### VARIABLE DECLARATION ##########################

*## PRICE BLOCK
   EXR          EXCHANGE RATE                              ($ PER WORLD $)
   PD(i)        DOMESTIC PRICES
   PE(i)        DOMESTIC PRICE OF EXPORTS
   PINDEX       COMPOSITE PRICE INDEX
   PINDOM       DOMESTIC PRICE INDEX
   PM(i)        DOMESTIC PRICE OF IMPORTS
```

```
   PN(i)      INTERMEDIATE INPUT PRICE BY SECTOR
   PQ(i)      PRICE OF COMPOSITE GOODS
   PV(i)      VALUE ADDED PRICE
   PX(i)      AVERAGE OUTPUT PRICE
*## PRODUCTION BLOCK
   D(i)       DOMESTIC SALES OF DOMESTIC OUTPUT
   E(i)       EXPORTS
   M(i)       IMPORTS
   N(i)       COMPOSITE INTERMEDIATE INPUT
   Q(i)       COMPOSITE GOODS SUPPLY
   V(i)       VALUE ADDED
   X(i)       DOMESTIC OUTPUT
*## FACTOR BLOCK
   FS(f)      FACTOR SUPPLY
   FDSC(i,f)  FACTOR DEMAND BY SECTOR
   WF(f)      FACTOR PRICE variable
   AVWF(f)    Average factor price
   WFDIST(i,f)  FACTOR PRICE SECTORAL PROPORTIONALITY RATIOS
   YF(f)      FACTOR INCOME
*## INCOME AND EXPENDITURE BLOCK
   CD(i)      FINAL DEMAND FOR PRIVATE CONSUMPTION
   CORSAV     CORPORATE SAVINGS
   CORTAX     CORPORATE TAXES
   DK(i)      VOLUME OF INVESTMENT BY SECTOR OF DESTINATION
   EXPTAX     EXPORT TAX REVENUE
   FXDINV     FIXED CAPITAL INVESTMENT
   RFXD       Ratio of fixed investment to gdpva
   GD2(i,gt)  Govt demand by type of govt
   GD(i)      FINAL DEMAND FOR GOVERNMENT CONSUMPTION
   GDPVA      VALUE ADDED IN MARKET PRICES GDP
   GHT        GOVT TO HH TRANSFERS
   GOVCON     TOTAL VOLUME OF GOVERNMENT CONSUMPTION
   GOVSAV     GOVERNMENT SAVINGS
   GR         GOVERNMENT REVENUE
   GTCOR      GOVT TO CORP TRANSFER
   HHPOP(hh)  EMPLOYMENT BY HOUSEHOLD TYPE
   HHSAV      TOTAL HOUSEHOLD SAVINGS
   ID(i)      FINAL DEMAND FOR PRODUCTIVE INVESTMENT
   INDTAX     INDIRECT TAX REVENUE
   INT(i)     INTERMEDIATES USES
   INVT       TOTAL INVESTMENT
   MPS(hh)    MARGINAL PROPENSITY TO SAVE BY HOUSEHOLD TYPE
   NCIMP      Noncompetitive Imports
   RGDP       REAL GDP
   SAVING     TOTAL SAVINGS
   STK(i)     INVENTORY INVESTMENT BY SECTOR
   TARIFF     TARIFF REVENUE
   HHTAX      HOUSEHOLD TAX REVENUE
   SSTAX      Social Security
   VATREV     VALUE ADDED TAX REVENUE
   YH(hh)     HOUSEHOLD INCOME
   YINST(ins) NON-AG INSTITUTIONAL INCOME
   YCORP      CORPORATE INCOME
*BALANCE OF PAYMENT BLOCK
   CURACT       CURRENT ACCOUNT

*Walras Law variable
   WALRAS1      Savings investment Walras variable
   WALRAS2      Balance of trade Walras variable
   DEVIATE      Squared error of Walras variables
        ;

*#####################################################################

 EQUATIONS
```

```
*#################### EQUATION DECLARATION ############################

*PRICE EQUATIONS
   PMDEF(I)            DEFINITION OF DOMESTIC IMPORT PRICES
   PEDEF(I)            DEFINITION OF DOMESTIC EXPORT PRICES
   ABSORPTION(I)       VALUE OF DOMESTIC SALES
   SALES(I)            VALUE OF DOMESTIC OUTPUT
   PVDEF(I)            DEFINITION OF ACTIVITY PRICES
   PNDEF(I)            DEFINITION OF INTERMEDIATE INPUT PRICE
   PINDEXDEF           DEFINITION OF GENERAL PRICE LEVEL
   PINDOMDEF           DEFINITION OF DOMESTIC PRICE LEVEL
*OUTPUT EQUATIONS
   ACTIVITY(i)         PRODUCTION FUNCTION
   ACTIVITY2(i)        PRODUCTION FUNC. FOR SECTORS WITHOUT INTER. INPUTS
   INTERMED(i)         F.O.C. FOR INTERMEDIATE INPUT USE
   VALUEADD(i)         VALUE ADDED FUNCTION
   PROFITMAX(i,f)      FIRST ORDER CONDITIONS FOR PROFIT MAXIMUM
   CET(i)              CET EXPORT AGGREGATION FUNCTION
   CET2(i)             DOMESTIC SALES FOR NONTRADED SECTORS
   ESUPPLY(i)          EXPORT SUPPLY
   ARMINGTON(i)        COMPOSITE GOOD (ARMINGTON) AGGREGATION FUNCTION
   ARMINGTON2(i)       COMPOSITE GOOD AGG. FOR NONTRADED SECTORS
   COSTMIN(i)          F.O.C. FOR COST MINIMIZATION OF COMPOSITE GOOD
*INCOME EQUATIONS
   YFEQ(f)             FACTOR INCOME
   WAGE1(f)            Average wage
   YCORPEQ             CORPORATE INCOME
   YINST3              FIRM INCOME DISTRIBUTED TO HOUSEHOLDS
   HHINCEQ(hh)         HOUSEHOLD INCOME
   HHPOPEQ(hh)         HOUSEHOLD WORKERS
   TARIFFDEF           TARIFF REVENUE
   INDTAXDEF           INDIRECT TAXES ON DOMESTIC PRODUCTION
   EXPTAXDEF           EXPORT DUTIES
   CORTAXDEF           CORPORATE INCOME TAX REVENUE
   SSTAXDEF            Soc Security Tax
   HHTAXDEF            TOTAL HOUSEHOLD TAXES COLLECTED BY GOVT.
   NCEQ                Noncompetitive imports
   GREQ                GOVERNMENT REVENUE
   HHSAVEQ             TOTAL HOUSEHOLD SAVINGS
   CORSAVEQ            CORPORATE SAVINGS
   TOTSAV              TOTAL SAVING
*## EXPENDITURE BLOCK
   INTEQ(i)            TOTAL INTERMEDIATE USES
   CDEQ(i)             PRIVATE CONSUMPTION BEHAVIOR
   GDEQ(i)             GOVT CONSUMPTION OF COMMODITIES
   GDEQ2               Aggregate govt demand
   FIXEDINV            FIXED INVESTMENT NET OF INVENTORY
   IEQ(i)              INVESTMENT BY SECTOR OF ORIGIN
   IEQ1                FXDINV as share of gdpva
   GDPY                TOTAL VALUE ADDED INCLUDING INDTAX
   GDPR                REAL GDP
*## MARKET CLEARING
   EQUIL(i)            GOODS MARKET EQUILIBRIUM
   FMEQUIL(f)          FACTOR MARKET EQUILIBRIUM
   CURRACTEQ           CURRENT ACCOUNT BALANCE (FOR. CURR.)
   GOVSAVEQ            GOVERNMENT SAVINGS
   WALRAS              WALRAS LAW EQUATION
   OBJECTIVE           Objective function
     ;

*The WALRAS equation is redundant, given that the model satisfies Walras' Law.
*In this case, we drop the Savings-Investment balance equation.

*######################## EQUATION ASSIGNMENT  ########################
```

```
*## PRICE BLOCK

 PMDEF(im)..     PM(im) =E= pwm(im)*EXR * (1 + tm(im)) ;

 PEDEF(ie)..     PE(ie) =E= pwe(ie)*EXR * (1 - te(ie))   ;

 ABSORPTION(i).. PQ(i)*Q(i) =E= PD(i)*D(i)+(PM(i)*M(i))$im(i);

 SALES(i)..      PX(i)*X(i)*(1+tr(i)) =E= PD(i)*D(i)*(1-tx(i))
                     +(PE(i)*E(i))$ie(i);

 PVDEF(i)..      PX(i)*X(i)  =E=  PV(i)*V(i) + PN(i)*N(i) ;

 PNDEF(iint)..   PN(iint)      =E= SUM(j, aa(j,iint)*PQ(j) )
                                   + PNC(iint)*NC(iint);

 PINDEXDEF..     PINDEX    =E= SUM(i, wtq(i)*PQ(i) ) ;

 PINDOMDEF..     PINDOM    =E= SUM(i, wtd(i)*PD(i) ) ;

*## QUANTITY EQUATIONS

 ACTIVITY(iint)..  X(iint) =E= AX(iint)*(BX(iint)*V(iint)**(-rhox(iint)) +
                     ( 1-BX(iint))*N(iint)**(-rhox(iint)))**(-1/rhox(iint)) ;

 ACTIVITY2(iintn).. X(iintn) =E= V(iintn) ;

 INTERMED(iint)..  V(iint) =E= N(iint)*( PN(iint)/PV(iint)*BX(iint)/
                     (1-BX(iint)) )**(1/(1 + rhox(iint))) ;

 VALUEADD(i)..    V(i)   =E= av(i)*PROD(f$bv(i,f), FDSC(i,f)**bv(i,f));

 PROFITMAX(i,f)$WFDIST0(i,f)..  WF(f)*WFDIST(i,f)*FDSC(i,f) =E=
                                       V(i)*PV(i)*bv(i,f) ;

 CET(ie)..       X(ie) =E= at(ie)*( bt(ie)*E(ie)**rhot(ie) +
                     ( 1-bt(ie) )*D(ie)**rhot(ie) )**(1/rhot(ie)) ;

 CET2(ien)..     X(ien) =E= D(ien) ;

 ESUPPLY(ie)..   E(ie) =E= D(ie)*( PE(ie)/(PD(ie)*(1 - tx(ie)) )
                        *(1-bt(ie))/bt(ie) )**(1/(rhot(ie)-1) ) ;

 ARMINGTON(im)..  Q(im) =E= ac(im)*(bc(im)*M(im)**(-rhoc(im)) +
                     (1-bc(im))*D(im)**(-rhoc(im)))**(-1/rhoc(im)) ;

 ARMINGTON2(imn)..  Q(imn) =E= D(imn) ;

 COSTMIN(im)..    M(im) =E= D(im)*(PD(im)/PM(im)*bc(im)/(1-bc(im)) )
                        **(1/(1 + rhoc(im))) ;

*## INCOME EQUATIONS

 WAGE1(f).. AVWF(f) =E= SUM(i, wfdist(i,f)*wf(f)
                          *fdsc(i,f))/SUM(j, fdsc(j,f)) ;

