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WORKING PAPER NO. 741

The Role of Defense Cuts in the California Recession: omputable General Equilibrium Models and Interstate Factor Mobility

by

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DIVISION OF AGRICULTURE AND NATURAL RESOURCES
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Abstract

This study develops a computable general equilibrium (CGE) model to examine the impact of recent defense cuts on California's economy. The study demonstrates use of a CGE model to examine the sensitivity of regional economy models to assumptions about factor migration. The results show that California is indeed sensitive to defense cuts, but that the perceptions of workers and producers about the permanency of the cuts and about other future opportunities in the state economy significantly affect gross state product (GSP) multipliers. Depending on how these perceptions affect factor migration, GSP multipliers can be expected to range from 1 to almost 5.

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California experienced a period of boom and bust during the 1980s and early 1990s. Between 1980 and 1990, the number of jobs in California increased by 35%, gross state product increased 53% and state population grew by 25%. A recession hit in late 1989. By early 1994, California had gone 44 months without employment returning to its mid-1990 peak. Between 1980 and their peak in 1984, real prime defense contract awards to firms in California rose 61%. They fell by a third between 1984 and 1990. Governor Wilson expressed a widely held view in claiming that, "there is no question that the [defense] build-down is by far the leading cause of the state's economic distress" (Gov., 1994, p. 14).

With defense spending accounting for an average of only 4.6% of California GSP over the past 20 years, is it possible that defense cuts alone could have driven the California recession? The impact of the defense cuts depends on how highly linked other California industries are to defense and on expectations about the permanence of the defense cuts. Using a state computable general equilibrium model, we develop estimates of the contribution of defense cuts to the California recession. The range of these estimates depends on assumptions about how factor markets respond to exogenous shocks--such as defense cuts. By varying assumptions about factor mobility, we examine the role of factor market assumptions in modeling regional economies.

In section 1, we discuss the role of defense spending in the California economy, regional concentration of defense production in the United States, and theoretical explanations of how regional industrial concentration occurs and affects regional growth. Section 2 discusses approaches to modeling regional economies and presents a multisectoral CGE model of California. In section 3, we present empirical results from this model under different assumptions about factor market operation. We discuss how these assumptions affect analysis of the regional impact of defense spending cuts.

1. DEFENSE IN THE CALIFORNIA ECONOMY

National Defense Spending in the 1980s. The 1980s 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). In 1986, defense budget authority was 49% higher in real terms than in 1980 (CBO, 1992). Relative to other economic activities, the build-up was not massive. Defense spending's share of GDP has declined steadily from 9.5% in 1960, to 4.7% in 1993 (Commerce, various years). This trend is due more to a secular increase in U.S. GDP than to reductions in defense spending (Jayne, 1988).

From 1986 to 1990, Congress slowed the increase in nominal defense appropriations, effectively cutting them in real terms by 2% annually. By 1991, real national defense budget authority was 20% below its 1985 peak (CBO, 1992). In the early 1990s, both the Bush and Clinton Administrations proposed significant cuts in the defense budget. The Congressional Budget Office estimates that annual, national defense outlays fell 17% in real terms between 1990 and 1994 (Thomas, 1994). Under the Clinton FY1995 budget, annual procurement budget authority in 2000 would be 43% below 1990 levels (CBO, 1994).[1]

There were also two rounds of base closures and realignments during the early 1990s. The 1991 round of base closures caused a direct net loss of 31 thousand military and 28 thousand civilian jobs nationwide. National military personnel payroll decreased by $2.8 billion between 1990 and 1992 (1990 dollars) (DoD Atlas, various years). The 1993 round recommended closing an additional 130 bases and realigning 43 bases nationally (BRAC, 1993). These closures are expected to result in a net loss of 53 thousand jobs nationwide, and a net savings of $3.8 billion

(BRAC, 1993; DoD, 1993a). The Base Closure Commission is expected to recommend further cuts in 1995.

Regional Concentration of Defense Production. U.S. defense procurement spending is highly concentrated geographically. For the past 50 years, more than 60% of prime defense contract awards have been concentrated in 10 states (Malecki and Stark, 1988). In 1986, while the rest of the country received only $660 in prime contract awards per capita, New England states received $1,440 and California received $1,200 per capita (1990 dollars) (Commerce, various years).

Geographic concentration of defense production amplifies national level fluctuations in defense spending in regions with large defense industries. Between 1980 and 1986, prime contract awards increased $418 per capita in the New England census area and $293 per capita in California (1990 dollars) (Commerce, various years). During the same period it increased only $97 per person in the rest of the country. From 1986 to 1990, per capita prime contracts fell $385 in New England and $363 in California. In the rest of the country prime contract awards fell $125 per person.[2]

Several empirical studies have suggested that concentration of federal defense spending may affect regional economic growth (Atkinson, 1993; Mehay and Solnick, 1990; and Markusen et al., 1991). The question of how concentration of defense spending affects regional growth remains open.

Regional growth theory maintains that labor and capital migration can contribute to formation, growth, and persistence of industrial regions by effecting local external economies through increasing either final demand or factor supply (Richardson, 1973). Historical events, such as major changes in defense spending, can affect location of capital investment in ways that affect regional growth (Arthur, 1986). Migration decisions are also based on expectations about the future. Where external economies play a role, future returns also depend on the factor allocation decisions of other people--which in turn depend on their expectations about future earnings. As a result, expectations about regional growth can become self-fulfilling and large enough to effect costs through external economies (Krugman, 1991). One would expect both history and expectations to play a role in determining decisions of workers to migrate or producers to move capital or allow it to depreciate.

