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The Economic Impact of Public Resource Supply Constraints in Northeast Oregon

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Interior Columbia Basin Ecosystem Management Project: Scientific Assessment

Thomas M. Quigley, Editor

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Abstract

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Traditional, fixed-price (input-output) economic models provide a useful framework for conceptualizing links in a regional economy. Apparent shortcomings in these models, however, can severely restrict our ability to deduce valid prescriptions for public policy and economic development. A more efficient approach using regional computable general equilibrium (CGE) models as well as a brief survey of relevant literature is presented. Computable general equilibrium results under several different resource policy scenarios are examined and contrasted with a fixed-price analysis. In the most severe CGE scenario, elimination of Federal range programs caused the loss of 1,371 jobs (2.3 percent of regional employment) and $29 million (1.6 percent) of household income; and an 80-percent reduction in Federal log supplies resulted in the loss of 3,329 jobs (5.5 percent of regional employment), and $76 million (4.2 percent) of household income. These results do not include positive economic impacts associated with improvement in salmon runs. Economic counter scenarios indicate that increases in tourism and high-technology manufacturing and growth in the population of retirees can largely offset total employment and income losses. Evidence suggests that a regional economic transformation, characterized by stable or declining employment in resource-based industries and growth in tourism and retirement-based services, is already underway.

Keywords: Regional economics, computable general equilibrium models, input-output models, economic base theory, public resource policy.

Preface

The Interior Columbia Basin Ecosystem Management Project was initiated by the Forest Service and the Bureau of Land Management to respond to several critical issues including, but not limited to, forest and rangeland health, anadromous fish concerns, terrestrial species viability concerns, and the recent decline in traditional commodity flows. The charter given to the project was to develop a scientifically sound, ecosystem-based strategy for managing the lands of the interior Columbia River basin administered by the Forest Service and the Bureau of Land Management. The Science Integration Team was organized to develop a framework for ecosystem management, an assessment of the socioeconomic and biophysical systems in the basin, and an evaluation of alternative management strategies. This paper is one in a series of papers developed as background material for the framework, assessment, or evaluation of alternatives. It provides more detail than was possible to disclose directly in the primary documents.

The Science Integration Team, although organized functionally, worked hard at integrating the approaches, analyses, and conclusions. It is the collective effort of team members that provides depth and understanding to the work of the project. The Science Integration Team leadership included deputy team leaders Russel Graham and Sylvia Arbelbide; landscape ecology–Wendel Hann, Paul Hessburg, and Mark Jensen; aquatic–Jim Sedell, Kris Lee, Danny Lee, Jack Williams, Lynn Decker; economic–Richard Haynes, Amy Horne, and Nick Reyna; social science–Jim Burchfield, Steve McCool, and Jon Bumstead; terrestrial–Bruce Marcot, Kurt Nelson, John Lehmkuhl, Richard Holthausen, and Randy Hickenbottom; spatial analysis–Becky Gravenmier, John Steffenson, and Andy Wilson.

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Interior Columbia Basin Ecosystem Management Project

Introduction

During the 1980s, annual timber harvest from public lands in Oregon consistently approached historic high levels. In 1990, timber harvests in western Oregon began a dramatic decline, largely reflecting increasing land use restrictions because of the listing of the northern spotted owl *(Strix occidentalis caurina)* as an endangered species. East of the Cascade Range, however, the decline has been less precipitous. Although total cut on west-side National Forests (USDA FS) decreased by 81 percent from 2,238 million board feet Scribner rule (MMBF) in 1988 to 416 MMBF in 1993, over the same period, east-side Forest harvest declined by 45 percent from 1,250 MMBF to 685 MMBF (table 1). This trend also is evident on Bureau of Land Management (BLM) lands, although on the east side, BLM harvests are of relatively minor importance (Oregon Department of Forestry 1988-93).

Table 1 also shows an opposite, positive response for private timber. Private harvest increased by 93 MMBF (3 percent) on the west side and by 257 MMBF (51 percent) on the east side. As a result, total harvest from these three sources decreased by 44 percent on the west side but by only 18 percent on the east side, between 1988 and 1993.[1]

Historically, natural resource industries have provided a significant portion of Oregon's employment and income. In 1992, livestock and timber-related industries together directly provided an estimated 105,000 jobs, representing about 6.5 percent of total jobs and 7.7 percent of employee compensation paid in the State (table 2). This total does not include several thousand resource management jobs in Federal, State, and local governments.

In the five northeast Oregon counties focused on for this study (that is, Baker, Grant, Umatilla, Union, and Wallowa Counties), employment in livestock and timber-related sectors is significantly more important. Of about 60,000 regional jobs in 1992, livestock directly provided 5,300 jobs. Logging, lumber, and wood products provided another 4,100 jobs. Together, these industries contributed about 15 percent of regional employment and employee compensation (table 2).

Recent concern over the viability of several native anadromous fish runs has jeopardized traditional public land uses. Ecological disturbance caused by logging and riparian cattle grazing has been shown to damage salmon spawning beds. In July 1994, the Ninth Circuit U.S. Court of Appeals issued an injunction that would effectively stop grazing activities (and eventually, perhaps, logging and road building) in the Umatilla and Wallowa-Whitman National Forests. To help maintain viable spawning habitat for threatened or endangered salmon, considerable change in east-side public land management policy may be necessary. Consequently, how much future access will be available to much of the remaining east-side public forest land for timber harvest and cattle grazing is uncertain.

Although it is unclear what changes in logging and grazing policy will be introduced, the relative importance of livestock and timber-related industries in northeast Oregon suggests that any reduction in access to these natural resource inputs could have significant impacts on regional employment and income.

Purpose

The main purpose of this study was to estimate the regional economic impact of alternative Forest Service policies regarding access to public resources in northeast Oregon. As a prelude to this analysis, we provide a historical overview of the economy of northeastern Oregon over the past quarter of a century.

Estimates of total change in regional employment and income are provided under different assumptions about the nature and size of the policy shift and length of time over which adjustment to the new policy occurs. Analysis is limited to examining the impact of hypothetical resource supply constraints resulting from

[1] Care should be taken when comparing historical harvests. As cuts include more private and younger aged trees, the ratio of total processed output to log input will change, thereby creating a measurement problem. The log-scale measurement was established for large trees and for times when logs were less fully used. As a result, private timber harvest may contain 20 to 30 percent more effective input than the log scale is measuring.

Table 1—Annual Oregon timber harvest volume[a]

Ownership	1988 West	1988 East	1993 West	1993 East	Change 1988 to 1993 West	Percent	East	Percent
	Million board feet				*MMBF*		*MMBF*	
USDA FS	2,238	1,250	416	686	-1,822	-81	-564	-45
BLM	1,399	40	339	23	-1,060	-76	-17	-43
Private	2,754	505	2,847	762	+93	+3	+257	+51
Total	6,391	1,795	3,602	1,471	-2,789	-44	-324	-18

[a] Volume is measured by using Scribner rule.

Source: Oregon Department of Forestry, 1988-93.

Table 2—The northeast Oregon regional economy, 1992[a]

Employment sectors[b]	State		Region	
	Number of jobs	*Percent*	*Number of jobs*	*Percent*
Livestock related	24,461	1.5	5,353	8.9
Other agriculture	42,454	2.6	3,744	6.3
Food processing	25,053	1.6	2,792	4.7
Logging and wood processing	81,074	5.0	4,101	6.8
Other agriculture and natural resources	26,110	1.6	1,484	2.5
Other employment	1,420,848	87.7	42,294	70.8
Total	1,620,000	100.0	59,768	100.0

[a] Northeast Oregon = Baker, Grant, Umatilla, Union, and Wallowa Counties.
[b] Full- and part-time employment.

Source: IMPLAN (Alward and others 1989) and Bureau of Economic Analysis, Regional Economic Information System, U.S. Department of Commerce, 1969-92.

Table 3—Total and per capita personal income over time for northeast Oregon[a]

Category	1969	1974	1979	1984	1989	1990	1991	1992
Total personal income (thousand $)	304,105.0	540,576.0	915,643.0	1,251,392.0	1,542,637.0	1,632,475.0	1,717,510.0	1,818,414.0
Population (thousands)	92.2	97.9	111.8	116.8	112.0	113.3	114.7	116.1
Per capita personal income ($)	3,298.0	5,522.0	8,190.0	10,714.0	13,774.0	14,408.0	14,974.0	15,662.0
Total employment (jobs)	41,093.0	45,749.0	54,569.0	53,336.0	57,049.0	59,146.0	59,644.0	59,768.0

[a] Northeast Oregon = Baker, Grant, Umatilla, Union, and Wallowa Counties.

Source: Bureau of Economic Analysis, Regional Economic Information System, U.S. Department of Commerce, 1969-92.

implementation of salmon habitat protection and improvement measures on Federal lands. No attempt was made to estimate the effects of other possible policy changes (for example, river flow augmentation, commercial harvest restriction, and reduction in recreational access).

Besides a traditional analysis using a conventional, demand-driven fixed-price model,[2] this study also presents results obtained by using flexible-price, computable general equilibrium (CGE) models of the regional economy. These models provide several advantages over more conventional regional models. The structure of a CGE model is more consistent with neoclassical economic theory and flexible enough to incorporate factor and commodity substitution into the structure of production and demand.