 YFEQ(f)..      YF(f) =E= SUM(i, WF(f)*WFDIST(i,f)*FDSC(i,f));

 YCORPEQ..      YCORP =E= YF("capital") + EXR*yfw0('capital') +GTCOR ;

 YINST3..       YINST("corp")   =E= YCORP*(1-ctax)*(1-csav) ;

 HHINCEQ(hh).. YH(hh) =E= SUM(ilab, LFACTOHH(hh,ilab)*
                     (YF(ilab)+EXR*YFW0(ilab)) ) +
          SUM(ins,  KFACTOHH(hh,ins)*YINST(ins) ) + GHT - SSTAX ;
```

```
HHPOPEQ(hh)..   HHPOP(hh) =E= SUM(ilab, EMPTOHH(hh,ilab)*FS(ilab) ) ;

TARIFFDEF..     TARIFF  =E= SUM(im, tm(im)*M(im)*pwm(im)) )*EXR ;

INDTAXDEF..     INDTAX    =E= SUM(I, tx(i)*PD(i)*D(i)+tr(i)*PX(i)*X(i) );

EXPTAXDEF..     EXPTAX    =E= SUM(ie, te(ie)*pwe(ie)*E(ie) ) * EXR  ;

CORTAXDEF..     CORTAX   =E= YCORP * ctax ;

SSTAXDEF..      SSTAX     =e= SUM(ilab, YF(ilab))*sst ;

HHTAXDEF..      HHTAX     =E= SUM(hh, th(hh)*YH(hh) ) ;

GREQ..     GR =E= TARIFF + EXPTAX + INDTAX + HHTAX + VATREV + CORTAX + SSTAX ;

HHSAVEQ..       HHSAV   =E= SUM(hh, MPS(hh)*YH(hh)*(1 - th(hh))) ;

CORSAVEQ..      CORSAV =E= YCORP * (1 - ctax) * csav ;

TOTSAV..        SAVING  =E=  HHSAV  + GOVSAV  + CORSAV  -  CURACT*EXR  ;

*## EXPENDITURE EQUATIONS

INTEQ(i)..    INT(i)  =E= SUM(j, aa(i,j)*N(j));

CDEQ(i)..     PQ(i)*CD(i) =E= SUM(hh, cc(i,hh)*(1-NCH(hh))*(1-MPS(hh))
                              *YH(hh)*(1-th(hh))) ;

NCEQ..        NCIMP =E= SUM(hh, NCH(hh)*(1-MPS(hh))*YH(hh)*(1-th(hh)))
                        + NCG*SUM(i,GD(i)*PQ(i)) + SUM(i,PNC(i)*NC(i)*N(i)) ;

GDEQ(i)..     GD(i)  =E= SUM(gt, gd2(i,gt)) ;

GDEQ2..       GOVCON =E= SUM(i, GD(i)*PQ(i)) ;

FIXEDINV..    FXDINV =E= INVT - SUM(i, STK(i)*PQ(i)) ;

IEQ1..        FXDINV =E= rfxd*GDPVA ;

IEQ(i)..      PQ(i)*ID(i)  =E=  bbb(i)*FXDINV ;

GDPY..          GDPVA =E= SUM(i, PV(i)*V(i)) + INDTAX + TARIFF ;

GDPR..          GDPVR =E= SUM(i, CD(i) + STK(i) + ID(i) + GD(i))
                + SUM(ie, E(ie)) - SUM(im, (1.0 - tmreal(im))*M(im))
                - SUM(i, PNC(i)*NC(i)*N(i)) ;

*## MARKET CLEARING

EQUIL(i)..      Q(i)   =E= INT(i) + CD(i) + GD(i) + ID(i) + STK(i) ;

FMEQUIL(f)..    SUM(i, FDSC(i,f)) =E= FS(f) ;

CURRACTEQ..     CURACT  =E=  SUM(ie, pwe(ie)*E(ie)) + SUM(f, YFW0(f))
                - SUM(im, pwm(im)*M(im)) - NCIMP/EXR + WALRAS2 ;

GOVSAVEQ..      GR  =E= SUM(i, PQ(i)*GD(i))*(1+NCG) + GOVSAV + GHT + GTCOR ;

WALRAS..        SAVING =E= INVT + WALRAS1;

OBJECTIVE..     DEVIATE =E= WALRAS1*WALRAS1 + WALRAS2*WALRAS2;

*#### ADDITIONAL RESTRICTIONS CORRESPONDING TO EQUATIONS
```

```
*    AVWF.FX(f)    = AVWF.L(f) ;
*    FS.LO(f)      = -inf ;
*    FS.UP(f)      = +inf ;

*SR lock up output in the mining/oil sector
     FDSC.FX(ioil,f)                      = fdsc.l(ioil,f) ;
     wfdist.lo(ioil,f)$wfdist0(ioil,f) = -inf ;
     wfdist.up(ioil,f)$wfdist0(ioil,f) = +inf ;

*## NUMERAIRE PRICE INDEX
*In this case, the consumer price index

   PINDEX.FX = PINDEX.L ;
*  PINDOM.FX = PINDOM.L ;

*############################ END OF MODEL ##############################
```

```
*# PMDEF, PEDEF, ESUPPLY, COSTMIN, AND PROFITMAX
*# FOR NON-TRADED SECTORS AND SECTORS WITH FIXED WORLD EXPORT PRICES

 PM.FX(imn)    = PM0(imn) ;
 PE.FX(ien)    = PE0(ien) ;
 E.FX(ien)     = 0;
 M.FX(imn)     = 0;
 PN.FX(iintn)  = PD0(iintn) ;
 N.FX(iintn)   = 0 ;
 FDSC.FX(i,f)$(WFDIST0(i,f) EQ 0) = 0 ;

*############################ MODEL CLOSURE ##############################

*## FOREIGN EXCHANGE MARKET CLOSURE
* In the California version, exchange rate is fixed and foreign capital
* inflow is the equilibrating variable.

   EXR.FX         = EXR.L ;
   GTCOR.FX       = GTCOR.L ;
   GHT.FX         = GHT.L ;
   VATREV.FX      = 0 ;

*## INVESTMENT-SAVINGS CLOSURE
* This version specifies fixed aggregate investment (invt).
* Aggregate savings adjusts.  Inventory investment is fixed at zero.

*  MPS.FX(hh) = MPS.L(hh) ;
   INVT.FX    = INVT.L ;
*  ID.FX(i)   = ID.L(i) ;
   STK.FX(i)  = STK.L(i) ;
*  rfxd.fx    = rfxd0 ;

*##Set Walras variable, dropping either savings-investment
*  or balance of trade constraint equation

   WALRAS1.FX = 0.0 ;
*  WALRAS2.FX = 0.0 ;

*## EXOGENOUS GOVT EXPENDITURE
*## AND GOVT CLOSURE RULE
* Real government spending (GOVCON) is fixed exogenously.  The government
* deficit (GOVSAV) is determined residually.
* In this version, we fix govt expenditure by type of govt:
*   state, fed non-defense, fed defense.

*  GOVSAV.FX    = GOVSAV.L ;
   gd2.fx(i,gt) = gd20(i,gt) ;

*## FACTOR MARKET CLOSURE
* Commented equations in the labor blocks allow a version with fixed wage
*   for each labor type, with total employment endogenous.

   FS.FX(ilab)         = FS.L(ilab) ;
   WFDIST.FX(i,ilab)   = WFDIST.L(i,ilab) ;
*  AVWF.FX(ilab)       = AVWF.L(ilab) ;
*  FS.LO(ilab)         = -inf ;
*  FS.UP(ilab)         = +inf ;

   FS.FX("capital")          = FS.L("capital") ;
   WFDIST.FX(i,"capital")    = WFDIST.L(i,"capital") ;
*  AVWF.FX("capital")        = AVWF.L("capital") ;
*  FS.LO("capital")          = -inf ;
*  FS.UP("capital")          = +inf ;