Several studies have found that defense spending is positively related to interstate migration. Deitrick (1984) found high correlations between migration rates into California and defense spending cycles—higher than those between migration rates and business cycles. Defense firms tend to recruit engineers and scientists interregionally and hire blue-collar workers locally (Ellis et al., 1993). Cambell (1993) and Ellis et al. (1993) found a net flow of scientists and engineers from North Central states to Pacific Coast and New England states during the 1970s and 1980s. Defense firms are heavily oriented toward research, development and design. Ellis et al. (1993) found that a \$100 increase in state per capita prime contract awards resulted in a 3.1% increase in defense-dependent engineering and scientific occupations and a 2.4% increase in defense-dependent blue collar occupations.

Campbell (1993) found that past increases in defense awards have induced greater in-migration than cuts have induced out-migration. This supports Markusen's argument that defense spending may increase a region's growth rate by effectively creating a long-run improvement in its professional/technical labor pool (Markusen et al., 1991). It remains to be seen whether workers drawn to defense-dependent states during the 1980s build-up will remain during the 1990s build-down.

Driver's license address changes indicate substantial migration out of California during the late 1980s and early 1990s. Annual changes to addresses outside of the state increased 61% from 1985 to 1992 (CDF, 1993b). Net address changes shifted from 138 thousand into the state in 1985 to 100 thousand out of the state in 1992. Between 1990 and 1992, 1.1 million people changed their driver's license addresses out of California.[3] Even in a state of 31 million people, this indicates a historical shift to large levels of out-migration following a long history of net in-migration.

Defense Spending in California in the 1980s and 1990s. California has ranked among the top three states for average annual prime defense contract awards since World War II (Clayton, 1965; Malecki and Stark, 1988; DoD Prime Contract Awards, various years). 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—substantially more than its 12.1% of U.S. population (CBO, 1993; DoD Prime Contract Awards, various years). In 1992, California continued to lead the nation in direct and indirect defense spending (CBO, 1993).[4]

During the 1980s, California gained considerably from the up-side of the defense procurement boom (see Figure 1). Between 1980 and 1986, California accumulated $74 billion in excess of its average annual prime contract awards for the period from 1960 through 1979 (1990 dollars) (DoD Prime Contract Awards, various years). At the peak of the 1980s defense build up, California received more than $60 billion in defense outlays (1992 dollars), over

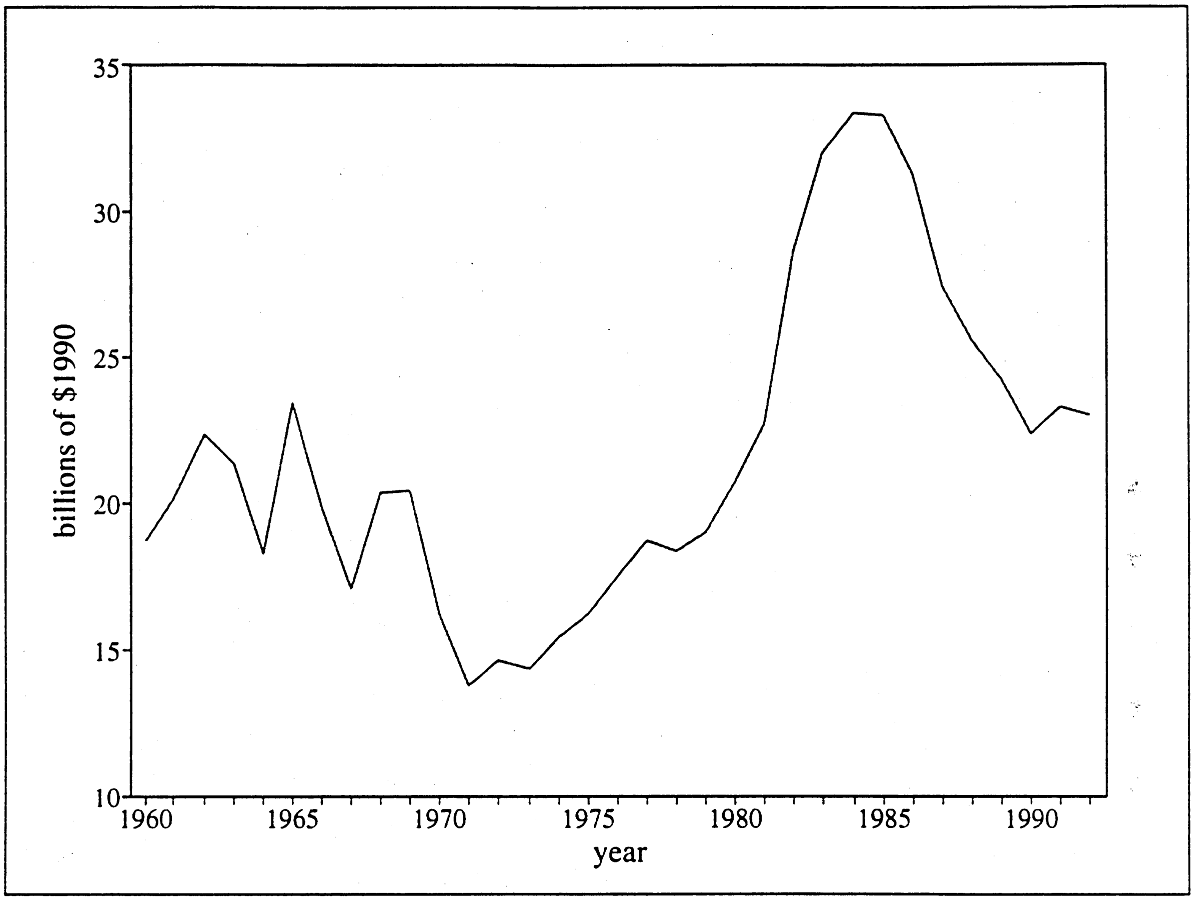

Figure 1. Prime Contract Awards over $25,000 to California Firms, 1960-1992.