A Profile of the Northeast Oregon Regional Economy

The following discussion is based largely on data obtained from the Regional Economic Information System (REIS) of the Bureau of Economic Analysis (BEA). The data describe the regional economy of Baker, Grant, Union, Umatilla, and Wallowa Counties in northeast Oregon from 1969 to 1992. The region contains no metropolitan counties and is economically related to larger urban centers in Lewiston, Idaho, and Walla Walla, Washington.

More than 116 thousand persons presently reside in the five-county, northeast Oregon region. From 1969 to 1992, regional population grew from roughly 92,200 to 116,100 persons (table 3). The number of full- and part-time jobs increased from roughly 41,100 in 1969 to 59,800 jobs in 1992.

According to our estimates for 1992, full- and part-time employment in agriculture and agricultural processing was 13,373 jobs (table 2). The corresponding employment figure for the logging and woods products industry was 4,101 jobs. Agriculture and agricultural processing contribute 22.4 percent of total jobs, whereas lumber and wood products constitute 6.9 percent of total jobs. Combining the two industries, we find that 29.3 percent of total jobs in the region are in traditional natural resource-based industries. By any measure, resource-based industry is important to the region. In the cases of cattle production and logging and wood products industries, much of the resource base is held as public lands. Behind these aggregate figures, however, stands a dramatic, ongoing transformation of the regional economy.

We are especially interested in establishing the current economic baseline for this economy and reviewing structural changes that have characterized this economy over the last two decades. As we move into the future, it will be important to understand the past and the implications of that past for future patterns of economic development.

Sources of Personal Income

Personal income as defined by the BEA comes from five different sources: (1) employee compensation, (mainly wages and salaries); (2) interest, dividends, and rent (income derived from property ownership); (3) transfers (mainly social security and medicare payments); (4) proprietor income (income to self-owned businesses and farms); and finally (5) adjustments to account for people who receive income in the area but do not live there (for example, commuters). The relative contribution of each of these components to personal income is summarized in table 4.

The major components of earned income are employee compensation and proprietor income. In 1969, employee compensation made up 56.47 percent of total personal income. By 1992, the share had declined to 49.6 percent. In 1969, proprietor income contributed 21.16 percent of total personal income, 44 percent from farms and 56 percent from nonfarm sources. By 1992, the contribution of proprietor income to personal income had declined to

[2] For example, input-output (IO), economic base, and social accounting matrix (SAM) models. These types of models produce constant, marginal multipliers (that is, invariant of the size of the economic shock) by assuming that factor (labor and capital) supply constraints are nonbinding; and that factor demand ratios, commodity supply proportions, and all prices are fixed. Multipliers derived from fixed-price models generally can be described as providing an upper bound on the amount of economic impact resulting from an exogenous demand shock.

Table 4—Components of per capita personal income over time for northeast Oregon[a]

Personal income category	1969	1974	1979	1984	1989	1990	1991	1992
				Current dollars				
Employee compensation per capita	1,922	2,782	4,636	5,478	6,913	7,482	7,742	8,092
Dividend interest and rent per capita	409	688	1,194	2,009	2,435	2,466	2,407	2,399
Transfers per capita	365	751	1,223	2,008	2,735	2,985	3,276	3,548
Proprietors per capita	720	1,439	1,150	1,374	2,040	1,823	1,933	2,005
Residence adjustment per capita	-12	45	260	243	247	264	263	286
Personal income per capita	3,403	5,705	8,462	11,112	14,369	15,021	15,622	16,329
				Percent				
Employee compensation	56.47	48.76	54.78	49.30	48.11	49.81	49.56	49.55
Dividends, interest and rent	12.03	12.07	14.11	18.08	16.95	16.42	15.41	14.69
Transfers	10.71	13.17	14.45	18.07	19.03	19.88	20.97	21.73
Proprietors	21.16	25.22	13.59	12.37	14.20	12.14	12.38	12.28
Residence adjustment	-.37	.78	3.07	2.18	1.72	1.76	1.69	1.75
Total percent	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

[a] Northeast Oregon = Baker, Grant, Umatilla, Union, and Wallowa Counties.

Source: Bureau of Economic Analysis, Regional Economic Information System, U.S. Department of Commerce, 1969-92.

Table 5—Transfer payments over time for northeast Oregon[a]

Transfer payment category	1969	1974	1979	1984	1989	1990	1991	1992
				Current thousand dollars				
Retirement and disability insurance benefit	20,902.0	45,439.0	84,076.0	141,695.0	172,305.0	186,536.0	201,275.0	213,747.0
Medical payments	3,628.0	7,797.0	19,178.0	40,322.0	71,190.0	82,387.0	95,117.0	106,395.0
Income maintenance benefits	1,628.0	5,319.0	9,961.0	15,303.0	22,071.0	24,721.0	28,937.0	32,766.0
Unemployment insurance benefit	1,621.0	5,070.0	6,553.0	15,023.0	13,687.0	16,581.0	21,893.0	28,100.0
Veterans benefits	3,387.0	5,899.0	7,539.0	9,061.0	9,558.0	9,891.0	9,785.0	10,519.0
Federal education and training assistance	72.0	291.0	1,167.0	2,268.0	3,702.0	3,764.0	3,529.0	3,897.0
Other payments to individual	65.0	379.0	716.0	359.0	427.0	553.0	507.0	696.0
Total government payments to individuals	31,379.0	70,284.0	129,275.0	224,075.0	293,006.0	324,519.0	361,095.0	396,131.0
Payments to nonprofit institutions	1,484.0	2,037.0	4,555.0	5,647.0	6,699.0	6,973.0	8,015.0	8,790.0
Business payments to individuals	753.0	1,249.0	2,878.0	4,816.0	6,569.0	6,761.0	6,601.0	6,980.0
Total transfers	33,616.0	73,570.0	136,708.0	234,538.0	306,274.0	338,253.0	375,711.0	411,901.0
Population (thousands)	92.2	97.9	111.8	116.8	112.0	113.3	114.7	116.1
Transfers per capita ($)	365.0	751.0	1,223.0	2,008.0	2,735.0	2,985.0	3,276.0	3,548.0

[a] Northeast Oregon = Baker, Grant, Umatilla, Union, and Wallowa Counties.

Source: Bureau of Economic Analysis, Regional Economic Information System, U.S. Department of Commerce, 1969-92.

12.28 percent, 23 percent of which was from farm and 77 percent from nonfarm sources.

Two major trends emerge from examination of regional earnings data: (1) growth in wage, salary, and proprietor income has not kept pace with growth in transfer and property income;[3] and (2) farm income has declined from roughly one-half of proprietor income in 1969 to roughly one-fourth of proprietor income in 1992.

Probably the most striking feature of the structural change in personal income in the region is the tremendous growth in transfer income (table 4). Transfers grew from 10.71 percent of personal income in 1969 to 21.73 percent of personal income in 1992. Transfers were the fastest growing component of personal income, increasing twelvefold over the period (in unadjusted terms). Per capita transfers increased from $365 in 1969 to $3,548 in 1992, a nearly tenfold increase. By comparison, total per capita personal income increased less than fivefold over the same period.

The components of transfer income are displayed in table 5. In 1992, most of the transfers were retirement and disability insurance benefits and medical payments. These two components make up nearly 78 percent of total transfer income to the region. In 1992, income maintenance benefit payments (the welfare part of transfers) were $32.7 million, 7.9 percent of total transfers. The other major component of transfer income is unemployment insurance benefits that constituted 6.8 percent of the total.

Transfers have become the second most important source of income in the region (after employee compensation), and thus, should be viewed as a vital part of the new economic base of the region. The main components of transfer income are those received by retired persons who settle in the region and bring with them a significant amount of transfer and other property income.

Although not as dramatic as the trend in transfer income, income from dividends, interest, and rent also is significant. The portion of personal income from these sources increased from 12.03 percent in 1969 to 14.69 percent in 1992 (table 4). On a per capita basis, the portion accounted for by dividends, interest, and rental income grew nearly sixfold from $409 in 1969 to $2,399 in 1992.

We are not able to distinguish property income originating from within the region from that originating outside the region. We suspect, however, that the portion coming from outside has increased with the increasing attraction of the region as a vacation and retirement destination. Thus, property-type income also must be viewed as a part of the new economic base. Like transfer income, it will be an important determinant of the direction of economic change in the future. In 1992, transfer income and property-type income combined to make up 36 percent of total personal income in northeast Oregon.

Sources of Employment

Several features of the change in the structure of regional employment are worth reviewing. Employment growth by all levels of government did not keep pace with private sector employment growth. In 1969, government employment made up 24 percent of total nonfarm employment. By 1992, the share declined to 22 percent (table 6).

The major structural change in private sector employment was the growth in service-sector employment to the exclusion of nearly all other sectors. In 1969, service employment made up 23 percent of private nonfarm employment in the region. In 1992, service employment made up 30 percent of private nonfarm employment. The number of service jobs more than doubled from 5,996 jobs in 1969 to 12,335 jobs in 1992 (table 6).