*SR fix all wages and cut loose factor supplies
```

Appendix 2: 1990 California Social Accounting Matrix (SAM)

A2.1. The Social Accounting Matrix and CGE Models

The Social Accounting Matrix (SAM) both organizes the data used in CGE economywide modeling and provides its basic conceptual framework.[23] SAMs synthesize two widely used economic concepts. The first concept, from input-output analysis, is that expenditures by one sector in an economy are receipts for another. Traditional input-output analysis focuses on interindustry linkages in an economy. An input-output transactions table is a square matrix whose columns represent expenditures on intermediate products by industry and whose rows represent receipts from sales of intermediate product for those same industries. A standard input-output table is extended to include sales to final demand (additional columns) and also payments to factors of production, or value added (additional rows). These additional transactions are recorded in the accounts of the purchaser (represented by columns) and of the seller (represented by rows). The result is a set of double-entry bookkeeping accounts for all sectors—total receipts or sales must equal total expenditures for each sector.

A SAM extends this double-entry accounting approach to include all actors in an economy, not just sectors of production. The columns of the SAM record expenditures by all actors, and the rows record their receipts. By defining the various accounts properly, a SAM provides a convenient method of reconciling the input-output and national income and product accounts in a single accounting system. The basic defining characteristic of a SAM is that it is a square matrix in which corresponding row and column sums are equal. Income equals expenditure for each account and, hence, for the economy as a whole. The SAM represents a closed accounting system, defining the "circular flow" in an economy.

Available data are almost never accurate enough to generate a balanced SAM, just as the national accounts always have entries representing "statistical discrepancy" or "errors and omissions." Estimates of the size and location of these errors are necessary to estimate a balanced SAM. For example, we found state-level data on investment generally unavailable or of poor quality. As is commonly done in the national accounts, it seemed reasonable to estimate investment residually, implicitly assuming that the savings data are better and that all errors and omissions are in the investment account.

Some individual accounts did not initially balance: other property income, households, the federal government (non-defense), and state/local government (non-education). We did not have separate data on state, local, and federal finances, so were only able to balance them in the aggregate. The net aggregate government deficit is assumed to be financed by net government saving or dissaving. As is usual in the construction of SAMs, minor discrepancies remain between a number of accounts due to slight inconsistencies between data sources and other measurement error. These discrepancies were adjusted using a simple,

[23]For an introduction to SAMs see Sadoulet and de Janvry (forthcoming).

commonly used, matrix-balancing technique call the RAS method to create a completely balanced set of macro and sectoral accounts (Deming and Stephen 1940).

The California SAM, following standard accounting practice in input-output tables, also distinguishes between "activities" (production) and "commodities" (consumption). This distinction permits more than one type of activity to produce the same commodity, or a single activity to produce more than one commodity. In input-output analysis, the distinction is between "make" and "use" matrices. The "make" matrix maps from activities to commodities, while the "use" matrix tabulates the demand for commodities as intermediate inputs used by activities.

Separating activities and commodities allows for a richer treatment of imports. In input-output models, imports are often seen as perfect substitutes for domestically produced goods, and so provide an alternative source of supply of commodities. In models based on the SAM with activities and commodities, imports are included in the commodity account, while exports are viewed as a demand for the output of activities. Imports can be treated as an "input" into commodities, but do not have to be viewed as perfect substitutes for domestically produced goods.

The SAM, then, creates the basic framework of the general equilibrium model. Devarajan, Lewis, and Robinson (1993) describe the links between the accounts and a model:

> The different accounts in the SAM delineate the boundaries of an economywide model. Specification of a "complete" model requires that the market, behavioral, and system relationships embodied in each account in the SAM be described in the model. The activity, commodity, and factor accounts all require the specification of market behavior (supply, demand, and clearing conditions). The household and government accounts embody the private-household and public-sector budget constraints (income = expenditure). Finally, the capital and rest-of-world accounts represent the macroeconomic requirements for internal (saving = investment) and external (exports + capital inflows = imports) balance.

A2.2. Aggregate SAM Data Sources and Construction

It is relatively easy to construct a current aggregate SAM for the United States at the national level. Most of the needed data can be read directly from the input-output and the National Income and Product Accounts maintained by the Bureau of Economic Analysis, U.S. Department of Commerce. Constructing a current state level SAM is more difficult. Data are frequently unavailable on a yearly basis, or are of poor quality.

We have used a combination of U.S. government IMPLAN (the IMpact of PLANning) data base maintained by the U.S. Forest Service, state, and national data sources to construct a 1990 SAM for California (IMPLAN 1993). From IMPLAN, we obtained a 528-sector 1990 California input-output table, the commodity row and activity column of a 1990 California

SAM with three household income levels, and federal expenditures divided between military and nonmilitary expenditures. The Forest Service updates the state input-output tables every five to seven years. California tables are available for 1982 and 1990.

Because this study focuses on the impact of defense cuts on the California economy, particular attention was paid to the detail and quality of data on defense expenditures. A 537-sector vector of defense-related expenditures in California was obtained from the U.S. Department of Commerce. A description of this vector follows in Data Appendix 3.

The IMPLAN data are largely estimated by "allocating" or "spreading" national data to states and counties. While this top-down approach is desirable to maintain consistency between state and national data, it does not take advantage of particular data available at the state level. We supplemented IMPLAN data with state data whenever possible. In particular, we used data from the California Energy Commission (CEC) and aggregated the IMPLAN data to reconcile with the sectoral aggregation used by the CEC. We have generally followed IMPLAN's conventions and definitions of the accounts, with some exceptions given our particular focus on defense spending. Data sources for this California SAM are found in Table A2.1.

Table A2.2 gives the aggregate SAM for California used in this study. In the aggregate SAM, the input-output table is reduced to a two by two matrix, at the intersection of the industry and commodities accounts. In the full SAM, this input-output table includes many sectors. We have defense data for 538 industrial categories, and IMPLAN input-output data at a level of 528 sectors. Both were aggregated to correspond to the 64 sectors used by the California Energy Commission (CEC) in its state-wide modeling. The CEC aggregation is shown in Table A2.3. Data for the 64 CEC sectors were finally aggregated to 23 sectors for the CGE model. These 23 sectors were defined so as to keep the major components of government expenditure on defense separate, and also capture the major input-output linkages between defense industries and the rest of the California economy. The aggregation is shown in Table A2.3.

TABLE A2.1. CALIFORNIA SOCIAL ACCOUNTING MATRIX: DATA SOURCES

Note: 1) except where otherwise indicated, all reported figues are in million of dollars for the 1990 calendar year.
2) "IMPLAN" refers to numbers from the IMPLAN, California Aggregate Table for Calendar Year 1990

Row 1. Sources of Receipts for Industries

Expenditures by Commodities *(Row 1, Col. 2)*

[sum of Col. 1 (Row 18, Col. 1)] 1,203,235.84

Row 2. Sources of Receipts for Commodities

Expenditures by Industries *(Row 2, Col. 1)*

Total commodity production by Industries
[IMPLAN: Total Intermediate Goods] 480,776.78

Expenditures by Households *(Row 2, Col. 7)*

Household Consumption of Domestic Commodities

[IMPLAN: Sum of Households]	448,993.44	
PLUS: Adjustment to balance commodity account	+ 4,194.30	
		453,187.74

Expenditures by Federal Government, Non-Defense (Row 2, Col. 8)

Federal Government Purchases of Domestic Commodities (Non-Defense)

Total Federal Procurement minus DOD purchases	FY 1989-90	29,500 – 21,952 = 7,548.00	
	FY 1990-91	+ 32,101 – 23,631 = 8,470.00	
PLUS: All Other Fed'l Agencies	FY 1989-90	+ =3,293.68	
Salaries and Wages,	FY 1990-91	+ =3,471.28	
DIVIDED BY 2 + 2 =	Calendar 1990		11,167.17

Data Source: Calif. Statistical Abstract Tables M-2, M-3 (1991, 1992)

Note: 1) No adjustment has been made for DOE expenditures
The federal government's fiscal year changes October 1. I assumed that it changed July 1, and therefore weighted the two relevant fiscal years equally.