Source: U.S. Dept. of Defense, *Prime Contract Awards by Region and State*, (various years), Washington, D.C.

$10 billion (1990 dollars) more than it received at the height of the Vietnam War (CDF, 1992). In real terms, prime contract awards have still not fallen below their peak during the Vietnam War.

Between 1984 (the peak of 1980s contract awards to California) and 1992, total defense procurement contracts to California firms decreased 30%. The California Commission on State Finance (CSF) estimates that defense procurement expenditures in California will fall by 40% between 1990 and 1997 (CSF, 1992; 1993). The California Governor's Office translates the 40% cut annual U.S. defense outlays expected between 1990 and 2000 into a 60% cut in contract awards to California firms (Gov., 1994).

California has also been affected by base closures. In 1990, 15% of all U.S. DoD employees, 306 thousand people, worked in California (DoD Atlas, FY1991). The 1991 round of base closures cut 10% of these positions. California absorbed 54% of the national net loss of DoD military jobs and 55% of the national net loss of DoD civilian jobs in the 1990 round. California military payroll dropped by half a billion dollars from 1990 to 1992 (1990 dollars) (DoD Atlas, various years). In the 1993 round, 10 of the 130 recommended base closings and 3 of the realignments were in California (BRAC, 1993; DoD, 1993a). DoD expects California to suffer a net loss of 15 thousand military jobs (75% of U.S. net loss) and 14 thousand civilian jobs (34% of U.S. net loss) as a result of the 1993 round (DoD, 1993a).

The 1990s Recession in California. The 1980s were a boom time for California. By 1990 California added more than 4 million jobs to the 11 million that existed in 1980. Gross state product increase 53% during the same period (see Figure 2). By the late 1980s, the unemployment rate fell to an unprecedented 4.5%. During the last year of the boom,

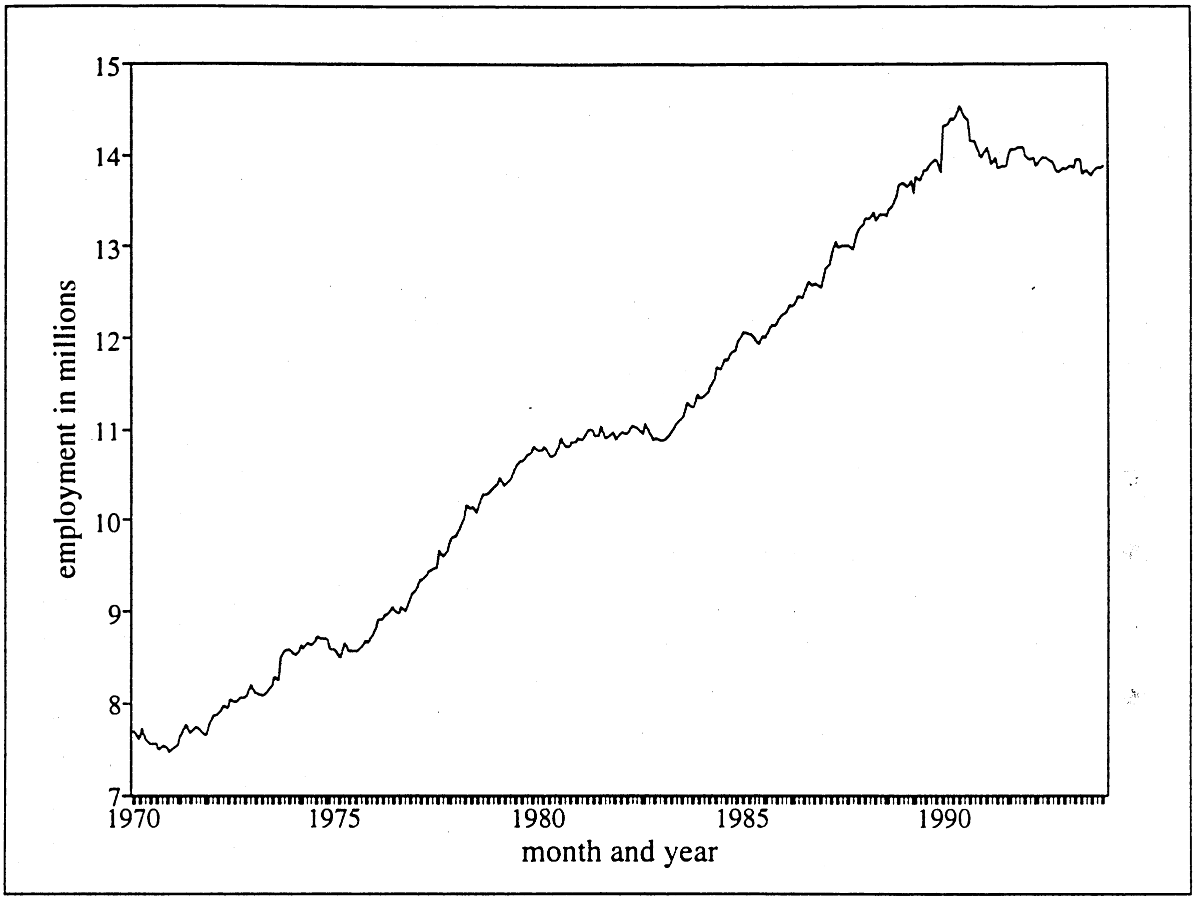

Figure 2. California Seasonally Adjusted Monthly Employment, 1970-1993.