In relative terms, job opportunities in manufacturing increased the least of the various employment sectors. Although manufacturing jobs increased from 6,292 in 1969 to 8,506 in 1992, these jobs declined as a percentage of total jobs in the region. In 1969, manufacturing accounted for 24 percent of total private sector jobs. In 1992, jobs in manufacturing declined to 20 percent.

Our final observation regarding regional employment trends concerns proprietors, (that is, self-owned businesses and farms), an economic

[3] This is true for most rural Oregon counties.

Table 6—Sectoral composition of employment over time for northeast Oregon[a b]

Employment category	1969	1974	1979	1984	1989	1990	1991	1992
				Number of jobs				
Private nonfarm employment:								
Agricultural services and other ANR[c]	534	708	783	935	1,205	1,231	1,336	1,308
Mining	109	142	180	68	146	181	159	153
Construction	1,391	1,643	2,284	1,781	1,600	1,838	1,878	1,810
Manufacturing	6,292	6,854	8,716	7,915	8,191	8,681	8,642	8,506
Transportation and public utilities	2,376	2,701	3,298	2,982	3,187	3,291	3,268	3,285
Wholesale trade	1,212	1,419	2,030	1,869	2,087	2,165	2,068	2,212
Retail trade	6,252	7,303	9,058	8,746	9,471	9,446	9,528	9,637
Finance, insurance and real estate	1,938	2,208	2,963	2,784	2,533	2,491	2,486	2,494
Services+	5,996	6,963	8,820	9,601	10,818	11,437	12,005	12,335
Total private nonfarm employment	26,112	29,951	38,140	36,904	39,250	40,764	41,374	41,739
Government employment:								
Federal, civilian	1,970	1,534	2,027	2,005	2,258	2,334	2,240	2,402
Military	553	554	494	569	561	554	552	542
State and local	5,702	6,604	7,369	7,075	8,025	8,325	8,480	8,592
Total government employment	8,225	8,692	9,890	9,649	10,844	11,213	11,272	11,536
Total nonfarm employment	34,337	38,643	48,030	46,553	50,094	51,977	52,646	53,275
Farm employment	6,756	7,106	6,539	6,783	6,955	7,169	6,998	6,493
Total employment	41,093	45,749	54,569	53,336	57,049	59,146	59,644	59,768

[a] Full- and part-time employment.
[b] Northeast Oregon = Baker, Grant, Umatilla, Union, and Wallowa Counties.
[c] ANR = Agriculture and natural resources.

Source: Bureau of Economic Analysis, Regional Economic Information System, U.S. Department of Commerce, 1969-92.

sector in which another major change is evident. From 1969 to 1992, the number of farm proprietors declined slightly from 4,469 to 4,393 (table 7). In the same period, the number of nonfarm proprietors grew from 5,937 to 10,774. Farm proprietors have been relatively constant, whereas the number of nonfarm proprietors has nearly doubled. The result is that proprietor employment and income is now dominated by nonfarm business. This was not the case two decades ago.

Summary of Regional Trends

Firms will remain under pressure to control labor costs to remain competitive. This will involve recent labor market trends such as capital-labor substitution, corporate downsizing, and more competition for good jobs. Much of future job growth is likely to go to proprietors (self-owned business) rather than wage labor jobs. For example, from 1989 to 1992, the number of wage and salary jobs grew

Table 7—Characteristics of regional employment over time for northeast Oregon[a b]

Employment category	1969	1974	1979	1984	1989	1990	1991	1992
				Number of jobs				
Total proprietors:	10,406	11,129	12,023	13,535	13,978	14,186	14,815	15,167
Farm	4,469	4,304	3,851	4,353	4,377	4,293	4,336	4,393
Nonfarm	5,937	6,825	8,172	9,182	9,601	9,893	10,479	10,774
Total wage and salary employment	30,687	34,620	42,546	39,801	43,071	44,960	44,829	44,601
Total employment	41,093	45,749	54,569	53,336	57,049	59,146	59,644	59,768

[a] Full- and part-time employment.
[b] Northeast Oregon = Baker, Grant, Umatilla, Union, and Wallowa Counties.

Source: Bureau of Economic Analysis, Regional Economic Information System, U.S. Department of Commerce, 1969-92.

by 1,530 jobs. Over the same period, the number of proprietors grew by 1,189, almost exclusively in nonfarm businesses (table 7). It also seems likely that the growth of relatively high-paying wage labor jobs will be limited, especially in sectors producing highly competitive tradable goods.

The reduction in communication cost brought about by computers and satellites favors relatively remote regions like northeast Oregon. Some businesses, professionals, and proprietors that were formerly unable to locate in the region may now find it profitable to do so. Examples include firms providing producer services, a component of the services sector in table 6. The service sector is usually thought of as a nonbasic sector with sales mainly to the local population. Although this is true of many service businesses, it is also true that selected service firms do export most of their services outside the region. Examples are tourist-oriented and producer service businesses. The communication revolution has opened the location decision for export-oriented services. Many of these businesses are choosing to locate in high-amenity regions. It is likely that such firms will become an even more important part of the northeast Oregon economy in the future.

High-amenity value also is attractive to those seeking recreation and retirement destinations. The abundant natural amenities of the region are becoming increasingly well known and appreciated. As more people take advantage of these attractions, we expect to continue to see an increase in the proportion of transfer and property income in the region.[4]

The Issue of Regional Economic Base

Although we have previously referred to the term "economic base," we will here broaden our discussion of this key concept. Economic base (or export base) theory conceptually divides a regional economy into "basic" and "nonbasic" activities, postulating a causal relation between the two. A basic activity is one that creates an inflow of money in return for goods and services sold to buyers outside the region (that is, "exported"). Regional economic activities that are traditionally counted as basic include the extractive industries (agriculture, mining, forestry, and fishing) and all primary and secondary manufacturing.

Export dollars received by basic activities are used to purchase productive inputs of goods and services, including labor. The degree to which these goods and services are supplied by regional producers and households determines the amount of nonbasic activity in the region. It is assumed that nonbasic activity is induced, and therefore, could not exist without basic activity. Traditional nonbasic sectors include most services, retail trade, and state and local government functions.

Multipliers are calculated as the ratio of total activity (that is, basic plus nonbasic) to basic

[4] The future growth of transfer income also will depend on the outcome of the current political debate in Congress.

activity. In practice, estimates of industry employment and payroll generally are used as indicators of regional economic activity. Thus, an economic base employment multiplier can be interpreted as calculating the total number of jobs generated by an increase in export sales sufficient to require the addition of one job in a regional basic industry.

Although useful in understanding how regional economies work, the concept of economic base has been subject to some criticism and much discussion over the years. Critics point out that the static nature of the hypothesized relation between basic and nonbasic sectors fails to accommodate structural changes that characterize a developing economy. Also, the linear relation between basic and total activity is assumed invariant relative to the magnitude and direction of the change. Thus an employment multiplier of 2.0 would be used to predict an increase of 20 total jobs in response to the addition of 10 basic jobs, and a loss of 2,000 total jobs in response to the elimination of 1,000 basic industry jobs.

A more fundamental criticism concerns the definition of basic activity. At the national level, balance of trade statistics are kept. These include accounts of international flows of goods, services, and finances. There is no authoritative accounting of transboundary (that is, exports and imports) flows, however, from subnational regions. Consequently, it is necessary to estimate the contribution of the activities of various industries to the economic base of a region. Generally, this is done either by the simple assignment method, in which all manufacturing and resource-based activity is defined as basic, or the location quotient method in which a basic industry provides a greater proportion of regional employment than is true of that industry at the national level. Both of these methods can create serious errors in the estimates of the export base, especially if the structure of regional production and consumption is different than the national average. **Also, neither method accounts for the growing prevalence of self-employed activity, the emergence of nonmanufacturing exports (for example, producer services), or the increasing importance of transfer and property-type income.**

Lately, the question of what activities constitute Oregon's economic base has received much attention. Until recently, the answer seemed obvious: lumber and wood products industries claimed a major share of employment, income, and export sales of most counties. Links with forestry, logging, transportation, and secondary wood products industries, as well as substantial industry payrolls, ensured that growth in wood products had significant multiplier impacts on regional economies. The almost pervasive nature of employment in wood products is also key. Mills have traditionally located near major timber sources, often providing the main employment in small towns and rural areas.

In a recent paper, Beuter (1995) reported that in 1990, wood products industries provided more than one-third of Oregon's economic base, with forestry, fisheries, agriculture, and food processing contributing another one-third. According to Beuter, in eastern Oregon the contribution of wood products was less, about one-quarter, with forestry, agriculture, and food processing contributing more than 50 percent of the economic base of the region. High-technology manufacturing, much touted as the foundation of Oregon's economic future, comprised about 11 percent of the economic base of the Portland metropolitan region but less than 1 percent of the economic base statewide. Beuter's analysis stresses the importance to the State economy of maintaining a viable wood products industry. He also doubts whether high-technology manufacturing will ever become significant outside the Interstate 5 corridor because of its locational requirements, which differ from those of the timber industry.