2) U.S. Post Office is treated as a private enterprise.

Expenditures by Federal Government, Defense (Row 2, Col. 9)

Federal Government Purchases of Domestic Commodities (Defense)

See Data Appendix I for construction of a sectorally disaggregated vector of defense expenditures in California.

39,655.4

Expenditures by State/Local, Non-Education *(Row 2, Col. 11)*

State and Local Government Purchases of Domestic Commodities

[IMPLAN: State Purchases – State Sales – NCIMP (R15, C11)] = 72,148.31

83027.44 – 9305.999 – 1573.13 =

Expenditures by State/Local, Education *(Row 2, Col. 12)*

We have combined this with state/local, non-education (Row 2, Col. 11)

Expenditures by Investment (Inventory) *(Row 2, Col. 13)*

Investment (Inventories) Purchases of Domestic Commodities	
[IMPLAN: Stocks]	2,900.65

Expenditures by Investment (Capital Formation) *(Row 2, Col. 14)*

Investment (Capital formation)	
[IMPLAN: Capital]	113,328.47

Expenditures by Domestic Trade *(Row 2, Col. 16)*

[IMPLAN: DEXP]	278,965.5

Expenditures by Foreign Imports *(Row 2, Col. 17)*

[IMPLAN: FEXP]	57,751.8

Row 3. Sources of Receipts for Employee Compensation/Income

Expenditures by Industries *(Row 3, Col. 1)*

Employee Compensation less Contribution to Social Security

Wages and Salaries	366,428	
PLUS: Other labor Income	+ 35,048	
LESS: Personal Contributions to Social Security	+ 30,022	
PLUS: Federal Receipts from Calif. for Social Security	+ 59,236	
PLUS: State Receipts for Social Insurance	+ 7,593	
EQUALS:		438,283

Bea, Survey of Current Business, NIPA Table 3.2 Federal Government Receipts and Expenditures,
NIPA Table 3.3 State and Local Government Receipts and Expenditures (March 1992).
Bea, Survey of Current Business, NIPA Tables 3.2, 3.3 (Aug. 1992).

Neither California or Federal receipts for Social Security/insurance was available at a state level.
They were determined as follows:

1) total Federal and state government receipts for social insurance = (444.7+57.0)/225.368 = 2.226
personal contributions for social insurance from California

2) total California contributions to social insurance = 2.226 * (personal contribution for U.S.) = 66,829

3) Federal receipts for social insurance = .88638
total government receipts for social insurance

4) U.S. receipts for social insurance from Calif. = (total Calif. contribution)*(U.S. Fed/U.S. total)
= (66,829)*(.88638)
= [illegible]

5) Calif. state receipts for social insurance from Cal[illegible]otal Calif. contribution – Fed. receipts from Calif. = 7,593

Expenditures by Domestic Trade *(Row 3, Col.16)*

Adjustment for residence	326

Source: BEA, Survey of Current Business, State Personal Income Table 3, Personal Income by Major Sources
and Earnings by Industry, 1988-90 (Aug. 1991)

Row 4. Sources of Receipts for Proprietors Income

Expenditures by Industries *(Row 4, Col. 1)*

Proprietary Income (PoW)			
farm		5,759	
PLUS: non-farm	+	52,539	
EQUALS:			58,298

Source: BEA, Survey of Current Business, State Personal Income Table 3, Personal Income by Major Source and Earnings by Industry 1988-90 (Aug. 1991)

Row 5. Sources of Receipts for Other Property Surplus

Expenditures by Industries (Row 5, Col. 1)

Alternative Used: [IMPLAN: Factor Payments, OPROPY] 177,579.17

Alternative not used:

Gross State Product (1)	750,000	(estimate)	
LESS: Wages & Salaries (2)	- 35,048		
LESS: Other Labor Income (2)	- 58,298		
LESS: Indirect Taxes (3)	- 56,496		
EQUALS:	=		196,923

Source: (1) California Dept. of Finance, Jan. 21, 1993
(2) BEA, Survey of Current Business, State Personal Income Table 3, Personal Income by Major Source and Earnings by Industry 1988-90 (Aug. 1991)
(3) IMPLAN

Expenditures by Foreign Trade (Row 5, Col. 16)

Net Foreign Exports of Capital Services

Adjustment created to balance Row 6 and Col. 6 19,990

Row 6 **Sources of Receipts for Enterprises**

Expenditures by Other Property Inc. *(Row 6, Col. 5)*

(Row 5, Col. 1) less Capital Consumption Allowance (CCA) = (D)*(tot. Row 5) = 117,746.92

Derivation of D:
1) Data used:

Corporate profits with IVA & CCAdj	319,000
PLUS: Net Interest	+ 490,100
EQUALS: U.S. Other Prop. Inc. – CCA	= 809,100
Capital Consumption Allowance (CCA)	548,500

2) $\frac{\text{U.S. Other Prop. Inc. – CCA}}{\text{U.S. Other Prop. Inc. + CCA}} = \frac{809.1}{809.1 + 548.5} = D$

Sources: BEA, Survey of Current Business, NIPA Table 1.14 National Income by Type of Income,
NIPA Table 1.9 Relationship of GDP, GNP, NNP, National Income, and Personal Income (March 1992).

Expenditures by Households *(Row 6, Col. 7)*

Federal Government Interest Income

[omitted]

Expenditures by Federal Government, Non-Defense *(Row 6, Col. 8)*

Federal Government Dividend Income [omitted]

PLUS: Federal Government Subsidies less Surplus of Govt Enterprises
U.S. total: 24,700
California share: (CA GSP/ US GDP)*(24,700) = 21,771.58

PLUS: Federal Government Interest Paid to Persons and Businesses
U.S. total: 171,400
California share: (CA GSP/US GDP)*(171,400) = 28,028.52

EQUALS: 49,800.10

Source: BEA, Survey of Current Business, NIPA Table 3.2 Federal Government Receipts & Expenditures (March 1992)

Expenditures by State/Local Government Non-Education *(Row 6, Col. 13)*

U.S. total:

State and Local Government Interest Paid		61,100
LESS: State and Local Government Subsidies less Surplus for Government Enterprises	–	20,000
EQUALS:	=	41,100

California share: (U.S. total)*(Calif. GSP/US GDP) = 41,100 *.13 5,446.21

Source: BEA, Survey of Current Business, NIPA Table 3.3 State & Local Government Receipts & Expenditures (March 1992)

Row 7. Sources of Receipts for Households

Expenditures by Employee Compensation Income *(Row 7, Col. 3)*

Total Factor Payments (total for Row 3)		438,609	
LESS: Federal Receipts for Social Security	–	59,236	
LESS: State Receipts for Social Security	–	7,593	
PLUS: Labor Residence Adjustment	+	326	
EQUALS:			371,780

Source: BEA, Survey of Current Business, State Personal Income Table 3, Personal Income by Major Source and Earnings by Industry 1988-90 (Aug. 1991);
and (Row 3, Col. 1).

Expenditures by Proprietor's Income *(Row 7, Col. 4)*

Proprietary Income (PoW) Farm + Nonfarm = (Row 4, Col. 1)
5,759 + 52,539 58,298

Source: BEA, Survey of Current Business, State Personal Income Table 3, Personal Income by Major Source and Earnings by Industry 1988-90 (Aug. 1991)

Expenditures by Enterprises *(Row 7, Col. 6)*

Rental Income of Persons (a)		2,469.00	
PLUS: Personal Dividend Income (a)	+	16,277.00	
PLUS: Net Interest Income (a)	+	87,758.00	
PLUS: Net Property Income from ROW (b)	+	769.77	
PLUS: Business Transfers to Persons (c)	+	3,604.80	
PLUS: Business Transfers to Non-Profit Instit.	+	1,178.38	
PLUS: Federal Government Interest Payments to Persons	+	28,028.52	
PLUS: Adjustment to balance enterprise account	+	4,756.75	
EQUALS:			139,904.27

Sources: (a) California Statistical Abstract Table D-5 (1991 and 1992)
(b) IMPLAN
(c) BEA, Local Area Personal Income Computer Printout – Transfer Payments, U.C.B Data Archives 6/24/93

We omit the following items from (R7,C6) and (R6,C7) which are included in IMPLAN's 1982 California SAM:
Interest Received by Persons and Business from Federal Government
Interest Received by Persons and Business from State and Local Government
Other Property Income
Source: Survey of Current Business, NIPA Tables 3.2, 3.3 (March 1992)

Expenditures by Federal Government (non-defense) *(Row 7, Col. 8)*

Federal Government Transfers to Persons	FY 1989-90	+	51,448.00	
	FY 1990-91	+	56,631.00	
DIVIDED BY 2:	Calendar Year 1990	=	54,039.50	
PLUS: Federal Government Transfers to Institutions		+	477.97	
EQUALS:				54,517.47

Source: California Statistical Abstract, Table M-2 Federal Expenditures to California by Type (1991 and 1992)
BEA, Local Area Personal Income Computer Printout – Transfer Payments, U.C.B. Data Archives 6/24/93

Expenditures by State/Local, (non-Education) *(Row 7, Col. 11)*

State and Local Govt Transfers to Persons

Total Govt Payments to Individuals (d)	+	78,130.215	
LESS: Federal Government Transfers to Individuals (e)	–	54,039.500	
PLUS: State & Local Government Transfers to Individuals (d)	+	880.646	
EQUALS:			24,971.346

(d) BEA, Local Area Personal Income Computer Printout, UCB Data Archives 6/24/93
(e) (Row 7, Col. 8)

Row 8. Sources of Receipts for Federal Government, Non-Defense

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Expenditures by Industries *(Row 8, Col. 1)*

Federal Government Indirect Business Taxes

Tot. State Indirect Business Tax (IBT) in U.S. / Fed'l IBT + Tot. State IBT in U.S. *(IMPLAN Aggregate Indirect Tax) = 65.8 / 65.8 + 373.4 * 56,496 = 8,464

Data Sources:
BEA, Survey of Current Business NIPA Table 3.2, Federal Government Receipts & Expenditures (March 1992)
see, U.S. Bureau of the Census, U.S. Merchandize Trade: Selected Highlights series FT 920

Expenditures by Employee Compensation/Income *(Row 8, Col. 3)*

Federal Contributions for Social Security

[see (Row 3, Col. 1) for derivation] 59,236

Expenditures by Enterprises *(Row 8, Col. 6)*

Federal Govt Corporate Profit Taxes

Corp. Income Tax	FY 1989	12,704.348	
	FY 1990	+ 12,117.343	
DIVIDED BY 2:	Calendar 1990		12,410.85

Data Source: Calif. Statistical Abstract Table M-8 (1990, 1991).

Expenditures by Households *(Row 8, Col. 7)*

Federal Govt Personal Tax and Non-Taxes

Individual Income and Employment Tax (1)			
	FY 1989	+	101,940
	FY 1990	+	110,328
PLUS: Estate Tax	FY 1989	+	1,249
	FY 1990	+	1,560
PLUS: Gift Tax	FY 1989	+	160
	FY 1990	+	259
DIVIDED BY 2:	Calendar 1990	=	107,748
LESS: Personal Contribution to Social Insurance		−	30,022
EQUALS:			77,726

Data Sources: California Statistical Abstract Table M-8 (1990, 1991)
BEA, Survey of Current Business, State Personal Income Table 3, Personal Income by Major Source and Earnings by Industry 1988-90 (Aug. 1991).