Source: California Employment Development Dept., *Annual PLanning Information: Statistical Appendix*, 1993, Sacramento, California.

employment growth accelerated. Employment increased by 800 thousand jobs between mid-1989 and mid-1990. In June of 1990, the boom came to an abrupt halt. Employment peaked at 14.5 million jobs. By mid-1991, employment dropped back to mid-1989 levels of slightly under 14 million jobs and held at this level through mid-1993 (CDF, 1994). By mid-1994, the California economy appeared to be moving into a steady, but shallow recovery.

California has gone through two other recessions since 1970. One in the mid-1970s, associated with the post-Vietnam War defense build-down, and the other in the early 1980s, associated with a national recession. Unemployment patterns in the current recession follow those of the 1975 recession than more than those of the 1980s recession. The 1982 recession had a deeper, but shorter, impact on unemployment rates than either of the other recessions. Unemployment peaked at 11.2% in late 1982 and early 1983. It remained above 9% for 18 months. During the 1970s and 1991 recessions, unemployment peaked at slightly over 10%. It remained above 9% for 24 and 25 months, respectively (EDD, 1994).

Arguably the patterns in these recessions indicate that expectations regarding the permanence of defense cuts affect their impact on California's economic performance. Both the 1975 and the 1991 recessions followed a sizeable defense build-down, and in neither case was it clear that this loss in demand would be rapidly replaced in the California economy. The 1982 recession was part of a national recession; and California producers and workers expected demand for California defense production to boom under the Reagan defense build-up.

We use 1990 data as a base from which to model the subsequent downturn which began in earnest in 1991. Table 1 presents California 1990 state product accounts.[5] In 1990, California had the largest GSP of any state in the country (14% of U.S. GDP)—over twice that of the next largest state, Texas (Commerce, 1993a, table 694). California's import and export shares were very high (43.3% and 46.1%, respectively) indicating, as expected, that California was highly integrated with the rest of the U.S. economy. Defense spending, and government spending in general, played a larger role in the California economy in 1990 than for the nation as a whole. In 1990, government expenditure was 19.7% of California GSP and 18.9% of U.S. GDP (CEA, 1993). Federal defense purchases of goods and services were 6.7% of California GSP, compared to 5.7% of U.S. GDP (CEA, 1993).

Although defense spending accounts for a smaller share of California GSP now than it did at the height of the 1980s boom in defense expenditures, it still accounts for a significant part of state value added. The following section presents a model that allows us to examine the impact of cuts in defense on the California economy.

2. MODELING THE REGIONAL IMPACT OF DEFENSE CUTS

A large class of input-output models has been developed to examine the impacts of exogenous shocks on regional economies (Miller and Blair, 1985). Input-output models focus solely on capturing linkages embodied in flows of intermediate goods. These are linear, demand-driven models which assume constant returns to scale, no external economies, no substitution effects, and no need to account for capital flows or international or interregional trade. They are simple to use and give some idea of the direct and indirect effects of an external shock or policy change but, by ignoring the role of substitution possibilities in supply, demand, and price formation, they generally overstate the total effect.

Table 1. **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).

Linear models have been developed that extend the basic input-output table to include the distribution of income among, and expenditure by, households and institutions (Hewings and Jensen, 1986). These models have taken various forms, some extending the input-output matrix by adding demographic accounts, others by adding institutions such as government. A formal accounting framework for these models is provided by a Social Accounting Matrix (SAM), which integrates input-output accounts with national income and product accounts. The SAM traces the flows of goods, services, and income flows through the private and public sectors. SAM-multipliers can be obtained in much the same way as input-output multipliers (Pyatt, 1988). SAM-multiplier models, like input-output models, are linear, have fixed coefficients, and are demand driven. SAM-multiplier models have been used to analyze both national and regional economic impacts (Cohen, 1989; Rose and Beaumont, 1988).

Computable general equilibrium (CGE) models use SAMs as their data foundation, but allow for substitution through non-linear supply and demand equations (Robinson, 1989). In CGE models, all supply and demand equations for the economy are fully specified and wages and prices are determined endogenously. Neoclassical assumptions of perfect competition, perfectly functioning markets with flexible prices, and free mobility of products and factors can be relaxed. CGE models have been used to analyze national impacts defense spending cuts (Roland-Holst, Robinson, and Tyson, 1988). Development of state and regional CGE models has been hampered by data limitations, but a literature exploring these applications is developing (Despotakis and Fisher, 1988; Kraybill, Johnson, and Orden, 1992).

3. THE CALIFORNIA CGE MODEL.

We use a state-level, multi-sectoral, CGE model of California (CA-CGE) to estimate the impact of defense cuts on the state economy. The model is in the tradition of CGE models that have been applied to a number of countries to explore issues of structural adjustment.[6] The CA-CGE model has a number of special features to capture the fact that the state economy is imbedded in a larger national economy, with linked capital, labor, and product markets. This CGE model is constructed so that under one set of assumptions (full factor mobility, fixed wages and prices, and adjustment through interstate migration) it behaves as a SAM-multiplier model. Under another set of assumptions (all factors of production immobile and adjustment through intersectoral relocation), the model acts as a full employment model with no factor market linkages to the rest of the United States. Varying these model assumptions allows us to examine the role of interstate migration of both labor and capital in determining the impact of an exogenous shock. It also allows us to explore the role modeling assumptions play in estimating economic impact of government policy. A simplified specification of the CA-CGE model is given in Appendix 1.

Modeling Factor Markets. The CA-CGE model has three occupational categories: high-skilled service, other service, and industrial. High-skilled service labor works in the engineering and professional services sector (which includes engineers and scientists). Other-service labor occupies other, less-well-paid, service jobs. Industrial workers include all other labor, including those in agriculture and state and federal government. This segmentation permits to us to examine how migration incentives vary across different labor groups. Each category has a separate wage and market-clearing equation, which segments the labor market.

