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PREDICTING THE ECONOMIC IMPACTS OF INTENSIFIED FOREST MANAGEMENT:

DOUGLAS COUNTY, OREGON, AS A CASE STUDY

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FOREST RESEARCH LAB

SCHOOL OF FORESTRY OREGON STATE UNIVERSITY

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INTRODUCTION

The fear of a pending "timber famine" in the United States has been discussed since the mid-19th century. Although such a famine has never occurred, by the 1960's Hamill (1963) and Fedkiw (1964) were questioning whether the timber resources of the Pacific Northwest could sustain existing regional mills at full capacity. In the next decade, Wall (1972), Gedney et al. (1975), Beuter et al. (1976), and Brodie et al. (1978), all of whom examined potential growth and harvest volumes of the area's current forest resources or the consequences of differing policies about forest management, concluded that these resources cannot sustain current levels of consumption through the end of this century. These researchers predicted that changes in forest management will make more wood available in the long run but that the possibility of a shortfall around the 1990's remains.

Shortfalls have been predicted for most of western Oregon, especially in the southwestern portion, where Douglas County is an important center for the manufacture of forest products. But past studies of the future availability of timber in this area failed to assess the costs of management intensification that might mitigate the projected shortfalls, nor did they evaluate whether the additional employment and earnings created by such intensification would offset the predicted losses in employment and earnings in the logging and forest products industries. Accordingly, this paper describes a model for estimating the capital and labor required by various intensities of forest management within a specific area such as a county, as well as the income and employment generated by the resulting harvests. The model is then applied to data from Douglas County as a case study.

BACKGROUND

To better understand the forest products industry in Oregon and how it has coped with changes in the market, Manock et al. (1968), Schuldt and Howard (1974), and Howard and Hiserote (1978) examined timber flows, flows of mill residues, and utilization patterns within the State. They found that the industry has been adapting to changing levels of supply and demand by increasing the prices it pays for stumpage and receives for its products (in real dollars). Concurrently, smaller material is being processed as the old-growth timber is replaced by second-growth. In combination, these factors have forced the closure of less efficient mills for forest products and the emergence of larger, integrated ones. In the period between 1968 and 1976 alone, the number of mills in Oregon declined by 19 percent. More important, the number of small mills declined by 50 percent while that of larger mills increased by 49 percent (Howard and Hiserote 1978). At the same time, the structure of the industry changed, with plywood and veneer and secondary wood processing expanding in capacity while sawmill capacity declined.

Although the number of sawmills declined, total mill capacity state-wide has remained stable, while the labor required for production has decreased. Many researchers have attempted to assess the role and composition of labor in Oregon's forest products industries. Smith and Gedney (1965) found that employment in forest-based industries declined by 11 percent betwen 1950 and 1963, primarily because of declines in total produciton, increases in the efficiency of manpower, and changes in the kinds of products and amount of product refinement. Manpower per unit of production declined most in plywood (50 percent) and sawmills (42 percent) and least in paper processing (36 percent) and logging (26 percent).

Wall (1973) predicted that if levels of timber management, structure of the forest industry, and rising trends in labor productivity continue as at present, then employment within the industry in Douglas County will decline by 45 percent from 1970 to the year 2000, a result not only of increased productivity but also of rising log exports and falling harvests. Wall and Oswald (1975) also demonstrated that, from 1950 to 1970, the consumption of raw materials from forests throughout the Pacific Northwest declined faster than employment within the region's forest products industry.

Although the above-mentioned studies have centered on the relationship between employment and raw materials within the forest products industries, changes in harvest levels affect not only these industries but also those industrial sectors that supply or do business with them and their employees. Gustafson (1975) predicted that a reduction in shipments of forest products because of alteration in supply or demand would affect the economy of Oregon in three ways: First, there would be the direct effect of reduced production, employment, profits, and wages within the forest products industry. Second, there would be an indirect effect in the linked industries, where sales and services to the forest products industry would decline. Third, there would be a reduction in income within both the public and private sectors, resulting in less capital available for consumption and investment throughout the State's economy.

The interactions between the forest industry and the surrounding economic region have also been discussed by Zivnuska (1949), Schallau (1974), Dickerman and Butzer (1975), Waggener (1977), and Beuter and Schallau (1978). These researchers have theorized that the degree of forest management (e.g., harvest levels) is important to the stability or instability of the surrounding economic region. Although empirical evidence for this assumption may be lacking, the passage of the National Forest Management Act of 1976 has made community stability an explicit policy objective for National Forests.