Row 9. Sources of Receipts for Federal Government (Defense)

Expenditures by Federal Government (non-defense) *(Row 9, Col. 8)*

Transfer from Federal General Government Receipts to Defense	
[Sum of Col. 9]	41,891.13

Row 10. Sources of Receipts for Federal Government (CCC)

Expenditures by Federal Government *(Row 10, Col. 10)*	
Transfer from Federal General Government Receipts to CCC	
[Sum of Col. 10]	0

Row 11. Sources of Receipts for State/Local, Non-Educ.

Expenditures by Industries *(Row 11, Col. 1)*

State and Local Government Indirect Business Taxes
[IMPLAN total Indirect Business Tax – (Row 8, Col. 1)] 48,032

Expenditures by Employee Compensation Income *(Row 11, Col. 3)*

State & Local Government Contributions to Social Security (f)	66,829	
MINUS: (Row 8, Col.3)	59,236	
EQUALS:		7,593

Sources: (f) see (Row 3, Col. 1) for derivation]

Expenditures by Enterprises *(Row 11, Col. 6)*

(1) Expenditures by Enterprise

Dividends Received by All State Governments (h)	900	
PLUS: Interest Received by All State Governments (h)	+ 114,900	
	115,800	

(2) CA GSP (from IMPLAN) = sum of factor income: 443,800 + 56,500 + 52,680 + 177,580 = 730,560
US GDP (h) 5,513,800

California State and Local Government Dividend and Interest Income

$$\frac{\text{CA GSP}}{\text{US GDP}} * (115{,}800) =$$ 15,343.4

Sources: (h) Survey of Current Business, NIPA Table 1.1 Gross Domestic Product, NIPA Table 3.3 State & Local Government Receipts & Expenditures (March 1992)

Expenditures by Households *(Row 11, Col. 7)*

State and Local Personal Tax and Non-Tax Payments to State & Local Gov'ts

Total Personal Income (i)	619,381	
LESS: Disposable Personal Income (j)	– 528,276	
LESS: Federal Personal Tax Paid by Californians (k)	– 77,726	
EQUALS:	=	13,379

Sources: (i) BEA, Survey of Current Business, State Personal Income Table 3 (Aug. 1991)
(j) California Department of Finance, FAX. Based on BEA data.
(k) see (Row 8, Col. 7)

Expenditures by Federal Government (non-Defense) *(Row 11, Col. 8)*

Federal Grants to State and Local Governments	FY 1989-90	13,932.372	
	FY 1990-91	+ 16,884.897	
DIVIDED BY 2:	Calendar 1990	=	15,408.63

Data Source: California Statistical Abstract, Table M-4 Federal Grants to State & Local Governments (1990, 1991)

Row 12. Sources of Receipts for State/Local Govovernment Education

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Expenditures by State/Local, Non-Education *(Row 12, Col. 11)*

Col. 12 State/Local Government (Education) is combined with Col. 11 State/Local Government (Non-Education)

Row 13. Sources of Receipts for Investment (Inventory)

Expenditures by Capital Formation	*(Row 13, Col. 14)*	
[sum of col. 13]		2900.65

Row 14. Sources of Receipts for Investment (Capital Formation)

Expenditures by Other Property Income (Row 14, Col. 5)

(Row 5, Col. 18) – (Row 6, Col. 5) = 79,822.25

Expenditures by Enterprises (Row 14, Col. 6)

Retained Profits (undistributed profits w/IVA & CCA)
U.S. total: 49,900

California share: Corp. Inc. Reported for Calif Inc. Tax 1989 (l)*(U.S. retained profit) = .11 * 49,900 5,335
U.S. before Tax Corp. Profit for 1989 (m)

Sources: (l) Economic Report of the Governor 1992, Table 18
(m) BEA, Survey of Current Business, NIPA Table 1.14 National Income by Type of Income (March 1992)

Expenditures by Households (Row 14, Col. 7)

Personal Savings
(Row 7 total) – (Col. 7 total with this cell excluded) 99,600.8

Expenditures by Federal Government (Non-defense) (Row 14, Col. 8)

Federal Government Surplus Attributable to California
(Row 8 total) – (Col 8 total with this cell excluded) = –31,354.76

[note: U.S. total: 205,800.
BEA, Survey of Current Business, NIPA Table 3.2 (March 1992)]

Expenditures by State/Local, (Non-Educational) (Row 14, Col. 11)

(Row 11 total) – (Col. 11 total excluding this cell) = –4730.51

Row 15. Sources of Receipts for Non-Competitive Imports

Expenditures by Industries *(Row 15, Col. 1)*

Total Domestic Intermediate Commodity Use from N/C N/I

[IMPLAN: NC/IMP INTERMED] 266.89

Expenditures by Households *(Row 15, Col. 7)*

N/C N/I purchases by all households

[IMPLAN NC/IMP sum of households] 5577.55

Expenditures by Federal Govt (Non-Defense) *(Row 15, Col. 8)*

Federal Government Non-Defense, N/C purchases

$$\frac{\text{IMPLAN: 1982 SAM N/C federal non-defense}}{\text{IMPLAN 1982 SAM total federal non-defense}} * (\text{Row 2, Col. 8}) = \frac{5.324 + 157.71}{5.324 + 157.71 + 8115.866} * (\text{R2,C8})$$ 224.33

Expenditures by Federal Government (Defense) *(Row 15, Col. 9)*

Federal Government Defense N/C N/I purchases

$$\frac{\text{IMPLAN 1982 SAM N/C federal defense}}{\text{IMPLAN 1982 SAM total federal defense}} * (\text{Row 2, Col. 8}) = \frac{5.324 + 157.71}{5.324 + 157.71 + 8115.866} * (\text{R2,C8})$$ 2235.73

Expenditures by State/Local, (Non-Education) *(Row 15, Col. 11)*

State/Local Government Non-Educution N/C N/I purchases

$$\frac{\text{IMPLAN 1982 SAM total N/C imports}}{\text{IMPLAN 1982 SAM [(R2,C11) + (R2,C12)]}} * \text{total 1990 non-competitive imports (R2,C11)} =$$

$$\frac{246.042 + 105.651 + 1.968 + 16.876}{9269.876 + 8094.568} * (737121.44)$$ 1573.13

Row 16. Sources of Receipts for Domestic Trade

Expenditures by Employee Compensation Income (Row 16, Col. 2)

Net Domestic Imports of Labor Services

[IMPLAN: Total Imports] – Foreign Imports (R17, C2) = 306,646 – 97,121.5 — 209,524.5

Expenditures by State/Local, Non-Educ. (Row 16, Col. 11)

Total Domestic Commodity Imports by State & Local Government (Non-Education)

	FY 1989	3,279
PLUS:	FY 1990	1,235
DIVIDED BY 2:	Calendar 1990	347

Data Source: California Statistical Abstract (1992)

Expenditures by Investment (Capital Formation) (Row 16, Col. 14)

Total Domestic Commodity Imports to Capital formation

(Total of Col. 16) – (Total Row 16 excluding (R16, C14) — 79,532.11

Expenditures by Non-Competitive Imports (Row 16, Col. 15)

[Total Row 15] 9877.63

Row 17. Sources of Receipts for Foreign Trade

Expenditures by Industries *(Row 17, Col. 2)*

California Foreign Imports 97,121.5

Source: California Statistical Abstract, Table K-8 (1991)

Expenditures by Federal Government (Non-Defense) *(Row 17, Col. 8)*

1) Data Used:

Transfers to Foreigners by the Federal Government (U.S. tot)	12,600	
Interest Payments to Foreigners by the Federal Government (U.S. tot) +	37,900	
		50,500

Source: BEA, Survey of Current Business, NIPA Table 3.2 Federal Government Receipts & Expenditures (March 1992)

2) Derivation:

California share: $\frac{\text{Calif. total federal income tax payments}}{\text{US total tax receipts}} * (12{,}600 + 37{,}900) = \frac{12410.85 + 78426}{112{,}100 + 482{,}200} * (50{,}500)$ 7718.76

Sources: (Row 8, Col. 6), (Row 8, Col. 7).

Expenditures by Investment (Capital Formation) *(Row 17, Col. 14)*

(Tot. Col. 17) – (Tot. Row 17 excluding (R17, C14)) –47,088.44

Table A2.2. Social Accounting Matrix for California, 1990

	Expenditures									
Receipts	Commodity	Activity	Labor	Capital	Corp	Hshlds	Govt.	Cap acct	World	TOTAL
Commodity		474.6				453.2	131.4	116.2		1175.4
Activity	868.8								336.7	1205.5
Labor		438.3							0.3	438.6
Capital		235.9							20.0	255.9
Corporate				255.9	0.0		55.2		0.0	311.1
Households			371.8	0.0	198.2		79.5		0.0	649.5
Government	0.0	56.5	66.8	0.0	27.8	91.1	0.0		0.0	242.2
Capital acct		0.0			85.2	99.6	-28.0		-40.5	116.2
Rest of world	306.6	0.3			0.0	5.6	4.0	0.0		316.5
TOTAL	1175.4	1205.5	438.6	255.9	311.1	649.5	242.2	116.2	316.5	

Sources: U.S. Department of Agriculture, Forest Service, *IMPLAN: California Aggregate Input/Output Table for 1990* (1990); Henry, David, "1990 U.S. Defense Bill of Goods," at U.S. Department of Commerce, Economics and Statistics Administration (1993).

Notes: Blanks indicate no information in cell.

Table A2.3. Sectoral Aggregation for CA-CGE Model

CALIFORNIA COMPUTABLE GENERAL EQUILIBRIUM (CA-CGE)		CALIFORNIA ENERGY COMMISSION (CEC)	
Sector Code	Sectors	Sector Code	Sectors
1.	Agriculture	2.	Agriculture
		61.	Agriculture services
2.	Mining	3.	Mining
3.	Construction	4.	Construction
4.	Food Manufacturing	5.	Canned and Frozen foods
		6.	Other Food and Kindred Products
5.	Textiles	7.	Textiles
		8.	Apparel and Textile Products
		18.	Leather
6.	Wood	9.	Logging and Sawmills
		10.	Other Lumber and Wood Products
		11.	Furniture
		12.	Paper Products
		13.	Printing and Publishing
7.	Chemicals	14.	Chemicals
		15.	Petroleum Products
		16.	Plastic Products
		17.	Rubber Products
8.	Metal	19.	Stone, Clay, and Glass
		20.	Primary Metal Products
		21.	Fabricated Metal Products
9.	Electric	22.	Computers and Office Equipment
		24.	Electronic Components
10.	Machinery	23.	Other Non-electric Equipment
		25.	Other Electrical Machinery
11.	Cars	26.	Motor Vehicles
12.	Planes	27.	Aircraft
13.	Ships	28.	Ship Building
14.	Space	29.	Missiles and Space
15.	Instruments	31.	Navigation and Search Instruments
		32.	Measuring and Control Instruments
		33.	Medical Instruments
		34.	Other Instruments
16.	Miscellaneous	35.	Miscellaneous Manufacturing

CALIFORNIA COMPUTABLE GENERAL EQUILIBRIUM (CA-CGE)		CALIFORNIA ENERGY COMMISSION (CEC)	
Sector Code	Sectors	Sector Code	Sectors
17.	Transportation Services	36.	Railroads
		37.	Local Transit
		38.	Trucking
		39.	Water Transportation
		40.	Air Transportation
		41.	Pipelines Transportation
		42.	Travel Services
		43.	Communications
18.	Utilities	44.	Utilities
19.	Trade	45.	Wholesale Trade
		46.	Retail Trade
20.	Housing	49.	Real Estate
21.	Professional Services	47.	Finance
		48.	Insurance
		52.	Business Services
		57.	Legal Services
22.	Engineering Services	60.	Engineering and Management
23.	Other Services	50.	Hotels
		51.	Personal Services
		53.	Auto and Miscellaneous Repair Services
		54.	Motion Picture f&d
		55.	Amusements and Theaters
		56.	Health Services
		58.	Educational Services
		59.	Social Services and Membership
		63.	Organization
			Post Office
24.	Public Administration	62.	Federal Government