Workers can work in any industrial sector in which their occupational category is employed but cannot change occupational category.

The degree to which California factor markets are economically integrated into the rest of the U.S. economy will affect how the California economy will respond to a change in demand. By economic integration we mean the degree to which labor, capital, and products can move between regions. Anything that diminishes the mobility of factors or products reduces the level of economic integration. For example, if workers expect to be recalled after a lay-off, they may remain within California, even though wages there are falling relative to the rest of the country.

The CA-CGE model allows variants in modeling assumptions that can be used to analyze the impact of different levels of factor market integration. A typical CGE model of a national economy assumes that the aggregate supplies of factors of production are fixed and solves for market-clearing wages and capital rentals endogenously. In a regional or state economy, factor markets are embedded in larger, national markets. We model this by assuming that California labor markets clear at a wage proportional to the prevailing national wages. That is, we assume that the California economy is not large enough to affect prevailing national wages, which are then taken as given. If labor demand in California falls, labor will migrate out of the state instead of the wage falling to clear the local market.

For each labor category that we assume is integrated with the national economy, we specify that the wage in California is proportional to that category's fixed national wage. 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 and that investors will shift their capital stock into or out of California until the average rate of return in California equals the national average.

In the experiments described below, we use three model variants listed in Table 2: (1) a "no migration" 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 but capital can only be reallocated across sectors within the state, and does not migrate; and (3) a "full integration" variant in which all factors can migrate. These three variants, with their differing degrees of factor mobility, generate empirical estimates that provide lower and upper bounds on the extent of expected adjustment to the defense cuts. Variant 1 acts as a typical aggregate employment, price-adjusting CGE model. Variant 3 acts as a fixed-price, demand-driven, SAM-multiplier model.

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 may 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 to be, 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 simply because wages in California fall. In this case, variant 1 is more applicable. Recent history, however, indicates that the California economy has lagged behind the rest of the economy, both in the onset and turning point of the recession.

Table 2. Model Variants for the California Computable General Equilibrium Model

	Variant	Market-Clearing Mechanism
1.	*No Migration*	
	Labor stays	Wage adjustment
	Capital stays	Rental rate adjustment
2.	*Partial Migration*	
	Labor can migrate	Quantity adjustment
	Capital stays	Rental rate adjustment
3.	*Full Integration*	
	Labor can migrate	Quantity adjustment
	Capital can move	Quantity adjustment

Modeling External Trade. The CA-CGE model, like most trade-focused CGE models, differentiates between domestic and traded commodities (Devarajan, Lewis, and Robinson, forthcoming). We specify that goods of the same sectoral classification produced in California are different from goods produced elsewhere. By doing so, we are able to model two-way trade reflecting regional subsector specialization. Highly integrated economies are generally characterized by high levels of regional specialization. In California, we see a high level of two-way trade within sectors such as "cars" ("autos and parts") or "planes" ("aircraft and parts").

We model this product differentiation by using trade-aggregation functions. Demand for intermediate inputs is assumed to be a constant elasticity of substitution (CES) function of California produced goods and imported goods. Similarly, demand for sectoral output produced in California is assumed to be differentiated by market of destination: the California market or a "foreign" market. Goods produced in California are transformed for delivery to different markets according to a constant elasticity of transformation (CET) function specified for each industrial sector. The result is that the structure of domestic prices within California are closely, but not perfectly, linked to external prices.[7]

Modeling Government Demand and Revenue. Government expenditure on goods and services is broken into two categories: defense and non-defense. Defense expenditures are made by the federal government, while non-defense expenditures are made by federal, state, and local governments. 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.

The model also includes a number of taxes, but does not distinguish among local, state, or federal taxes.[8] Thus, the model solves for the aggregate government budget deficit, but cannot distinguish by level of government. We distinguish government demand by type of expenditure rather than level of government. Both categories of government expenditure are fixed exogenously by sector. The experiments below consider the impact of variations in defense expenditures.

Base Sectoral and Labor Data. We constructed a California SAM for 1990 using data from IMPLAN supplemented with state data (IMPLAN, 1993; Robinson et al., 1994). The U.S. Department of Commerce supplied DoD data on actual 1990 defense expenditures at a 527-sector level (Henry, 1993). Robinson, Hoffmann, and Subramanian (1994) describes this data base in detail.

The California SAM shows 7.33 million industrial, 6.52 million low-skilled service, and 2.69 million high-skilled service workers employed in California in 1990. Government is clearly an important player in the state. In 1990, over two million workers were employed in public administration.

Table 3 presents data on the industrial sectors used in the CA-CGE model. We divided the California economy into 24 sectors, focusing on industries with high defense-related final demand. In 1990, defense expenditures generated only 3.4% of aggregate gross demand in California, but over 10% of sectoral demand for planes, ships, space and missiles, instruments, engineering services, and public administration.

Table 3. Selected Sectoral Data for California, 1990

Sector	Value added	Output	Supply	Exports/ output	Imports/ supply	Govt/ supply[a]	Defense/ supply[b]
		$ billion			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

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

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 3 also shows very high levels of two-way trade across almost all non-service sectors. California mining, ships, and space (which includes missiles) sectors export more than 90% of their production, and import more than 90% of total state sectoral demand. Eight sectors have both export and import shares greater than 50%. High levels of two-way trade at the sector level indicate a high level of subsectoral, regional specialization and economic integration at the sectoral level.