Several models have been devised in an attempt to measure the economic impact that changes within the forest industry have on the surrounding region. These models estimate multiplier relationships between the forestry sector and the regional economic sector. [A *multiplier* (one of the coefficients developed when a model is estimated) provides the direction and amount of change in one variable (e.g., employment) when the variable being estimated (e.g., harvest volume) is changed.] Such studies have varied greatly in their approach and scope. Schuster et al. (1975) used short-run economic-base multipliers to determine how Idaho's economy was affected by its forest products industries. Bell (1979) developed a method for generating an economic-base multiplier, which he linked with supply terms to relate changes in forest harvests to employment in the surrounding region as a whole.

Youmans et al. (1973) developed an input-output model for Douglas County, Oregon. [An *input-output model* attempts to quantify the flows and interactions among all economic sectors in a particular region.] Darr and Fight (1974) used this model to examine the impact of a change in demand for forest products on the local economy, as well as of changes in harvest levels throughout the County and by various types of owners. Their analysis indicated that approximately two-thirds of the economic base of Douglas County is totaly dependent on the forest products industries and harvests from public lands.

Flacco and Youmans (1977) used the estimates on timber availability by Beuter et al. (1976) as exogenous variables in the same input-output model and included patterns of household consumption as established by a survey of Douglas County in 1975. Their work was the first real attempt to project the impacts of changing harvests on both income and employment within a county. They were also able to estimate how income resulting from a timber harvest was distributed among the local population.

Connaughton and McKillop (1979) and Gillis and Butcher (1979) developed economic-base differential-multiplier models to assess the effect of changes within the forestry sector on local economies. Connaughton and McKillop's model was used to determine the regional economic impact of changing harvests as a result of land-use reclassification by the U.S. Forest Service under its RARE-II program (Roadless Area Review and Evaluation). Gillis and Butcher's model was used to assess the regional economic impacts of alternative schemes for processing raw material.

Not all models of forest industries in the Pacific Northwest have concentrated on economic impacts. Beuter et al. (1976) simulated the effect of alternative management intensities and harvest policies on the future availability of timber in Oregon. They estimated that if current intensities and policies were continued, available stumpage would decline in most timbersheds, in some as early as 1985. Conversely, they estimated that higher management intensities by all owners and more flexible policies of harvest scheduling could maintain current harvest levels in both western and eastern Oregon for the next 25 years, although some timbersheds might still have a "deficit" during this period.

These researchers, however, did not measure the labor and capital required by increased management intensities, nor did they assess the impact of forest-based employment on the local economy. Furthermore, since their report was published, the U.S. Forest Service has reinventoried and, in some cases, reclassified its forested lands in Oregon; as a result, the available timber in some timbersheds has been reduced. Accordingly, the present study incorporates this updated inventory in new harvest simulations for Douglas County and presents a model for assessing how management intensification, along with harvesting and processing, affects employment and earned income within both the forest industries and the surrounding area.

THE MODEL: AN OVERVIEW

The model for simulating how intensification of forest management affects the economy of a region is actually a series of linked models (Fig.1). Data on harvest volumes and schedules as required by selected intensities of management are generated by the Timber Resource Economic Estimation System or TREES model (Tedder et al. 1980). In the first or silvicultural subunit of the overall model, the employment and income required to perform the silvicultural operations mandated by the selected intensity of management are calculated. In the second and third subunits, recursive econometric models estimate the employment and income generated within the logging and forest products industries by the selected intensity of management. And in the fourth subunit, a differential economic-base model estimates the regional (e.g., county-wide) employment and income resulting from the selected intensity of management. Because of the versatility of the TREES component of the model, the regional economic impacts of alternative management policies can be assessed by assigning different intensities of management according to ownership type, tree species, and site.

The subunits of the model are not interactive with TREES; rather, they utilize data derived from it. The system, therefore, is structured not to optimize any particular variable but to allow for multiple simulations by TREES and the separate model components. This arrangement should allow for the testing of model assumptions and the extent to which they affect the results. The system has been developed so that any component, including TREES, can be removed and substituted by another model, thereby allowing for easy adaptation to other economic regions. In the following case study, however, estimation of the parameters of the model's various subunits are based on data specific to Douglas County.