		64.	State Government
		65.	State Education
		66.	Local Government
		67.	Local Education

Appendix 3: Data on Defense Expenditures in California

This appendix describes how the vector of defense expenditures in California was gathered and constructed. Social accounting matrices used as the database for Computable General Equilibrium (CGE) models are generally constructed to conform with conventional national income accounts. These accounts reflect current expenditures and receipts made within a nation. The U.S. Department of Defense maintains annual data on procurement contract awards by state and by industrial sector, but does not publish data on actual expenditures at an industry or state level (DoD Prime Contract Awards, various years).[24] As a result, most studies of the regional impact of defense expenditures have been based on contract award data (DoD 1991). This data constraint makes it difficult to conduct regional input/output analysis or general equilibrium analysis of the impact of defense expenditures since contract awards do not accurately reflect actual annual expenditures. It may take two to seven years to make the agreed expenditures under a defense contract (Jayne 1988).

Several alternatives are available. For some purposes, it may be adequate to assume that defense expenditures are stable over a period of two to seven years and that contract data therefore adequately reflect expenditure patterns. More commonly, researchers have based expenditure estimates on previous contracting history and assumptions regarding typical past payout periods for different classes of procurement programs (DoD 1985, 1991).

The U.S. Department of Commerce, Economics and Statistics Administration, used internal Department of Defense (DoD) accounting records to constructed a vector of national level defense expenditures disaggregated to 537 industrial sectors, which correspond to input-output industrial categories.[25] These data were obtained for 1990 and 1993, both in 1982 dollars. There are no plans to collect data in this form on a continuing basis. The vector reflects expenditures by Department of Defense, Department of Energy (DoE), and other agencies on defense-related purchases, including operation and maintenance, wages and salaries, non-DoD (DoE) purchases, and defense-related salaries to foreign nationals. Unfortunately for regional analysis, this vector does not reflect where these expenditures were made. It conforms both to National Income and Product Accounts (NIPA) national expenditure definitions and to the standard Bureau of Economic Analysis (BEA) industrial categories used in US input-output tables.

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[24] Table 10 of U.S. Dept. of Commerce, Bureau of the Census, Federal Expenditures by State purports to present "Federal Expenditure for Defense Department," but actually reports the value of contract awards for DoD procurement rather than expenditures.

[25] Personal communication with David Henry, U.S. Department of Commerce, Economics and Statistics Administration (summer 1993). Mr. Henry constructed this data set from outlay records available in the Department of Defense Comptroller's office. Mr. Henry used these records to identify industrial sectors receiving outlays from each individual transaction.

Defense expenditures made in California during calendar year 1990 were calculated by estimating California's share of the BEA vector of national defense expenditures. Estimates of California's share of defense expenditures were based on California's share of defense contracting activity. Data from both the Department of Defense and the Department of Commerce on California's share of national defense-related contract awards were used to determine California's share of defense contract awards.[26]

It was assumed that a state's share of contract awards fairly reflect state level distribution of national defense expenditures. It seems reasonable to assume that, even if the level of expenditure varies significantly within a 2 to 5 year period, the location of industrial activities supplying defense demand will not. Defense economics researchers in the Department of Commerce, Department of Defense, and the Congressional Budget Office indicate that this method is believed to be provide the most reliable indication of geographic distribution of defense expenditures available. The most significant shortcoming of this approach is that contracts may not be performed in the state where they were awarded. Subcontracting may also lead to contracts being performed outside the state where the prime contract was awarded. At present, the only available way to correct for these shortcomings is to survey defense contractors. Data on subcontracting was gathered nationwide by DoD in FY1979. This effort has not been repeated (Malecki and Stark 1988). Local efforts to identify the location of subcontracting have also been made (Scott and Kwok 1989). See Hoffmann (1994) for a more complete discussion of subcontracting.

The Department of Commerce vector of 1990 national defense expenditures by 537 industrial categories includes expenditures for Operation Desert Storm. No attempt has been made to remove these expenditures from the data base, although separate data for Operation Desert Storm expenditures are available. Most additional expenditures for Operation Desert Storm were for provisions, petroleum, clothing, and other personal equipment. Petroleum extraction and refining was the only California activity that was strongly affected by these expenditures.[27]

The 1990 vector of national defense expenditures was converted to 1990 dollars using Department of Commerce, National Defense Purchases Price Indexes and scaled to agree with 1990 NIPA total defense purchases. The resulting vector was then multiplied by the California sectoral shares to obtain an approximation of 1990 defense expenditures in California at the 537-sector level. These 537 sectors were aggregated to 64 sectors conforming to the California Energy Commission's standard aggregation. The resulting

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[26] Personal communication, Tom Lienesch, U.S. Dept. of Commerce, Bureau of Economic Analysis (BEA), Regional Economic Analysis Division, "Prime Contract Awards by Industry, Fiscal Year 1991," provides a set of state shares of DoD contract awards at a level of detail roughly equivalent to two-digit SIC code. This source was used except where more detailed information was provided by the Department of Defense source. Department of Defense, Directorate for Information, Prime Contract Awards by Region and State (various years) reports the dollar amount of DoD contracts over $25,000 by state in which the contract was awarded. These contract awards are reported for 25 industrial sectors roughly equivalent to 4 digit SIC code.

[27] Personal communication, David Henry, U.S. Dept. of Commerce, Economics and Statistics Administration.

vector of 1990 defense expenditures in California is presented in Table A3.1. Defense purchases of goods and services in California in 1990 were $39.7 billion (1990 dollars); DoD military and civilian payroll was $10.4 billion. In total, the U.S. spent $50 billion on defense in California in 1990.

Table A3.1. 1990 Defense Purchases in California

BEA SIC Code	Millions of 1990 dollars	California as percent of US purchases by sector	% of CA total
10100	0.0	13.3%	0.0
10200	0.0	13.3	0.0
10301	0.0	13.3	0.0
10302	0.0	13.3	0.0
20100	0.0	13.3	0.0
20201	0.0	13.3	0.0
20202	0.0	13.3	0.0
20203	0.0	13.3	0.0
20300	0.0	13.3	0.0
20401	0.0	13.3	0.0
20402	0.0	13.3	0.0
20501	0.0	13.3	0.0
20502	0.0	13.3	0.0
20503	0.0	13.3	0.0
20600	0.0	13.3	0.0
20701	0.0	13.3	0.0
20702	0.0	13.3	0.0
30001	0.0	0.0	0.0
30002	0.0	0.0	0.0
40001	0.0	13.3	0.0
40002	0.0	13.3	0.0
50000	0.0	0.0	0.0
60100	0.0	0.0	0.0
60200	0.0	0.0	0.0
70000	0.0	3.8	0.0
80000	0.0	0.0	0.0
90001	0.0	3.8	0.0
90002	0.0	3.8	0.0
90003	0.0	3.8	0.0
90004	0.0	3.8	0.0
100000	0.0	0.0	0.0
110101	0.0	0.0	0.0
110102	0.0	0.0	0.0
110103	0.0	0.0	0.0
110104	0.0	0.0	0.0
110105	0.0	0.0	0.0
110106	0.0	0.0	0.0
110107	0.0	0.0	0.0
110201	0.0	0.0	0.0
110202	0.0	0.0	0.0
110203	0.0	0.0	0.0
110204	0.0	0.0	0.0
110205	0.0	0.0	0.0
110206	0.0	0.0	0.0
110207	0.0	0.0	0.0
110231	0.0	0.0	0.0
110232	0.0	0.0	0.0
110241	0.0	0.0	0.0
110250	0.0	0.0	0.0

BEA SIC Code	Millions of 1990 dollars	California as percent of US purchases by sector	% of CA total
110301	0.0	0.0	0.0
110302	0.0	0.0	0.0
110303	0.0	0.0	0.0
110304	0.0	0.0	0.0
110305	0.0	0.0	0.0
110306	0.0	0.0	0.0
110307	0.0	0.0	0.0
110308	0.0	0.0	0.0
110400	0.0	0.0	0.0
110501	0.0	0.0	0.0
110502	0.0	0.0	0.0
110601	0.0	0.0	0.0
110602	0.0	0.0	0.0
110603	0.0	0.0	0.0
110701	99.5	13.7	0.8
110702	0.0	0.0	0.0
110703	0.0	0.0	0.0
110704	0.0	0.0	0.0
120100	0.0	0.0	0.0
120201	0.0	0.0	0.0
120202	0.0	0.0	0.0
120203	0.0	0.0	0.0
120204	0.0	0.0	0.0
120205	0.0	0.0	0.0
120206	0.0	0.0	0.0
120207	0.0	0.0	0.0
120208	0.0	0.0	0.0
120209	0.0	0.0	0.0
120210	0.0	0.0	0.0
120211	0.0	0.0	0.0
120212	269.7	13.7	0.7
120213	0.0	0.0	0.0
120214	0.0	0.0	0.0
120215	0.0	0.0	0.0
120216	0.0	0.0	0.0
130100	4368.8	31.3	11.0
130200	520.6	12.6	1.3
130300	416.4	33.0	1.1
130500	113.4	26.5	0.3
130600	50.3	12.6	0.1
130700	609.4	12.6	1.5
140101	0.0	8.7	0.0
140102	0.0	8.7	0.0
140103	0.0	8.7	0.0
140104	0.0	8.7	0.0
140200	0.0	8.7	0.0
140300	0.0	8.7	0.0
140400	0.0	8.7	0.0
140500	0.0	8.7	0.0
140600	0.0	8.7	0.0
140700	0.0	8.7	0.0
140800	0.0	8.7	0.0
140900	0.0	8.7	0.0

BEA SIC Code	Millions of 1990 dollars	California as percent of US purchases by sector	% of CA total
141000	0.0	8.7	0.0
141100	0.0	8.7	0.0
141200	0.0	8.7	0.0
141301	0.0	8.7	0.0
141302	0.0	8.7	0.0
141401	0.0	8.7	0.0
141402	0.0	8.7	0.0
141403	0.0	8.7	0.0
141501	0.0	8.7	0.0
141502	0.0	8.7	0.0
141600	0.0	8.7	0.0
141700	0.0	8.7	0.0
141801	0.0	8.7	0.0