Beuter used 1990 location quotients to estimate export base indices and defined basic activities in a limited way, which tends to exaggerate the importance of resource-based industries. His analysis thus overestimates the current importance of wood products relative to other components of the regional economy. As evidence, consider that since 1990, Oregon wood products employment lost more than 10,000 jobs, whereas total employment in the State increased by more than 50,000 jobs. Also between 1990 and 1994, Oregon's exports to foreign countries increased 40 percent. This was largely due to dramatic increases in high technology and agri-

culture sales, whereas foreign exports of lumber and wood products remained about constant.

Although these aggregate numbers ignore the important geographical aspects of the employment shift, they do indicate a trend that is not predicted by a simple economic-base approach. A major problem with standard economic base analysis is that it excludes "nontraditional" components of regional economic base. For example, in 1992, combined transfer and property-type income contributed 36 percent of total personal income in northeast Oregon. Most of this is derived from sources outside the region. Federal Government spending is another important source of outside income often overlooked by standard economic-base analysis. Dollars from these outside sources directly finance a large portion of industry purchases, household consumption, and local government activity, and thus, should properly be included in the regional economic base.

Economic-base models provide a useful framework for conceptualizing economic links in a regional economy. Apparent shortcomings, however, can severely restrict our ability to formulate relevant prescriptions for public policy and economic development. One alternative is to use IO or SAM-based models. These fixed-price models provide internally consistent representations of regional economic structure but under restrictive assumptions (for example, fixed-proportion production functions, unconstrained factor and commodity supplies, and fixed or price-inelastic demand for goods and services). Ideally suited to estimating the impact of changes in final demand, fixed-price models are severely limited in their applicability to supply-side issues. A more efficient approach, using regional CGE models is described below.

Natural Resource Constraints and Regional Economic Analysis

For examples of innovative uses of fixed-price models to analyze the impacts of natural resource constraints, the reader is referred to Petkovich and Ching (1978) (mining), and Waters and others (1994) (timber). Examples of CGE applications to resource policy issues can be found in Despotakis and Fisher (1988) (petroleum) and Berck and others (1991) (water).

In the Pacific Northwest, several recent studies have used fixed-price (constant multiplier) methods to estimate impacts resulting from implementation of hypothetical salmon recovery plans. To our knowledge, there has been no comparable flexible-price analysis of this issue.

Aillery and others (1994) examine direct and total impacts resulting from flow modifications on the Snake River to facilitate downstream migration of salmon. They estimate that reduced irrigation capacity could reduce agricultural employment in the Upper Snake River basin by 2,500 jobs and total employment by 4,100 jobs.

Haynes and others (1992) compare the costs associated with implementing salmon recovery measures on National Forest land in the Columbia and Snake River basins with impacts of eliminating timber, range, and recreation programs in sensitive anadramous habitat areas. The authors conclude that even under their worst case scenario, any resulting job losses would seem minor spread over the entire region, but would be significant in certain localities. Job loss resulting from reduced timber availability in the Umatilla and Wallowa-Whitman National Forests is estimated at between 94 and 925 jobs, depending on availability of private log supplies.

In a later study, by using similar methods, Bolon and others (1994) compare incremental costs of adopting the proposed interim PACFISH[5] strategy on affected anadramous fish habitat with estimates of foregone sales if timber, range, and recreation programs on Western public lands were eliminated. Their baseline scenario includes any de facto restrictions on logging, grazing, and recreation activities resulting from recent legal and administrative actions. Consequently, the additional costs of implementing PACFISH seem minor compared with the value of timber and recreation programs on Federal lands. It seems, however, that the costs incurred in implementing the guidelines on public range may exceed the value of the Federal grazing program, particularly on BLM land. No esti-

[5] Comprehensive strategy for improved Pacific salmon and steelhead habitat management developed by the USDA Forest Service in 1992-93. PACFISH specifies riparian management objectives to assure maintenance or restoration of fish habitat.

mate of regional employment or income impacts was provided.

A detailed study by Robison and Freitag (1994) presents estimates of job and earnings impacts resulting from timber supply reductions in the three Oregon counties associated with the Wallowa-Whitman National Forest. The authors used nine community-level, economic-base models to derive employment and earnings response assuming a 56-percent (-167 MMBF) reduction in available log supplies and a particular geographical distribution of mill cutbacks and closures. In aggregate, they estimate that the three-county region would lose 1,943 jobs accounting for $56 million in earnings. The authors estimate it would take a fourteen-fold increase in recreation activity to replace these lost jobs, or a twenty-eightfold increase to replace lost earnings.[6] Finally, Robison and Freitag emphasize the uneven distribution of local economic impacts. They estimate that Union County would lose 15 percent of earnings and 13 percent of jobs, with the community of North Powder losing 70 percent of its employment. Wallowa County would lose 11 percent of earnings and 13 percent of jobs, with the communities of Wallowa and Joseph each losing more than 40 percent of their job base.

Obermiller[7] examined impacts of the range restrictions by using an updated, survey-based, IO-type model of the Wallowa County economy (Obermiller and West 1983). He assumes that the direct effect of closing the Wallowa-Whitman National Forest to livestock grazing would reduce the cattle herd by 38 percent. Total impacts resulting from the closure include a $2.5 million (42 percent of 1981 baseline) reduction in cattle sales, $6.3 million (2.8 percent of 1981 baseline) reduction in total regional sales, and $1.25 million (2 percent of 1981 baseline) reduction in local household income.

Niemi and others[8] estimated economic impacts of legal restrictions on public grazing. They juxtapose the relatively small localized impacts of the grazing restrictions against the backdrop of a diverse, 13-county economy spread across parts of three states (Oregon, Washington, and Idaho). The authors offer severe criticism of Obermiller's results but do not provide quantitative counter estimates. They predict that "for the region as a whole, the positive impacts of the injunction should outweigh the negative ones, especially in the long run." Niemi and others (1994) emphasize the inherent dynamism of this regional economy, stating that economic growth is being driven by population growth, which is strongly linked to quality of life and natural environmental amenities. Traditional resource-based industries, which tend to consume or alter these natural amenities, are shrinking and have become relatively unimportant as a source of regional growth. These themes are supported by both Power[9] (1995) and Rasker (1995).

Also, the cost estimates associated with salmon recovery efforts reported above should be placed in proper perspective against the potential gains. Radtke and Davis[10] (1995) estimated the annual state-level economic contribution of a fully restored salmon run (10-16 million fish) at $136 million to $273 million in exvessel sales, providing 13,000 to 25,000 total jobs and $254 million to $507 million personal income state-wide.

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[6] The basis for this calculation, however, seems curious given their description of the regional export base in which tourism was estimated to generate 4 percent of earnings in the three-county region.

[7] Obermiller, F. 1994. The local monetary costs of closure of the Wallowa-Whitman National Forest in Wallowa County, Oregon, to domestic livestock grazing; report to the Wallowa County Court. On file with: Fred Obermiller, Oregon State University, Department of Agricultural and Resource Economics, Corvallis, OR 97331-3601.

[8] Niemi, E.; MacMullan, E.; Whitelaw, E. 1994. Economic consequences of an injunction to protect salmon habitat on the Wallowa-Whitman and Umatilla National Forests; report prepared for Pacific Rivers Council. On file with: ECO Northwest, 99 W. Tenth St., Suite 400, Eugene, OR 97401. (Note: The Pacific Rivers Council is the lead plaintiff in the lawsuit that brought the Ninth Circuit US Court injunction restricting grazing in the Umatilla and Wallowa-Whitman National Forests).

[9] Power, T. 1995. Economic well-being and environmental protection in the Pacific Northwest. Unpublished report. On file with: University of Montana, Economics Department, Missoula, MT 59812.

[10] Radtke, H.; Davis, S. 1995. An estimate of the asset value for historic Columbia River salmon runs; report prepared for the Institute for Fisheries Resources. On file with: Hans Radtke, P.O. Box 244, Yachats, OR 97498.

The Northeast Oregon CGE Model

A regional CGE model consists of a system of equations representing the equilibrium behavior of factor and commodity markets and other relevant economic institutions. The system can simulate economic response to changes in various policy, management, and behavioral variables. A key feature is the inclusion of relative prices that reflect the economic scarcity of all commodities and productive factors in the model. Endogenous prices adjust until factor and commodity market equilibrium conditions are satisfied. Compared with fixed-price models, the CGE method is more consistent with modern economic theory, allows greater flexibility in the specification of economic behavioral relations, and generally produces more moderate estimates of economic impact.

Implementing a regional CGE model does not require a priori designation of an economic base. Basic activity is not necessarily limited to a few traditional manufacturing sectors. In a CGE model, economic change is governed by supply-side (for example, available quantities of productive goods and services) and trade-related constraints, rather than by backward links transmitted via changes in final demand. Also, because the opportunity to substitute among resource inputs is subject to diminishing returns in a CGE model, measures such as employment multipliers are variable depending on the level of resource inputs.

Figure 1 traces the basic steps of a regional CGE modeling effort. First, data are collected, organized, and reconciled into a benchmark equilibrium data set (the social accounting matrix).[11] Next, behavioral and accounting relations are specified, and the model parameters are calibrated given the benchmark data. Finally, the policy-change scenarios are introduced, and counterfactual equilibria representing the situation under the new policy regimes is calculated. Impacts are estimated by comparing the counterfactual equilibria against the benchmark scenario.