4. DEFENSE EXPENDITURE REDUCTION SCENARIOS AND RESULTS

Model Experiments. CGE models provide a framework for 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. CBO estimates that national defense outlays fell 17% between 1990 and January 1994; and projects that the Clinton budget would reduce defense outlays by roughly 40% by the year 2000 (Thomas, 1994). We conducted a series of five experiments, reducing federal military expenditures uniformly across all sectors in 20% steps. A 20% cut roughly represents defense cuts from 1990 to 1994. The 40% and 60% cuts represents CBO's estimate of nationwide cuts and the governor's projection for cuts in California by the year 2000. Defense cuts were simulated by uniformly reducing defense expenditures in all sectors. To explore the impact of migration, all the experiments were repeated for the three model variants.

Aggregate and Sectoral Experiment Results. Table 4 presents aggregate results for the three experiments. It shows how factor markets and GSP respond to cuts under the three model

Table 4. Procurement Cuts and Base Closures: Impact of Total Defense Reductions of 20-100% on Selected California Variables, Three Model Variants

	Experiment				
	1	2	3	4	5
	−20%	−40%	−60%	−80%	−100%
	Percentage 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 in billions of $ 1990.
Wage is total return to factors reported in trillions of $ 1990.
Labor is millions of workers.
Capital stock aggregate employment is in trillions of $ 1990.

variants. Table 5 presents sectoral results for the three experiments. It shows changes in sectoral production in response to defense cuts. The sensitivity of GSP multipliers to modeling assumptions is striking. Table 4 shows that the defense/GSP multiplier is almost invariant to the level of cut, but increases from 0 to almost 5 with the level of economic integration. 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 factor mobility on state employment and GSP (see Table 4).

In variant 1, where no factors migrate, the impact on GSP is constrained to be small. Since factors used to meet defense demand cannot leave the state, they relocate to other sectors. Since this variant also assumes that factor markets clear through wage adjustments, unemployment does not change. These are the results expected from a fixed employment model of a closed economy. When defense spending is eliminated, GSP actually rises slightly, indicating that capital, labor, or both have moved to more productive sectors within the state. Table 5 shows that few sectors lose value added.[9] Defense cuts decrease demand for industrial labor and professional services, which defense sectors use intensively. As a result of this decreased demand, industrial and professional services wages fall. The return to capital increases as the capital/labor price ratio increases (Table 4)

In variant 2, where labor markets clear through interstate migration and capital is assumed to remain in California, the picture changes. Industrial and professional labor leave the state. In-migration of low-skilled/low-wage service workers partially offsets this out-migration. As a result, the return to capital also falls. A 40% cut results in a 2% decline in GSP and a defense-GSP multiplier of 0.9. Even a 20% cut results in a significant (1%) reduction in GSP. Sectoral

Table 5. Changes in California Sectoral Value Added: Defense Procurement and Base Closure Expenditure Reductions, Three Model Variants

Sector	Base value	Variant 1 Exp. 1 –20%	Variant 1 Exp. 2 –40%	Variant 2 Exp. 1 –20%	Variant 2 Exp. 2 –40%	Variant 3 Exp. 1 –20%	Variant 3 Exp. 2 –40%
	$ billion	Percentage change from base					
Agriculture	$ 7.50	1.0	1.6	–0.7	–1.4	–6.3	–12.5
Mining	16.06	0.0	0.0	0.0	0.0	0.0	0.0
Construction	41.17	–0.3	–0.7	–0.8	–1.6	–1.6	–3.1
Food Manufacturing	13.23	0.9	1.7	0.6	1.0	–5.7	–11.3
Textiles	4.50	1.4	2.7	0.4	0.6	–5.7	–11.4
Wood	15.82	1.3	2.5	–1.4	–2.3	–4.3	–8.5
Chemicals	18.42	0.2	0.4	–0.1	–0.3	–5.0	–9.9
Metal	11.82	5.4	10.6	–10.6	–16.8	–3.6	–7.1
Electric	14.91	0.4	0.8	–5.2	–8.8	–3.7	–7.3
Machinery	13.49	1.2	2.2	–6.2	–10.4	–4.4	–8.7
Cars	1.81	1.7	3.1	–0.9	–1.5	–5.6	–11.2
Planes	12.76	9.1	21.8	–31.3	–47.2	–11.7	–23.4
Ships	0.68	12.8	26.4	–20.9	–31.4	–5.9	–11.8
Space	7.09	1.6	1.5	–20.2	–32.2	–7.6	–15.2
Instruments	16.47	0.1	0.3	–8.6	–14.6	–6.0	–12.0
Miscellaneous	6.98	0.7	1.4	0.8	1.4	–5.6	–11.2
Transportation Services	38.14	0.0	–0.1	–0.6	–1.2	–5.5	–10.9
Utilities	11.86	0.7	1.3	0.2	0.3	–5.2	–10.3
Trade	107.33	–0.1	–0.1	1.4	2.3	–5.5	–11.0
Housing	66.23	0.1	0.2	2.0	3.3	–5.4	–10.8
Professional Services	79.59	0.5	1.0	0.6	0.8	–5.7	–11.3
Engineering Services	26.59	–3.1	–6.2	–3.6	–7.1	–6.2	–12.4
Other Services	125.81	0.2	0.3	2.0	3.3	–5.8	–11.6
Public Administration	82.78	–3.5	–6.9	–3.5	–6.9	–3.5	–6.9
GSP	741.03	0.0	0.0	–1.1	–2.0	–5.1	–10.1

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

results in Table 5 show that only sectors using lower-skilled labor gain (food manufacturing, textiles, trade, housing, and low-skilled services). All other sectors lose value added. Defense oriented sectors lose most heavily.