141802	0.0	8.7	0.0
141900	0.0	8.7	0.0
142001	0.0	8.7	0.0
142002	0.0	8.7	0.0
142003	0.0	8.7	0.0
142101	0.0	8.7	0.0
142102	0.0	8.7	0.0
142103	0.0	8.7	0.0
142104	0.0	8.7	0.0
142200	0.0	8.7	0.0
142300	0.0	8.7	0.0
142400	0.0	8.7	0.0
142500	0.0	8.7	0.0
142600	0.0	8.7	0.0
142700	0.0	8.7	0.0
142800	0.0	8.7	0.0
142900	0.0	8.7	0.0
143000	0.0	8.7	0.0
143100	0.0	8.7	0.0
143200	0.6	8.7	0.0
150101	0.0	8.7	0.0
150102	0.0	8.7	0.0
150103	0.0	8.7	0.0
150200	0.0	8.7	0.0
160100	0.0	2.3	0.0
160200	0.0	2.3	0.0
160300	0.0	2.3	0.0
160400	0.0	2.3	0.0
170100	0.7	2.3	0.0
170200	0.0	2.3	0.0
170300	0.0	2.3	0.0
170400	0.0	2.3	0.0
170500	0.0	2.3	0.0
170600	0.0	2.3	0.0
170700	0.0	2.3	0.0
170900	0.0	2.3	0.0
171001	0.0	2.3	0.0
171002	0.0	2.3	0.0
180101	0.0	3.0	0.0
180102	0.0	3.0	0.0

BEA SIC Code	Millions of 1990 dollars	California as percent of US purchases by sector	% of CA total
180201	0.0	3.0	0.0
180202	0.0	3.0	0.0
180203	0.0	3.0	0.0
180300	0.0	3.0	0.0
180400	0.1	3.0	0.0
190100	0.0	1.4	0.0
190200	0.0	1.4	0.0
190301	0.0	1.4	0.0
190302	0.0	1.4	0.0
190303	0.0	1.4	0.0
190304	0.0	1.4	0.0
190305	0.0	1.4	0.0
190306	0.3	1.4	0.0
200100	0.0	9.2	0.0
200200	0.0	9.2	0.0
200300	0.0	9.2	0.0
200400	0.0	9.2	0.0
200501	0.0	9.2	0.0
200502	0.0	9.2	0.0
200600	0.0	9.2	0.0
200701	0.0	9.2	0.0
200702	0.0	9.2	0.0
200800	0.0	9.2	0.0
200901	3.2	9.2	0.0
200902	0.0	9.2	0.0
200903	0.0	9.2	0.0
210000	0.0	9.2	0.0
220101	1.8	9.2	0.0
220102	0.1	9.2	0.0
220103	0.0	9.2	0.0
220200	1.3	9.2	0.0
220300	2.6	9.2	0.0
220400	1.4	9.2	0.0
230100	7.0	9.2	0.0
230200	10.5	9.2	0.0
230300	1.0	9.2	0.0
230400	1.0	9.2	0.0
230500	0.8	9.2	0.0
230600	0.0	9.2	0.0
230700	0.0	9.2	0.0
240100	0.0	4.4	0.0
240200	5.7	4.4	0.0
240300	3.8	4.4	0.0
240400	2.5	4.4	0.0
240500	0.0	4.4	0.0
240602	0.0	4.4	0.0
240701	0.0	4.4	0.0
240702	0.0	4.4	0.0
240703	0.0	4.4	0.0
240704	0.0	4.4	0.0
240705	0.1	4.4	0.0
240706	0.0	4.4	0.0
250000	0.0	4.4	0.0

BEA SIC Code	Millions of 1990 dollars	California as percent of US purchases by sector	% of CA total
260100	0.0	3.4	0.0
260200	0.0	3.4	0.0
260301	0.0	3.4	0.0
260302	0.4	3.4	0.0
260400	2.3	3.4	0.0
260501	5.8	3.4	0.0
260502	0.0	3.4	0.0
260601	2.3	3.4	0.0
260602	0.8	3.4	0.0
260700	0.0	3.4	0.0
260801	0.0	3.4	0.0
260802	0.0	3.4	0.0
260803	0.3	3.4	0.0
260804	0.0	3.4	0.0
260805	0.0	3.4	0.0
270100	638.9	12.9	1.6
270201	0.0	12.9	0.0
270202	0.0	12.9	0.0
270300	0.0	12.9	0.0
270401	0.6	12.9	0.0
270402	0.0	12.9	0.0
270403	45.8	12.9	0.1
270404	0.0	12.9	0.0
270405	0.2	12.9	0.0
270406	13.3	12.9	0.0
280100	0.0	12.9	0.0
280200	0.0	12.9	0.0
280300	0.0	12.9	0.0
280400	0.0	12.9	0.0
290100	9.5	12.9	0.0
290201	6.3	12.9	0.0
290202	3.0	12.9	0.0
290203	1.4	12.9	0.0
290300	0.0	12.9	0.0
300000	1.3	12.9	0.0
310101	456.8	12.9	1.2
310102	0.0	12.9	0.0
310103	0.0	12.9	0.0
310200	11.4	12.9	0.0
310300	0.0	12.9	0.0
320100	3.2	2.3	0.0
320200	0.4	2.3	0.0
320301	0.0	2.3	0.0
320302	1.3	2.3	0.0
320400	0.4	2.3	0.0
320500	0.1	2.3	0.0
330001	0.0	2.3	0.0
340100	0.0	2.3	0.0
340201	0.0	2.3	0.0
340202	0.0	2.3	0.0
340301	0.0	2.3	0.0
340302	0.0	2.3	0.0
340303	0.0	2.3	0.0

BEA SIC Code	Millions of 1990 dollars	California as percent of US purchases by sector	% of CA total
340304	0.0	2.3	0.0
340305	0.0	2.3	0.0
350100	0.8	9.3	0.0
350200	0.0	9.3	0.0
360100	0.0	9.3	0.0
360200	0.0	9.3	0.0
360300	0.0	9.3	0.0
360400	0.0	9.3	0.0
360500	0.0	9.3	0.0
360600	0.0	9.3	0.0
360701	0.0	9.3	0.0
360702	0.0	9.3	0.0
360800	0.0	9.3	0.0
360900	0.0	9.3	0.0
361000	0.1	9.3	0.0
361100	1.0	9.3	0.0
361200	0.0	9.3	0.0
361300	0.0	9.3	0.0
361400	0.0	9.3	0.0
361500	0.1	9.3	0.0
361600	0.0	9.3	0.0
361700	0.3	9.3	0.0
361800	0.0	9.3	0.0
361900	0.0	9.3	0.0
362000	0.6	9.3	0.0
362100	0.0	9.3	0.0
362200	1.8	9.3	0.0
370101	0.8	8.1	0.0
370102	0.0	8.1	0.0
370103	0.0	8.1	0.0
370104	0.0	8.1	0.0
370105	0.0	8.1	0.0
370200	7.3	8.1	0.0
370300	0.0	8.1	0.0
370401	1.5	8.1	0.0
370402	1.4	8.1	0.0
380100	0.0	8.1	0.0
380200	0.0	8.1	0.0
380300	0.0	8.1	0.0
380400	0.6	8.1	0.0
380500	0.2	8.1	0.0
380600	0.0	8.1	0.0
380700	0.0	8.1	0.0
380800	0.0	8.1	0.0
380900	5.2	8.1	0.0
381000	0.5	8.1	0.0
381100	0.0	8.1	0.0
381200	1.7	8.1	0.0
381300	0.0	8.1	0.0
381400	0.0	8.1	0.0
390100	0.0	13.7	0.0
390200	0.1	13.7	0.0
400100	0.0	13.7	0.0

BEA SIC Code	Millions of 1990 dollars	California as percent of US purchases by sector	% of CA total
400200	0.0	13.7	0.0
400300	1.7	13.7	0.0
400400	4.4	13.7	0.0
400500	3.6	13.7	0.0
400600	158.6	13.7	0.4
400700	2.5	13.7	0.0
400800	0.0	13.7	0.0
400901	0.1	13.7	0.0
400902	0.0	13.7	0.0
410100	11.5	13.7	0.0
410201	0.0	13.7	0.0
410202	0.0	13.7	0.0
410203	0.1	13.7	0.0
420100	0.1	13.7	0.0
420201	5.9	13.7	0.0
420202	0.0	13.7	0.0
420300	2.2	13.7	0.0
420401	0.2	13.7	0.0
420402	0.1	13.7	0.0
420500	3.6	13.7	0.0
420700	0.0	13.7	0.0
420800	6.2	13.7	0.0
421000	0.0	13.7	0.0
421100	3.3	13.7	0.0
430100	48.5	12.5	0.1
430200	16.5	12.5	0.0
440001	0.9	12.5	0.0
440002	0.0	12.5	0.0
450100	20.7	12.5	0.1
450200	0.4	12.5	0.0
450300	0.5	12.5	0.0
460100	0.7	12.5	0.0
460200	19.3	12.5	0.0
460300	25.6	12.5	0.1
460400	48.8	12.5	0.1
470100	83.9	12.5	0.2
470200	18.8	12.5	0.0
470300	11.6	12.5	0.0
470401	4.8	12.5	0.0
470402	0.0	12.5	0.0
470403	12.1	12.5	0.0
480100	1.3	12.5	0.0
480200	0.0	12.5	0.0
480300	0.1	12.5	0.0
480400	0.0	12.5	0.0
480500	0.4	12.5	0.0
480600	7.9	12.5	0.0
490100	16.8	12.5	0.0
490200	8.5	12.5	0.0
490300	4.2	12.5	0.0
490400	0.6	12.5	0.0
490500	1.4	12.5	0.0
490600	0.2	12.5	0.0

BEA SIC Code	Millions of 1990 dollars	California as percent of US purchases by sector	% of CA total
490700	9.4	12.5	0.0
500001	3.1	12.5	0.0
500002	4.1	12.5	0.0
510101	620.1	12.5	1.6
510102	5.4	12.5	0.0
510300	3.1	12.5	0.0
510400	15.6	12.5	0.0
520100	0.6	12.5	0.0
520200	0.4	12.5	0.0
520300	13.7	12.5	0.0
520400	0.0	12.5	0.0
520500	1.7	12.5	0.0
530100	96.8	25.7	0.2
530200	14.3	25.7	0.0
530300	16.9	25.7	0.0
530400	103.9	25.7	0.3
530500	16.2	25.7	0.0
530600	3.3	25.7	0.0
530700	2.3	25.7	0.0
530800	5.9	25.7	0.0
540100	0.0	0.0	0.0
540200	0.0	0.0	0.0
540300	0.0	0.0	0.0
540400	0.0	0.0	0.0
540500	0.0	0.0	0.0
540600	0.0	0.0	0.0
540700	0.0	0.0	0.0
550100	5.6	25.7	0.0
550200	5.6	25.7	0.0
550300	3.3	25.7	0.0
560100	7.3	25.7	0.0
560200	1.4	25.7	0.0
560300	336.9	25.7	0.8
560400	7005.1	25.7	17.7
570100	0.3	25.7	0.0
570200	118.1	25.7	0.3
570300	143.1	25.7	0.4
580100	18.9	25.7	0.0
580200	15.7	25.7	0.0
580300	3.9	25.7	0.0
580400	13.8	25.7	0.0
580500	5.3	25.7	0.0
590100	0.4	2.0	0.0
590200	11.0	2.0	0.0
590301	60.5	2.0	0.2
590302	11.6	2.0	0.0
600100	4916.2	28.5	12.4
600200	216.7	2.4	0.5
600400	1153.3	14.3	2.9
610100	1185.8	8.8	3.0
610200	0.0	0.0	0.0
610300	0.0	0.0	0.0
610500	0.0	0.0	0.0

BEA SIC Code	Millions of 1990 dollars	California as percent of US purchases by sector	% of CA total
610601	0.0	0.0	0.0
610602	0.0	0.0	0.0
610603	0.0	0.0	0.0
610700	0.0	0.0	0.0
620100	271.0	21.0	0.7
620200	77.9	21.0	0.2
620300	16.4	21.0	0.0
620400	6.2	7.2	0.0
620500	18.2	7.2	0.0
620600	3.6	7.2	0.0
620700	4.6	21.0	0.0
630100	279.3	21.0	0.7
630200	4.2	21.0	0.0
630300	109.0	25.3	0.3
640101	0.0	12.7	0.0
640102	0.0	12.7	0.0
640104	0.0	12.7	0.0
640105	0.0	12.7	0.0
640200	0.0	12.7	0.0
640301	0.0	12.7	0.0
640302	0.0	12.7	0.0
640400	0.4	12.7	0.0
640501	0.0	12.7	0.0
640502	0.0	12.7	0.0
640503	0.0	12.7	0.0
640504	0.0	12.7	0.0
640600	0.0	12.7	0.0
640701	0.0	12.7	0.0
640702	0.0	12.7	0.0
640800	0.0	12.7	0.0
640900	0.0	12.7	0.0
641000	0.0	12.7	0.0
641100	0.0	12.7	0.0
641200	0.3	12.7	0.0
650100	79.4	6.2	0.2
650200	7.3	6.2	0.0
650300	67.8	6.2	0.2
650400	91.8	6.2	0.2
650500	229.4	6.2	0.6
650600	2.6	6.2	0.0
650701	9.2	6.2	0.0
650702	0.0	6.2	0.0
660000	166.3	4.5	0.4
670000	0.0	4.5	0.0
680100	345.2	11.6	0.9
680200	30.3	11.6	0.1
680301	39.0	11.6	0.1
680302	0.0	11.6	0.0
690100	51.0	1.4	0.1
690200	10.2	5.7	0.0
700100	0.0	0.0	0.0
700200	0.0	0.0	0.0
700300	0.0	0.0	0.0

BEA SIC Code	Millions of 1990 dollars	California as percent of US purchases by sector	% of CA total
700400	1.2	100.0	0.0
700500	1.2	100.0	0.0
710100	0.0	8.1	0.0
710200	52.1	8.1	0.1
720100	81.9	15.2	0.2
720201	119.2	12.7	0.3
720202	0.0	12.7	0.0
720203	0.0	12.7	0.0
720204	0.3	12.7	0.0
720[illegible]	0.0	12.7	0.0
7203[illegible]	42.0	12.7	0.1
7301[illegible]	773.4	20.6	2.0
730102	0.0	20.6	0.0
730103	0.0	20.6	0.0
730104	0.0	20.6	0.0
730105	0.0	20.6	0.0
730106	0.0	20.6	0.0
730107	470.3	20.6	1.2
730108	0.0	20.6	0.0
730109	0.0	20.6	0.0
730200	35.6	20.6	0.1
730301	435.9	20.6	1.1
730302	0.0	20.6	0.0
730303	0.0	20.6	0.0
740000	50.5	11.9	0.1
750001	14.4	8.7	0.0
750002	6.7	8.7	0.0
750003	0.0	8.7	0.0
760100	6.3	15.2	0.0
760201	10.1	15.2	0.0
760202	0.0	15.2	0.0
760203	0.0	15.2	0.0
760204	0.0	15.2	0.0
760205	0.0	15.2	0.0
760206	0.0	15.2	0.0
770100	88.7	11.1	0.2
770200	101.5	11.1	0.3
770301	17.4	11.1	0.0
770302	1.3	11.1	0.0
770401	170.2	11.1	0.4
770402	123.6	11.1	0.3
770403	0.0	11.1	0.0
770501	0.0	11.1	0.0
770502	0.0	11.1	0.0
770503	0.0	11.1	0.0
770504	0.0	11.1	0.0
770600	102.3	11.1	0.3
770700	0.0	11.1	0.0
770800	0.0	11.1	0.0
770900	0.0	11.1	0.0
780100	0.0	0.0	0.0
780200	0.0	0.0	0.0
780300	0.0	0.0	0.0

BEA SIC Code	Millions of 1990 dollars	California as percent of US purchases by sector	% of CA total
780400	0.0	0.0	0.0
790100	0.0	0.0	0.0
790200	0.0	0.0	0.0
790300	0.0	0.0	0.0
800000	0.0	0.0	0.0
810001	0.0	0.0	0.0
810002	0.0	0.0	0.0
820000	10373.1	0.0	26.2
830000	0.0	0.0	0.0
840000	0.0	0.0	0.0
850000	0.0	0.0	0.0
Total	39655.4		

Source: David Henry, Department of Commerce, Economics & Statistics Administration, 4874 Commerce Building, Washington, D.C. (202) 482-2566.

Notes: This is a vector of final U.S. expenditures by DoD, DoE and other agencies on defense related purchases. It includes: operatiosn & maintainance, wages & salaries, non-DoD defense (DOE), salaries to foreign nationals. Commodity categories are 1982 BEA I/O categories. Data includes supplemental appropriations for Operation Desert Storm.

Appendix 4: Local Impacts of the Defense Build-Down

A4.1. Los Angeles Basin

Most defense spending in California is concentrated in southern California and Silicon Valley (Fig. A4.1). These areas are presently experiencing the greatest impact from defense cuts. Monterey County will also experience significant disruption when Fort Ord closes.