[11] The data set for the northeast Oregon CGE was assembled mainly from IMPLAN-generated regional product accounts, state of Oregon tax and expenditure data, and REIS county income and employment estimates. Timber harvest estimates (Oregon Department of Forestry) and livestock grazing statistics (Bedell 1984, Bedell and Stringham 1984, Hewlett and others 1987) also were used to estimate benchmark resource flow levels.

Structure of the Northeast Oregon CGE Model

Allocation of all resources and commodities in the northeast Oregon CGE model is a function of economic scarcity as reflected by the relative prices of all goods, services, and productive factors. Thus, price variables assume a preeminent role in the model. Key determinants of relative prices include (1) factor supply and production constraints; (2) ability of regional consumers to substitute among alternative sources of commodity supply (that is, regional industrial supply, regional nonindustrial supply, and imported supply); (3) ability of regional producers to supply alternative markets (that is, regional versus outside the region, or "export"); and (4) demand conditions affecting regional and export markets.

Figure 2 traces the links among components of the regional CGE model.[12] First, value is added to inputs of labor, services of proprietors, and capital via linearly homogeneous Cobb-Douglas production functions, and combined with intermediate inputs to produce output for each sector (X). Behavioral assumptions ensure that producers maximize economic returns by equating the marginal factor cost with the value of the contribution of each factor to marginal product.

Each unit of X is either sold to local buyers (XXD) or exported outside the region (E). A constant elasticity transformation function (CET) governs the ease with which regional producers can switch between regional and export market destinations. Revenue maximizing behavior by producers determines the proportion of output supplied to satisfy regional demand versus export markets. Export demand is assumed to be perfectly elastic (that is, world commodity prices are fixed), whereas regional demand is influenced by endogenous price and income effects.

[12] A list of variables, parameters and equations, and detailed descriptions of the CGE and fixed-price models are available on request.

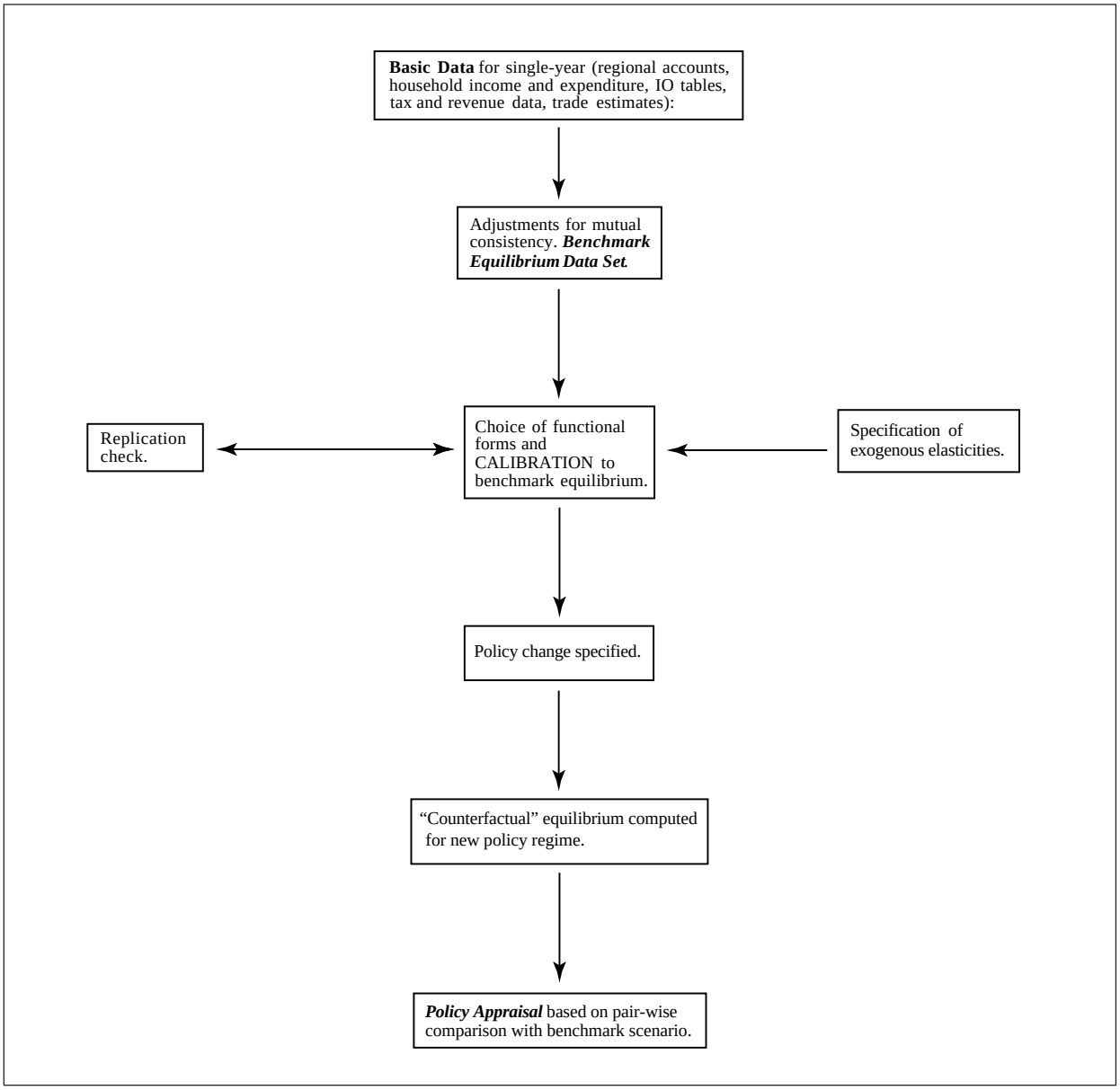

Figure 1—Flowchart of CGE modeling procedures.

Commodities produced for regional use (XXD) are combined with available nonindustrial supplies (GS, "government sales") to form total aggregate supply from regional sources (XD). This aggregation occurs via a constant elasticity substitution (CES) function. The treatment of government supplies as imperfect substitutes for private supplies in generating total regional commodity supply illustrates the flexibility of the regional CGE framework. In constructing the analysis for this paper, we imposed quantity restrictions on government supplies of logs and grazing.[13] Regional supply (XD) is, in turn, combined with competitive imports (M) via a CES aggregation to form a composite absorption good (or service) for each class of commodity (Q). The role of the nested CES functions is to allow partial substitution of public for private

[13] By using this framework, we also could have examined the potential impact of public grazing or logging fee (price) changes as an alternative policy.