The picture is even bleaker under variant 3, in which all factor markets clear through migration. Table 4 shows a dramatic movement of capital and all types of labor out of California, and a correspondingly large fall in GSP. Similar results would also be generated by a conventional SAM-multiplier model. With a 40% cut, GSP falls 10.1%. The defense-GSP multiplier is 4.7. Table 5 shows that the decline in defense-dependent sectors is large, though smaller than in variant 2. The large defense-GSP multiplier effect spreads the decline in demand across all sectors. While at least some sectors gain in model variants 1 and 2, in variant 3 all sectors lose.

Job Turnover. Job turnover provides an indirect measure of adjustment costs associated with a major economic shock. Table 6 shows that, even under variant 1 with no migration and no change in unemployment, there is still significant job turnover. Workers and capital move among sectors within California as defense demand is cut. Variant 2, which allows labor migration, yields larger disruptions for labor, especially for industrial occupations. People leaving industrial or professional labor categories either move into less skilled jobs or leave the state. The low-skilled service sector gains jobs. Sectoral capital turns over, even without capital migration, reflecting a good deal of sectoral restructuring. Under variant 3, there are no sectoral job gains—all sectors lose, and all who lose work due to defense cuts leave the state or increase unemployment in the state. While the assumption in variant 3 of perfect labor and capital mobility is extreme, the variant is useful in tracing out the potential size of multiplier linkages.

Table 6. **Procurement Cuts and Base Closures: Impact of Total Defense Reductions of 20-100% on Sectoral Job Turnover in California, Three Model Variants**

	Experiment				
Average sectoral decline in factor employment	1	2	3	4	5
	–20%	–40%	–60%	–80%	–100%
	Percentage 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 turnover 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 $ 1990.
Labor is millions of workers.

Job turnover results from this study fall within the range of existing estimates of defense-related job losses. The California Governor's Office estimated that 430 thousand defense-related jobs were lost between 1990 and 1993 (Gov., 1994). The Commission on State Finance estimated that in the aerospace industry alone, 176 thousand defense-related jobs were lost between 1990 and 1992 (CSF, 1992). Job turnover under variant 2 falls between the CSF and the Governor's estimates, with 291 thousand jobs lost as a result of a 20% cut (not tablulated). CSF anticipates that an additional 81 thousand defense-related jobs will be lost between 1993 and 2000. The CA-CGE model projects a turnover of between 191 thousand jobs under variant 1 and 516 thousand under variant 2 (not tabulated).[10] This indicates that the best estimate of the actual impact of defense cuts to date on California falls between the results in variants 2 and 3.

Base Closures. We also conducted a set of experiments to look at the impact of base closures alone. Base closures were simulated by reducing defense expenditure on public administration only. As before, expenditures were reduced by 20% to 100%. The most significant difference between the results from these experiments and those looking at total defense cuts was in the GSP multipliers. Public administration is a service sector and is less capital intensive than sectors hit by cuts in defense procurement. The base closure multiplier for variant 2 (labor migration only) is 1.7, roughly double that for total defense cuts (see Table 4). The base closure multiplier for variant 3 (labor and capital migration) is 4, slightly smaller than that for total defense cuts. More damage is done to the state by decreasing labor demand than by decreasing procurement demand because the state economy can make up for declining state demand for products through increased exports. Decreased demand for labor in a nontraded service sector, however, cannot be compensated for by export demand.

5. CONCLUSIONS

Is it true then that those who live by the sword die by the sword (at least in the case of defense spending in California)? In this study, we have used a multi-sectoral, computable general equilibrium (CGE) model to examine the impact of defense cuts on the California economy. We have shown that estimates of the regional impact of an economic shock are highly sensitive to assumptions about factor markets. Assuming that labor and capital do not leave the state, the model behaves like a long-run country model in international trade. Labor and capital move among sectors within the state, but there is no change in aggregate unemployment. Assuming instead that labor and capital can leave the state if wages and profits fall relative to other states, then the CGE model behaves like a regional, fixed-price, SAM-multiplier model commonly used in regional analysis.

With no interstate factor migration, defense cuts have little effect on gross state product (GSP), but do result in significant sectoral restructuring. Assuming that only labor migrates, while capital remains within the state, a dollar decrease in defense spending in California leads to roughly a \$1.00 decrease in GSP and a dollar decrease in base closures alone leads to roughly a \$1.50 cut in GSP (defense/GSP multiplier of 1.5). If both capital and labor migrate in response to cuts, the defense/GSP multipliers are very high: 4.7 for total cuts and 4.0 for base closures.

Our results indicate that, despite the fact that the California economy is large, defense cuts have the capacity to cause a significant downturn. The extent to which they, in fact, do so depends on the perceptions of workers and producers regarding the permanency of the cuts and the quality of alternative opportunities within the state. If workers and producers believe that the cuts indicate long-term problems for the state economy, they are more likely to leave the state and the multiplier will be closer to our high estimates. If they believe the cuts are temporary and are willing to wait them out or can find other opportunities in California, the multiplier will be closer to our low-end estimates.

How workers and producers react to shocks also depends on government policy. Labor and capital mobility are sensitive to investment in people and infrastructure. 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. State support for education and training, at all levels, has been in the past, and continues to be, very important to both workers and investors. The investment climate is certainly important, including policies to maintain and expand physical infrastructure. If California wishes to lessen the impact on the state economy of defense cutbacks, it should pursue policies that encourage capital and labor to remain in the state, lowering the negative multiplier associated with defense and other government expenditure reductions.

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1. Procurement spending is expected to increase during the first decade of the next century. Defense analysts view the current cuts as a "holiday" from procurement spending, made possible by extraordinarily high levels of advanced weapons systems procurement during the 1980s (CBO, 1994). This leaves open the possibility that California and other defense dependent regions could enter another boom-and-bust cycle early in the next century.