Studies of varying quality have been done of the potential impact of defense cuts on each of these areas. The Economic Roundtable prepared an excellent study of the impact on the Los Angeles basin together with a strategy for adjustment based on a survey 400 Los Angeles basin defense firms (ER 1992). A 1989 study by the Southern California Association of Governments also contains much information of continued relevance (SCAG 1989). An informal survey of projected job losses in Santa Clara County was completed in August 1992 (CEC 1992). The Congressional Budget Office report includes a case study of the impact of closing Fort Ord on Monterey County (CBO 1992). Telephone calls to local and state government offices confirm the Commission on State Finance's assessment that the impact of defense cuts will be concentrated in these areas.

In 1991, the aerospace industry provided 5% of Los Angeles County's jobs, 28% of its manufacturing jobs, and had annual sales of $30 billion (ER 1992).[28] This employment has significant multiplier effect for Los Angeles County both because it is well paid, and because 86% of these employees live in Los Angeles County. If defense cuts continue at the rate experienced in 1990 and 1991 (roughly the Bush FY 1992 proposal) through 1995, the Economic Roundtable estimates that by the year 2001 Los Angeles County will loose 184,000 jobs, $86.4 billion in personal income and $23.8 billion in retail trade. This will result in the construction of 122,000 fewer homes and $6.3 billion less in commercial buildings.[29]

Relocation of defense firms may also have a serious impact on Los Angeles County's economy. Twenty-four percent of 400 firms surveyed for the Economic Roundtable study, accounting for 51% of the County's total aerospace employment, said they anticipated relocating some or all of their jobs in the next five years. These firms represent 61% of the total employment by firms surveyed, or 76,174 jobs (31% of Los Angeles County aerospace employment) (ER 1992).

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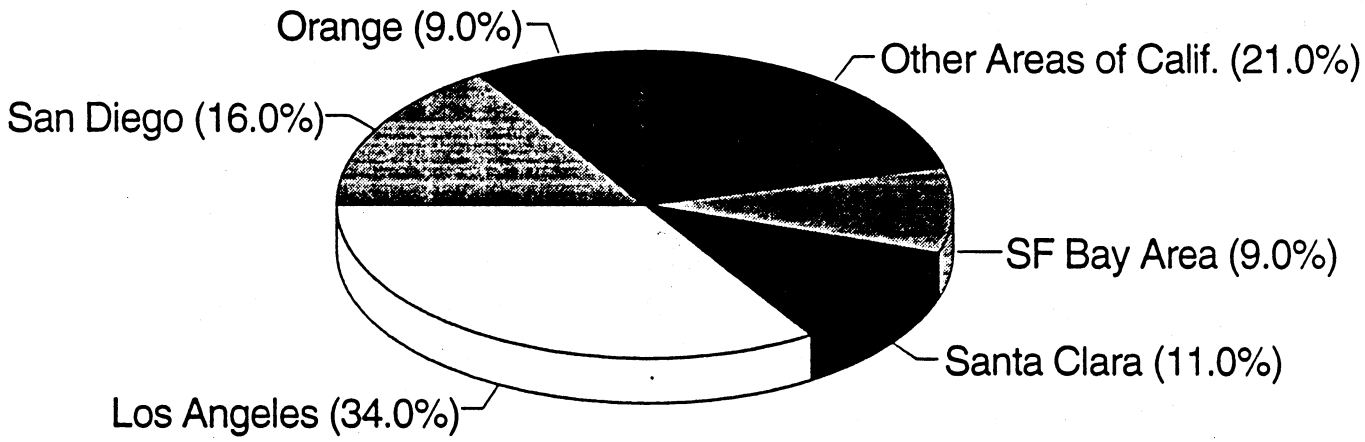
[28]The Economic Roundtable report uses the terms aerospace and high technology industries to refer to a group of industries: Computer Equipment (SIC 357), Communications Equipment (SIC 366), Electronic Components (SIC 367), Aircraft and Parts (SIC 372), Guided Missiles and Space Vehicles (SIC 376), Search and Navigation Equipment (SIC 381), and Measuring and Controlling Devices (SIC 382).

[29]A survey conducted for the Economic Roundtable provides fairly detailed information on linkages between defense contractors and suppliers within and outside of Los Angeles County. The survey is organized around SIC codes and so could be helpful in constructing a Computable General Equilibrium model of the Los Angeles basin.



$51 Billion Total

Source: California Commission on State Finance, *Impact of Defense Cuts on California* (1992). Total expenditure in California is $51 billion.

Figure A4.1 Regional Shares of California Defense Expenditures

Although defense industry employment accounts for only 5% of Los Angeles employment, it accounts for 28% of its manufacturing jobs. There is a high degree of concentration of prime contract dollars among Los Angeles firms making these jobs quite vulnerable. The ten largest firms received 80% of defense spending in Los Angeles County. "The ten largest contracts accounted for 40% of the county's defense receipts, the 50 largest for 65% and the 100 largest for 76%" (ER 1992 at 36). As a result, the loss of a major contract or the relocation decision of a major firm could have a significant impact on the Los Angeles economy.

The loss of these manufacturing jobs would be a serious problem for Los Angeles County and for California. While there have been considerable lay-offs of highly skilled workers in the Southern California defense industry, this part of the employment reduction has been fairly orderly with early retirements and reemployment in related industry or relocation out of the L.A. basin absorbing most of those dismissed. The real problem for the California economy and for the former defense industry employees comes at the lower end of the skill scale (Williams 1992). Semi-skilled and unskilled workers were able to find jobs paying upwards of $20 per hour in the defense industry. These jobs are not being replaced, and firms do not seem to be relocating the people who had them to facilities in other states. Rather dislocated semi- and unskilled workers seem to be looking for jobs in other sectors. It will be a challenge for California to replace these high paying, unskilled and semi-skilled jobs. This issue was not addressed in the CSF 1992 report (Williams 1992).

The UCLA Business Forecasting Project (BFP) conducted a simulation of the possible impact of a loss of 70,000 aerospace jobs in Los Angeles County by 1995 (DR 1992). This was <u>not</u> a forecast, rather a simulation of one possible scenario reflecting recent trends in the aerospace industry. For purposes of the simulation, BFP assumed that from 1992 through 1995, aerospace employment would continue to fall at the 1991-1992 average rate of 17,500 jobs per year. Based on previous studies BFP assumed that the loss of an additional 22,000 subcontracting jobs would be associated with the loss of these prime contract-related jobs. BFP also assumed that government policy and economic indicators in other sectors follow historic patterns after taking account of the current recession. Table A4.1 presents the BFP simulation results. The BFP study uses as a standard of comparison variable levels associated with a simulation which assumes that aerospace employment remains steady through the 1990s at 1992 levels. The values shown in the table are <u>losses</u> from this 1992 benchmark level simulated under the assumption that Los Angeles County looses 70,000 aerospace workers by 1995. Of most interest for energy forecasting are simulated reductions in population, construction activity, and manufacturing.

TABLE A4.1: ECONOMIC IMPACTS OF CONTINUED LOSSES IN AEROSPACE EMPLOYMENT IN LOS ANGELES COUNTY - DATA ARE NOT CUMULATIVE

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
					Personal Income, Taxable Retail Sales					
Personal Income (Billion $)	1.79	3.57	4.71	6.74	7.48	8.45	10.49	12.16	13.5	15.74
Real Personal Income (Billion 1982 $)	0.72	0.8	0.89	1.7	1.82	2.54	3.41	3.79	4.25	5.01
Taxable Retail Sales (Billion $)	0.51	1.03	1.35	1.92	2.12	2.39	2.95	3.41	3.77	4.38
Real Taxable Retail Sales (Billion 1982 $)	0.21	0.23	0.25	0.48	0.51	0.72	0.96	1.06	1.18	1.39
					Employment and Labor Force (Household Survey Thous.)					
Employment	37.2	70.1	86	114.5	116.9	121.8	141.5	153.1	158.1	172.5
Labor Force	9.1	24.1	39.6	58.5	73.7	86.7	101.4	115.7	127.9	140.9
Unemployment Rate (%)	–0.7	–1.1	–1.1	–1.3	–1.1	–0.9	–1.0	–1.0	–0.8	–0.9
					Nonfarm Employment (Payroll Survey, Thous.)					
Total Nonfarm	39.7	75.0	91.9	122.4	125	130.2	151.3	163.6	168.9	184.3
Construction	3.8	10.1	12.6	14	13.7	11.2	10.9	11.3	10.1	9.5
Manufacturing	21.5	41.2	59.7	79.3	77.4	76.9	77.1	76.4	75.8	76.1
Durable Goods	21.7	42.4	62.5	83.1	82	81.8	81.9	81.4	81.1	81.3
Trade	4.8	3.6	1.3	4.7	3.4	7.4	12.8	14	15.7	20.1
Finance, Ins. & Real Estate	1.0	1.5	0.8	1.4	2.1	3.0	5.3	6.7	7.5	9.1
Services	8.3	18.9	19.7	26.0	31.8	35.2	47.6	57.6	62.2	71.0
					Population and Construction Activity					
Total Population (Thous.)	22.3	58.9	96.2	141	176.5	206.3	240.2	272.2	299.3	327.8
Residential Building Permits (Thous. Units)	8.3	13.6	13.8	16.7	13.2	11.1	12.6	11.9	10.1	10.7
Nonresidential Construction (Million $)	337.8	578.6	620.2	788.3	658.3	585.1	702.6	702.9	627.5	698.7
Real Nonresidential Construction	248.6	408.6	415.5	500.4	396.0	332.6	377.3	357.4	302.3	318.5

Source: Southern California Association of Governments, *City of Los Angeles Jobs with Peace Initiative, Defense Spending Cutbacks and the Los Angeles Economy*, Table 1 (1989).

A4.2. Santa Clara and Monterey Counties

Most other areas of the state will not likely be hit as hard by cuts in defense purchases as the Los Angeles basin. One area which is likely to suffer significantly is Santa Clara County (Silicon Valley). In 1992, Santa Clara County received 11% of defense spending in California or $5.6 billion (CEC 1992). In 1987, 32,600 workers in Santa Clara County were employed in the aerospace sector. This figure dropped to 27,600 by August 1992. Defense employment by large Santa Clara County prime defense contractors fell by from 42,809 in September of 1991 to 24,475 in August of 1992 (CEC 1992).

Finally base closures are expected have only a small statewide impact, but very significant impact in limited localities (CSF 1992). In 1992, the military services spent $14 billion or 25% of defense spending in California to maintain 71 military installations. Under realignments already planned, California can expect to lose 34,000 military and 13,000 civilian jobs associated with base closings (CSF 1992). This loss in civilian jobs is small compared to the loss to date of 100,000 jobs in California's aerospace industry. But closures are expected to have severe effects in local areas. Monterey County will be heavily impacted by the closing of Fort Ord. Fort Ord accounts for more than 20% of Monterey County's economic activity (CBO 1992). It is expected that Monterey County will loss 13,619 military jobs and 2,835 civilian jobs when Fort Ord closes (CBO 1992). "DOD estimates that for every military and civilian job that is lost to a community as a result of a base closing, the local economy generally experiences the loss of another half job in businesses that provide services to base employees" (CBO 1992).