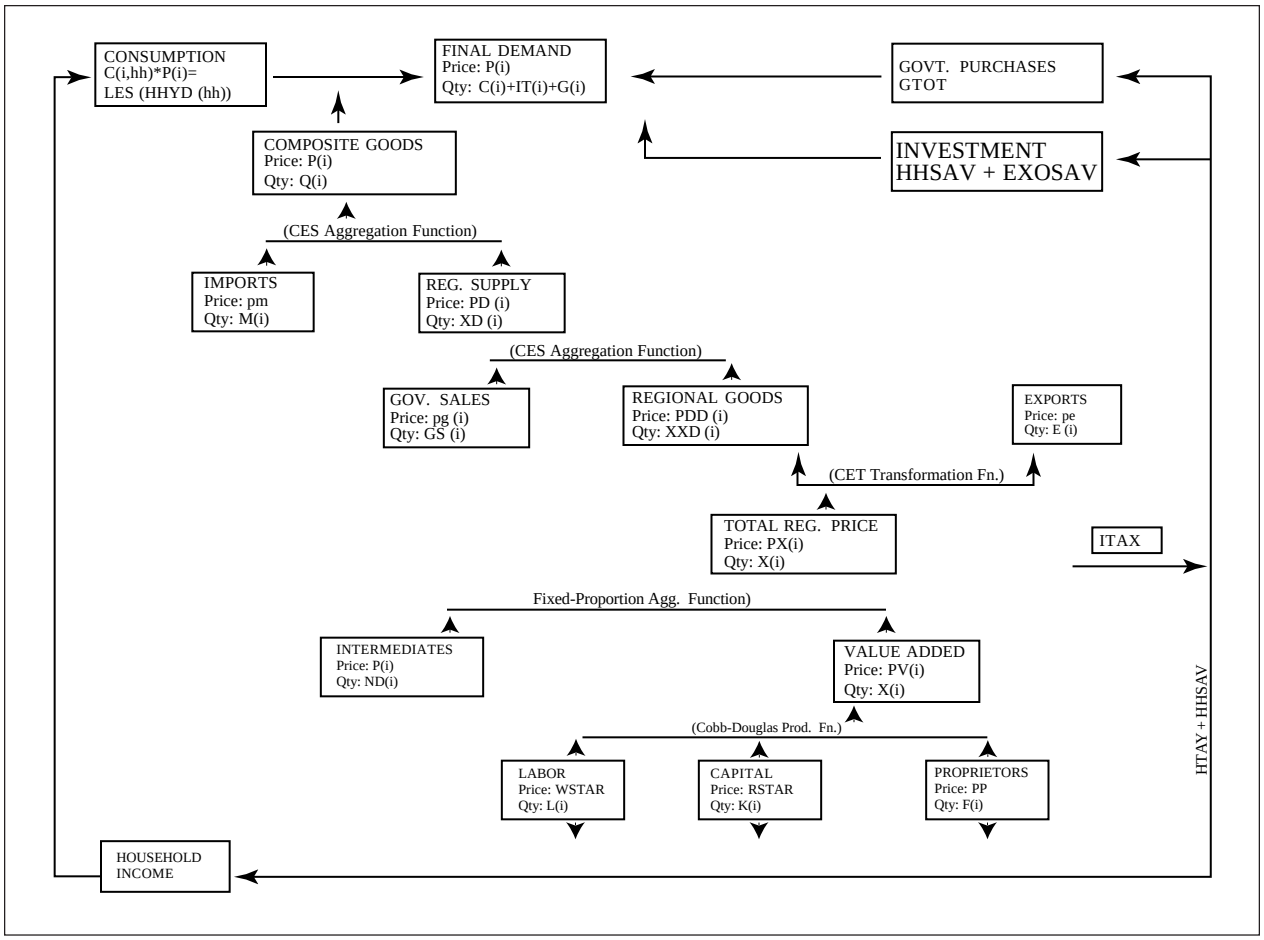

Figure 2—Schematic of the northeast Oregon CGE model.

(and imported) sources of logs and forage.[14] Expenditure minimization at both stages of aggregation determines substitution between XXD and GS, and between XD and M, respectively. The use of CET and CES functions in the model accommodates the observed phenomenon of "crosshauling" in which simultaneous imports and exports appear in highly aggregated commodity classifications.

Total supply of Q supports intermediate demand (ND) and final demand for consumer goods (C), investment needs (IT), and government purchases (G). In this model, all spending by local agencies of Federal, State, and local government is fixed at baseline levels. Any reduction in revenues from taxation or government sales are assumed to be offset by transfers from other sources (that is, State and Federal Government).[15] Consumption by each of three household income classes is driven by changes in endogenous factor incomes and relative commodity prices. Finally, business investment spending can be treated as either exogenous or endogenous, depending on the model specification and implied length of run.

Resource Shock Scenarios

The baseline for this study is the aggregate estimated economic structure of the five-county, northeast Oregon region in 1992. All direct-impact scenarios are measured as reduc-

[14] This treatment contrasts with a fixed-price analytical approach in which the relative proportions of inputs from public, private, and imported sources is assumed to be fixed.

[15] Although this assumption may tend to underestimate the extent of regional economic adjustment, it is not unreasonable given the currently changing relation between state and local fiscal responsibilities.

tions in resource supply relative to the 1992 baseline. It can be argued that in anticipation of de facto or perceived changes in resource management policy, considerable adjustment already has occurred. Thus, using 1992 as the base year will tend to overestimate the actual impact of a future policy shift. It is also useful, however, to view the effects of a major shift in public policy and attitude against the backdrop of a real level of resource use in the recent past. Whether this level of resource use was sustainable in the longer term or would have been reduced for other reasons (for example, forest health, fire) is an important question but one that is not directly addressed here. Positive impacts associated with the expected improvement in salmon spawning and migration success (for example, commercial and recreational fishing) are not directly considered here.[16]

The main scenarios examined are as follows:

1. Moderate resource shocks:
   A. A 25-percent reduction in Federal grazing animal unit months (AUMs)
   B. A 50-percent reduction in logging on Federal lands

2. Severe resource shocks:
   A. A 99-percent reduction in Federal grazing AUMs
   B. An 80-percent reduction in logging on Federal lands

Each scenario is examined by using fixed-price IO and flexible-price CGE methods. The CGE model results also are examined under different assumptions regarding the length of time over which economic adjustment occurs. This is done by assuming differing mobility of primary factors (labor, proprietors, and capital) as follows:

- Short run (1-2 years):
- Only labor is able to adjust. Workers who have been laid off remain in the region and receive an average unemployment benefit.
- Intermediate run (2-5 years):
- Unemployed labor leaves the region. Proprietors can move into other businesses but do not leave the region.
- Long run (5-10 years):
- Unemployed labor and unprofitable proprietors are able to leave the region.

In all three CGE formulations, sectoral (that is, "corporate") capital is assumed to remain fixed at baseline levels. In the CGE models, the resource shocks are implemented as proportional reductions in the baseline availability of GS commodities. Thus, the direct impacts of resource supply shocks are treated as supply-side phenomena. This treatment has logical appeal and also is consistent with neoclassical economic theory.

A key feature of the CGE models is the ability to substititute among public, private, and imported sources of logs and livestock forage via CES aggregation functions as described in the previous section. The ease of substitution is determined by exogenously specified elasticities and endogenous variation in the relative cost of inputs obtainable from the three alternative sources of supply. An implication of the constant elasticity specification used here is that, because of the law of diminishing returns, relatively small shifts in the availability of alternative supplies are much more easily accommodated than are major shifts. In practice, we have assumed that the substitution of private or imported logs and forage to replace reduced public supplies is difficult because of high transportation costs, seasonal grazing constraints, and the length of time necessary to alter timber growth and harvest rotations.[17]

In contrast to the CGE models, fixed-price models regard all factor supplies as interregionally and intersectorally elastic by holding all commodity and factor prices fixed. Constant multipliers result from the assumption of fixed proportion, column-normalized expenditure coefficients.[18] The magnitude of these multipliers reflects the strength of backward links in the regional economy.

[16] Enhancement of environmental amenities under stricter land use policies, however, may be responsible for some of the positive impacts illustrated in the next section (economic counter scenarios).

[17] This assumption also would result in larger estimates of economic impact in response to a reduction in resource supplies than would a less restrictive assumption.

[18] In the fixed-price model used for this study, factor incomes and household expenditures also are assumed endogenous.

Table 8—Results: comparative aggregate employment impacts

Shocks	Model configuration			
	Short run	Medium run	Long run	Fixed price
	Change in number of jobs			
Range shocks:				
Moderate (-25 percent)—				
Range and livestock	-9	-32	-29	-236
Other	-3	37	-12	-72
Total	-12	5	-41	-308
Employment multipilier	1.33	-.16	1.41	1.31
Severe (-100%)—				
Range and livestock	-516	-1,313	-1,036	-947
Other	-78	1,366	-335	-290
Total employment change	-594	53	-1,371	-1,237
Employment multiplier	1.15	-.04	1.32	1.31
Logging shocks:				
Moderate (-50 percent)—				
Logging and wood products	-928	-1,141	-1,138	-1,246
Other	-300	-359	-628	-914
Total	-1,228	-1,500	-1,766	-2,160
Employment multiplier	1.32	1.31	1.55	1.73
Severe (-80 percent)—				
Logging and wood products	-1,786	-2,118	-2,115	-1,993
Other	-580	-681	-1,214	-1,460
Total employment change	-2,366	-2,799	-3,329	-3,453
Employment multplier	1.32	1.32	1.57	1.73

The fixed-price specification embodies traditional behavioral assumptions and procedures regarding regional economic systems. Consequently, the resource supply shocks are modeled as "equivalent" reductions in exogenous demand for the output of the directly impacted industrial sectors. Although this approach is logically less appealing and less consistent with modern notions of microeconomic behavior, arguably reasonable results can be generated given careful construction of the direct-shock scenario. There are also several supply-side fixed-priced modeling techniques described in the literature that allow a more consistent treatment of the direct-shock scenario but usually at the cost of adopting even more questionable assumptions regarding the behavior of regional economic systems.

Results

Results obtained under each scenario by using CGE and IO methods are presented below. For each shock scenario, CGE model results under the three length-of-run assumptions (short run, intermediate run, and long run) are presented first, followed by results obtained by using the IO model. Aggregate employment results also are displayed in table 8. Income and revenue results are summarized in table 9.[19]

[19] More detailed sectoral results for other variables in the model are available on request.