2. The regional distribution of subcontracts may also affect defense spending concentration and the impact of defense cuts on state and regional economics. A survey of studies on DoD subcontracting concluded that it causes little further geographic dispersion (Malecki, 1984). Evidence from more recent program specific studies of DOD contracting is mixed (Dardia, 1994).

3. If each of these driver's license holders had been employed prior to leaving California, this would represent emigration of 7.8% of Californians employed in 1990.

4. Several industrial sectors in California play an even larger role in national defense supply than the state as a whole. California firms received 31.3% of DoD missiles and space contracts and 22.4% of electronics and communications contracts in 1991. California firms' share of national aircraft and parts contracts follow swings in total defense spending, ranging from 11% to 26.3% (DoD Prime Contract Awards, various years).

5. 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.

6. Devarajan, Lewis, and Robinson (1991) describe the structure and properties of trade-focused CGE models. See Kraybill and Lugani (1991) for a survey of multi-regional, but subnational, CGE models.

7. The CA-CGE model includes a category of "non-comparable" imports (goods which are imported into California but which have no local sectoral counterpart). These non-comparable imports are determined by fixed coefficients, with different coefficients by demand categories: intermediate use and final demand by government, investment, and private consumption.

8. There is a long tradition of public finance CGE models (Shoven and Whalley, 1984). It is feasible, given data, to extend a state CGE model to include a more detailed representation of federal, state, and local government fiscal systems.

9. Variant 1 yields unusual sectoral results. Manufacturing sectors hire former public administration and professional services workers at lower wages and expand, largely by exporting. Manufacturing sectors formerly dependent on defense demand (planes, ships, space, and instruments) expand because, with reduced labor costs, they can expand exports. This result reflects a modeling assumption that demand in the rest of the United States or the rest of the world remains strong and that firms can sell as much as they wish at fixed external prices. This assumption is probably unreasonable for these sectors since the fall in defense demand in California is really part of a nationwide cutback. These sectoral results indicate that model variant 1 is probably unrealistic.

10. Variants 1 and 3 of the CA-CGE model project job turnover outside existing estimates. With a 20% cut under variants 1 and 3, the CA-CGE model projects turnover of 92 thousand and 836 thousand jobs, respectively. With a 40% cut, variant 3 results in turnover of 1.7 million jobs.

APPENDIX 1: MODEL SUMMARY

This appendix summarizes the technical specification of the CA-CGE model. Table A1.1 lists the equations of a simplified version of the model. The model is implemented in a modeling language called GAMS (General Algebraic Modeling System).[1] 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 A1.1 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 (measured 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

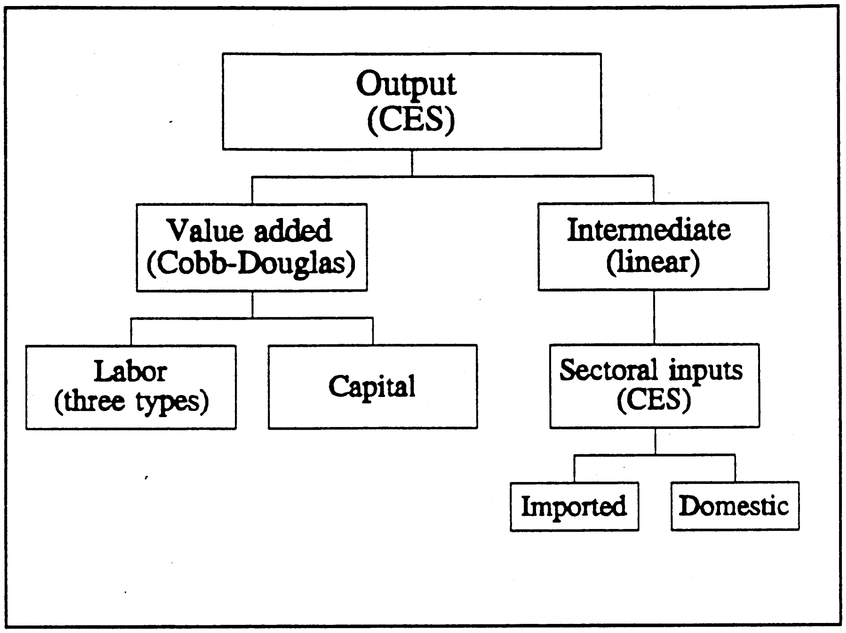

Figure A1.1. Sectoral Production Functions

equations, given homogeneity, and are, hence, not independent equations. The simplified model has ($9 \cdot i + i \cdot j + 5$) 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 A1.1 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.

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.[2] 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 the Johansen closure, after Lief Johansen who used it in the first CGE model (Johansen, 1960).

Table A1.1. Equations of a Simplified California CGE Model

	Equation	Description
	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.	$INT_i = \text{MIN}_j(a_{ji} X_{ji})$	Intermediate inputs production 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 function.
6.	$P_i^{INT} = \sum_j a_{ji} \cdot P_j^X$	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.

Table A1.1 continued

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·i + i·j + 5 variables and 9·i + i·j + 6 equations. Given that the system satisfies Walras' Law, there are 9·i + i·j + 5 independent equations.

Parameters

a_{ji}	Technical production coefficient
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

MIN	Leontief function
CD	Cobb-Douglas function
CES	Constant elasticity of substitution function

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 United States is fixed. In 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.

1. The GAMS software is described in Brooke, Kendrick, and Meeraus (1992). The full CA-CGE model equations in the GAMS language are presented in Robinson, Hoffmann, and Subramanian (1994).

2. For California, "elsewhere or foreign" 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.