Table 9—Results: comparative aggregate income and revenue impacts

Shocks	Model configuration			
	Short run	Medium run	Long run	Fixed price
Range shocks:		*Million dollars*		
Moderate (-25 percent)—				
Household income				
Low income households	-0.006	+0.019	-0.030	-0.240
Medium income householuds	-.130	-.052	-.489	-3.390
High income households	-.143	-.186	-.470	-3.220
Total change in household income	-.279	-.220	-.989	-6.850
State local government revenues:				
Range fees	-.093	-.093	-.093	
Other revenues	-.035	-.009	-.094	
Total change in government revenue	-.128	-.102	-.187	
Severe (-100 percent)—				
Household income				
Low income households	-.217	+.688	-.914	-.960
Medium income households	-4.891	-1.083	-14.541	-13.610
High income households	-5.450	-5.897	-13.993	-12.940
Total change in household income	-10.558	-6.292	-29.448	-27.510
State and local government revenues:				
Range fees	-.371	-.371	-.371	
Other revenues	-1.100	-.478	-3.23	
Total change in government revenue	-1.471	-.849	-3.601	
Logging shocks:				
Moderate (-50 percent)—				
Household income				
Low income households	-.932	-2.618	-2.814	-3.920
Medium income households	-8.025	-21.300	-24.060	-30.390
High income households	-5.032	-11.084	-13.579	-17.920
Total change in household income	-13.989	-35.002	-40.452	-52.230
State and local government revenues:				
Timber fees	-9.105	-9.105	-9.105	
Other revenues	-2.051	-3.080	-4.222	
Total change in government revenue	-11.156	-12.185	-13.327	
Severe (-80 percent)—				
Household income				
Low income households	-1.837	-4.901	-5.289	-6.260
Medium income households	-15.556	-39.614	-45.080	-48.590
High income households	-9.796	-20.663	-25.603	-28.650
Total change in household income	-27.189	-65.178	-75.971	-83.500
State and local government revenues:				
Timber fees	-14.568	-14.568	-14.568	
Other revenues	-4.059	-6.839	-8.031	
Total change in government revenue	-18.627	-21.407	-22.599	

Moderate Resource Shocks

Shortrun range shock—In the short run, with only labor adjusting, the 25-percent reduction in public range supply has only a slight impact on the regional economy. Regional private output of hay and pasture decreases by 1.74 percent, but imports rise by 13.9 percent. Consequently, total supplies of range, hay, and pasture remain about constant. Total employment decreases by only 12 jobs, including a loss of 9 livestock-related jobs. Changes in household incomes are slight with low, medium, and high income households experiencing declines of less than one-tenth of 1 percent (0.1 percent). Total state and local government revenues decline by $128,000.

Intermediate-run range shock—In the intermediate run, proprietors are free to pursue other business opportunities in the region. The 25-percent reduction in public range induces a reallocation of economic activity. Imports of hay and pasture slow somewhat compared with the shortrun scenario to a rate 8 percent above baseline levels. Overall, there is a 0.82-percent decrease in total supply of range, hay, and pasture. A loss of 32 livestock-related jobs is offset by small gains in some other sectors, and so total employment remains virtually unchanged. Total household income declines by $220,000.

Longrun range shock—In the long run, unemployed labor and unprofitable proprietors leave the region. Production of private hay and pasture recovers and increases 5.7 percent above baseline, adding 17 new jobs. Hay imports settle at a rate less than 1 percent above baseline levels. Total availability of range, hay, and pasture declines by only 0.87 percent. Employment declines for almost all other sectors for a net reduction of 41 jobs. Total household income falls by just less than $1 million (0.05 percent). Total state and local government revenues are down $187,000.

Fixed-price range shock—Under fixed-price analysis, output and employment changes are directly proportional. Hence, no sector exhibits employment increases. Livestock-related industries lose 236 jobs, and another 72 jobs are lost in the rest of the economy. Total household income falls by $6.85 million, with low, medium, and high income households each losing less than 1 percent of baseline income. Estimated fixed-price employment impacts are roughly seven to eight times greater than estimates using the regional CGE model.

Shortrun log shock—The shortrun impact of a 50-percent reduction in logging of public timber is more significant. Total employment decreases by 1,228 jobs. Output of private logs remains about constant but is allocated away from export markets to supply regional mills. Log imports increase 34.7 percent, but total supply of logs in the region falls by 13.9 percent. Logging and wood-processing sheds almost one-fourth of baseline employment (928 jobs) largely because of the increased cost of purchasing higher priced logs. Incomes of low, medium, and high income households decline by 0.2 percent, 0.91 percent, and 1.02 percent, respectively. Revenues of local governments decline by at least $11 million, mostly because of reduced Federal timber sales.[20]

Intermediate-run log shock—The reallocation of activity induced by the 50-percent reduction in public logging fails to insulate the economy from negative impacts. Compared with the shortrun scenario, log imports slow considerably. In the intermediate run, logs are imported at a rate of 17.7 percent above the baseline level, but total log supply falls 17.9 percent below baseline levels. Despite an increase in livestock, agriculture, and food-processing employment of 218 jobs, large decreases in logging and wood processing (-1,141 jobs) induce a net loss of 1,500 total jobs. Household income declines by $35 million, and incomes for low, medium, and high income households decrease by 0.58 percent, 2.42 percent, and 2.25 percent, respectively. State and local government revenues are down more than $12 million.

Longrun log shock—Regional log supplies remain about the same as in the intermediate run (that is, 17.98 percent below baseline). Employment shows the same trend as in the intermediate run, although more negative (less positive). Slight increases in livestock, agriculture, and food-processing employment are

[20] Note that reductions in local government revenues resulting from reduced Federal timber sales may actually be mitigated through revenue guarantees under The Northwest Forest Plan.

canceled by large reductions in logging and wood products (-1,138 jobs), services, and trade. Total employment decreases by 1,766 jobs. Total household income declines by $40.45 million, with reductions of 0.62 percent, 2.73 percent, and 2.76 percent in incomes of low, medium, and high income households, respectively.

Fixed-price log shock—Logging and wood products shed 1,246 of the total 2,160 jobs lost in the economy. A total of $52.23 million household income is lost. Low, medium, and high income households lose 0.86 percent, 3.45 percent, and 3.64 percent of baseline income, respectively. Here the fixed-price employment impacts range from 75 percent greater in the short run to 22 percent greater in the long run than estimates from the regional CGE model.

Severe Resource Shocks

Shortrun range shock—Even in the short run, the impact of the virtual elimination of public range in the region is unambiguously negative. Private hay and pasture decreases by 18.3 percent, but total supply of range, hay, and pasture in the region decreases by only 2.65 percent because of a sevenfold increase in hay imports. The livestock sector decreases output by 2.36 percent, and sheds 516 jobs. Altogether, 594 regional jobs are lost, along with $10.558 million in household income. This translates into a reduction in the incomes of low, medium, and high income households of 0.05 percent, 0.56 percent, and 1.11 percent, respectively. Local government revenues from sales of Federal grazing permits decline by $371,000, and total state and local government revenues are down $1.471 million.

Intermediate-run range shock—In the intermediate run, hay imports remain high, about six times baseline levels. Large cuts in livestock-related employment (-1,313 jobs) are countered by an increase of 1,366 jobs in other sectors (mainly trade, services, and other agriculture) so that net regional employment increases by 53 jobs. Total household income declines by $6.29 million, decreasing by 1.12 percent for medium income households and 1.2 percent for high income households, but increasing by 0.15 percent for the low income group. Total state and local government revenues decline by $849,000.

Longrun range shock—In the longer term, private production of hay and pasture returns to about baseline levels. Hay imports settle at a level 21 percent above baseline. Total supply of range, pasture, and hay is 19.8 percent below the original level. A large cut in livestock-related employment (-1,036 jobs) is accompanied by decreases in most other sectors, so that total regional employment decreases by 1,371 jobs. Total household income declines by $29.45 million, falling by 0.2 percent for low income households, 1.65 percent for medium income households, and 2.84 percent for the high income group. Total state and local government revenues are down by $3.6 million.

Fixed-price range shock—Livestock-related industries lose 947 jobs, and another 290 jobs are lost in the rest of the economy. In household income, $27.51 million is lost, with low, medium, and high income households losing 0.21 percent, 1.55 percent, and 2.63 percent of baseline household income, respectively. Under the severe range shock, the fixed-price model now underestimates economic impact relative to the regional CGE model.

Shortrun log shock—The response to an 80-percent reduction in baseline Federal log supplies is decidedly negative. A 68.5-percent increase in log imports partially counters the 80-percent decline in public log supply. But an 8.85-percent reduction in private log output combines to reduce total regional log supply by 28.36 percent from baseline levels. This contributes to a 48.38-percent reduction in wood products activity, and the loss of 1,786 logging and wood-processing jobs. Total employment falls by 2,366 jobs, with the loss of $27.19 million in household income. Incomes decline by 0.4 percent, 1.77 percent, and 1.99 percent for low, medium, and high income households, respectively. State and local government revenues decline by $18.627 million, $14.568 million of which is due to reduced Federal timber sales.

Intermediate-run log shock—Despite a 30.3-percent increase in log imports, total log supplies fall by 35.1 percent, including a 10-percent reduction in private logs. Logging and

wood products employment declines by one-half (-2,118 jobs). Total regional employment declines by 2,799 jobs, despite an increase of 411 jobs in livestock, other agriculture, and food processing. Household income declines by $65.18 million, therby resulting in decreases for low, medium, and high income households of 1.08 percent, 4.5 percent, and 4.2 percent, respectively. State and local government revenues are down more than $21 million.

Longrun log shock—Total log supplies remain about 35 percent below baseline levels as in the intermediate scenario. Logging and wood products employment remains weak (-2,115 jobs). Employment in services, trade, and most other sectors also weakens, so that total regional employment is 3,329 jobs below the baseline level. Household income declines by almost $76 million, thereby resulting in decreases for low, medium, and high income households of 1.17 percent, 5.12 percent, and 5.2 percent, respectively. There is also a loss of $22.6 million in state and local government revenues.

Fixed-price log shock—Logging and wood products shed 1,993 of the total 3,453 jobs lost in the economy. In household income, $83.5 million is lost, with low, medium, and high income households losing 1.38 percent, 5.52 percent, and 5.82 percent of baseline household income, respectively.

Combined intermediate-run range and log shocks—It is interesting to note that if both range and log shocks occur simultaneously, the intermediate-term impact seems significantly worse than the sum of the two individual shocks. Under the combined shock scenario, 2,847 jobs are lost compared with 2,746 jobs if the separate intermediate-run impacts of the log and range scenarios are summed. For reference, the fixed-price model indicates a loss of 4,690 jobs. There is also an additional $2.52 million loss in household income under the combined scenario. The difference can be attributed to increased pressure on relative prices (particularly the rate of return to proprietors), which exacerbates output and employment impacts under the combined shock scenario.

Economic Counter Scenarios

In addition to the range and logging supply shocks, several expansionary "economic counter scenarios" also were examined. Results of these scenarios are presented below and in table 10.[21]

The basic counter scenarios examined include the following:

"**High-technology**" assumes the location or expansion of a regional facility for manufacturing high-technology products, and the resulting hiring of 330 new workers at the facility.

"**Inmigration**" assumes 1,000 households settle in the region, bringing with them an average of $91,000 in transfer and property income (total $91 million). The inmigrants also build new houses at the rate of 200 per year, spending $100,000 per home in construction costs (total $20 million).

"**Tourism**" assumes there is roughly a doubling in nonresident tourist and recreation activity in the region (that is, enough to generate 2,200 service-sector jobs, or about 4 percent of the 1992 nonfarm employment base).

"**Combined**" refers to simultaneous impact of all three counter scenarios (that is, high-technology, inmigration, and tourism).

All counter scenarios include the "new baseline," which assumes the simultaneous, longrun impact of the severe public logging (-80 percent) and severe public range-reduction (-100-percent) scenarios. Thus, relative to the original 1992 situation, there are now 4,679 fewer jobs available in the new baseline, including 3,199 jobs lost from resource-based industries and 1,480 jobs lost from other sectors.[22] Total household income is $105 million less than it was in 1992.

The counter scenarios should be regarded as illustrative only, and not viewed as prescriptions

[21] In table 10, counter scenario impacts are expressed as changes relative to the original, 1992 baseline levels.
[22] This is slightly less severe than the straight sum of individual impacts under the severe logging and severe range scenarios (-4,700). The difference (21 jobs) is due to the need to slightly modify the standard CGE model to simultaneously accommodate the combined resource shocks and economic counter scenarios.

or predictions of future circumstances. Although the scenarios were selected assuming, arguably, reasonable growth prospects for the northeast Oregon regional economy over the next 5 to 10 years, they are not based on any knowledge of pending industrial locations or extrapolated from any current demographic or economic trends.

Expansion of high-technology manufacturing in the region adds 332 manufacturing jobs (236 plus 96 jobs previously lost in the baseline scenario) and 109 jobs in services industries. Altogether there are 433 more jobs than in the new baseline, and an additional $9 million in household income.

Inmigration results in the addition of 243 construction jobs and 860 service jobs. Total employment increases by 1,082 jobs but is still 3,597 jobs lower than in 1992. Largely because of the influx of exogenous, unearned transfer and property income, household income is $109 million greater than in the new baseline, and $4 million higher than it was in 1992.

Tourism expansion adds 2,179 service-sector jobs (eating, drinking, and lodging; trade and other services). Total employment increases by 2,229 jobs compared with the baseline in table 10. Household income increases by $26 million but remains $79 million lower than in 1992.

If all three expansion scenarios occur simultaneously, 3,707 total jobs are added, including 250 construction jobs, 330 manufacturing jobs, and 3,117 service-sector jobs. Total employment, however, is still 972 jobs lower than it was before the impact of the severe resource shocks. Household income is $38 million greater than it was in 1992, with medium and high income households adding $30 million and $11 million, respectively; low income households are still about $3 million worse off than they were in 1992.

Conclusions

The results presented here emphasize the complexity of the answer to the question How dependent is Northeast Oregon on resource-based industries? Data show that in 1992, 29 percent of regional employment was natural resource based. Consequently, by most measures, a sustained, severe reduction in the avail-

Table 10—Results: employment and income impacts under possible scenarios, change relative to original 1992 economy

Employment	New baseline[a]	High-technology	Inmigration	Tourism	Combined
			Change in number of jobs		
Resource-based:[b]	-3,199	-3,208	-3,218	-3,154	-3,189
Construction	-50	-49	193	-45	200
Other manufacturing[c]	-96	236	-98	-96	234
Services[d]	-1,334	-1,225	-474	845	1,783
Total jobs	-4,679	-4,246	-3,597	-2,450	-972
Household income:			*Million dollars*		
Low income households	-6	-5	-5	-5	-3
Medium income households	-59	-54	10	-44	30
High income households	-40	-37	-1	-30	11
Total household income	-105	-96	4	-79	38

[a] New baseline—includes the simultaneous longrun impact of the severe logging (-80 percent) and severe range reduction (-100 percent) scenarios.
[b] Resource based—includes livestock-related, logging and wood products, other agriculture, other natural resources, and agriculture processing.
[c] Other manufacturing—includes all manufacturing industry other than agricultural processing and wood products.
[d] Services—includes transportation, communications, and utilities; wholesale and retail trade; eating, drinking, and lodging; finance, insurance, and real estate; other services; and government industry and government enterprise.

ability of once abundant public range and timber resources will have dramatic impacts on the existing regional economic structure. In the most severe cases examined (1) elimination of Federal range programs caused the loss of 1,371 jobs (2.3 percent of regional employment) and $29 million (1.6 percent) of household income; and (2) an 80-percent reduction in Federal log supplies resulted in the loss of 3,329 jobs (5.5 percent of regional employment) and $76 million (4.2 percent) of household income.

Analysis of economic counterscenarios suggests that plausible, simultaneous increases in tourism, high-technology manufacturing, and the population of independently employed or retired persons can partially offset employment and income losses resulting from resource policy changes. The industry mix of the new jobs and the distribution of household income will both be different than they were originally.

Evidence suggests that the regional economy has already begun a transformation, characterized by stable or declining employment in resource-based industries and employment growth in tourism and retirement-based services. These trends are likely to continue with or without major changes in natural resource policy.

Proprietors currently provide the major input in the regional livestock industry. It was noted under "Sources of Employment" that nonfarm proprietors have become a fast-growing component of the northeast Oregon regional economy. If access to public range becomes restricted, we would expect to see an acceleration of this trend as small- and medium-sized livestock operations transfer some or all of their resources into other kinds of businesses.

In this analysis, commodity prices outside the region for logs, lumber, hay, and livestock were assumed to remain fixed. This assumption seems reasonable given that changes in the regional output of these commodities would not significantly affect world supplies. World commodity prices, however, have fluctuated during the period under consideration. If the effect of recently higher lumber prices had been included, the response of regional and imported log supplies would have been greater, thereby resulting in a smaller estimated decline in regional employment and income. On the other hand, incorporating the effect of falling prices, such as was recently observed for beef products, would have resulted in larger estimated reductions in the output and employment of livestock and related industries.

Our treatment of all government activity as fixed allows comparison of preshock and postshock scenarios in "revenue-neutral" terms (that is, assuming no change in government expenditures in the region). Although this assumption may tend to underestimate the amount of regional impact resulting from an economic shock, it is not unreasonable given the currently unstable relation between state and local fiscal responsibilities in Oregon. If reductions in government revenues had been translated directly into reduced expenditure levels, then the impact of the resource shocks would have appeared more severe.

Moderate shock results under the fixed-price model are more pessimistic than under CGE assumptions. In the case of the severe range or log shock, however, certain impacts appear less severe under the fixed-price treatment than in the corresponding longrun CGE model scenario.[23] This is because adjustment to severe restrictions on Federal land use is considerably more difficult when modeled as a CGE supply-side constraint than when modeled as a fixed-price reduction in demand. In the flexible-price model, increase in the regional cost of feed makes the livestock sector less profitable. For the severe log shock, increase in regional log prices hampers adjustment in the wood-processing sector. Clearly the elimination of public resource supply has differed, and severe consequences occur that are difficult to capture by using conventional, fixed-price models. It is interesting, however, that both the fixed-price and flexible-price models tell much the same story regarding total employment impacts under severe resource shocks in the long run. The difference between models is in estimated impact on the directly affected sectors (that is, range and livestock, or logging and wood products).

[23] For example, under the severe range shock scenario, the longrun CGE model estimates loss of an additional 89 livestock-related jobs and 45 other jobs compared with the fixed-price model.

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Traditional, fixed-price (input-output) economic models provide a useful framework for conceptualizing links in a regional economy. Apparent shortcomings in these models, however, can severely restrict our ability to deduce valid prescriptions for public policy and economic development. A more efficient approach using regional computable general equilibrium (CGE) models as well as a brief survey of relevant literature is presented. Evidence suggests that a regional economic transformation, characterized by stable or declining employment in resource-based industries and growth in tourism and retirement-based services, is already underway.

Keywords: Regional economics, computable general equilibrium models, input-output models, economic base theory, public resource policy.

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