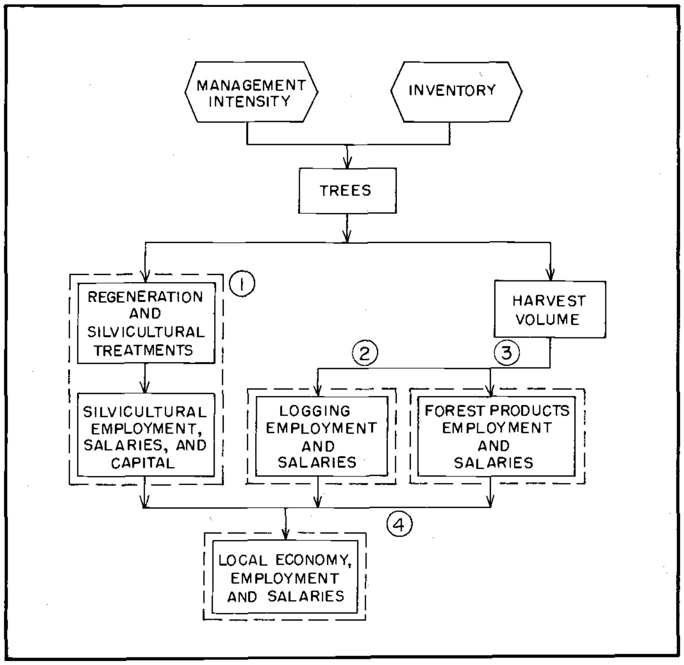


FIGURE 1.

THE SERIES OF LINKED MODELS (SUBUNITS) THAT MAKE UP THE OVERALL MODEL FOR PREDICTING HOW INTENSIFIED FOREST MANAGEMENT AFFECTS A REGION'S ECONOMY. (CIRCLED NUMBERS REFER TO THE SUBUNITS.)

DOUGLAS COUNTY: A CASE STUDY

The following sections describe how the parameters in the various subunits of the model were estimated for Douglas Clounty. Because the first subunit has no equation, data collection for it will be described in general terms.

METHODS

Silvicultural subunit

As stated above, the first subunit of the model calculates the capital and labor required to perform the silvicultural operations mandated by a given management intensity in an individual TREES run. The series of silvicultural operations possible are listed in Figure 2. Estimates of the labor and capital required for these operations were obtained by contacting the Woodlands Assistance Forester for Douglas County; the Reforestation Forester for the Coos Bay District, Oregon State Forests; silviculturalists on the Umpqua and Siuslaw National Forests; and silviculturalists on the Eugene and Roseburg Districts, Bureau of Land Management. In addition, private silvicultural contractors were surveyed by mail. The historical trends in the capital cost of silvicultural treatments were computed with data collected by the Industrial Forestry Association (1980) which publishes average treatment costs per acre as incurred by industrial tree farmers in the Pacific Northwest.

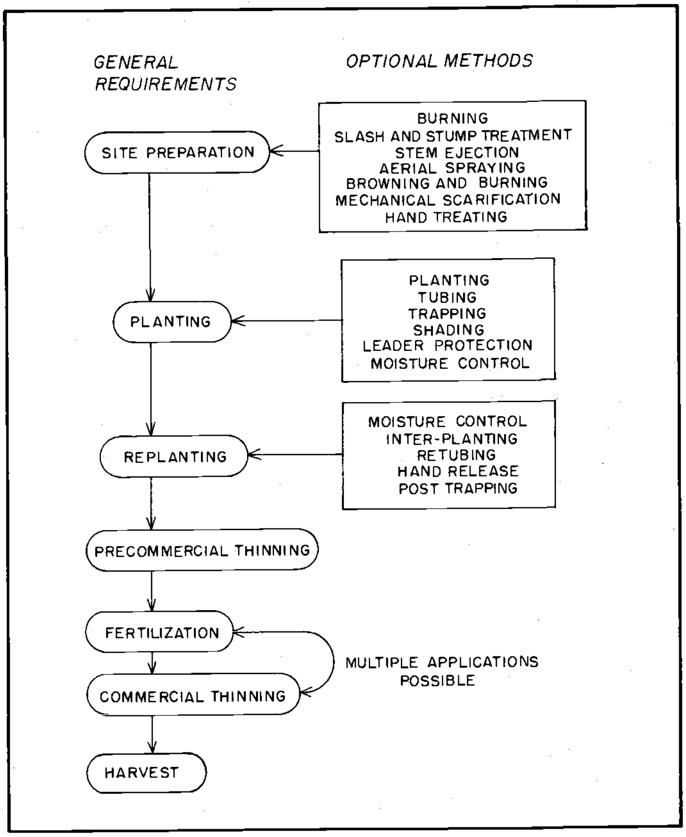


FIGURE 2.

SILVICULTURAL OPERATIONS POSSIBLE ON A FORESTED ACRE.

Table 1 lists the different units of forest ownership within Douglas County, their geographical areas, and the acreage included in each. When the professional foresters in each area were contacted, they provided a profile of the management scheme for each type of ownership. They also provided information on how the geographical area affects the types of treatment required. Whenever possible, the acreage that would require a particular treatment was estimated.

Capital and labor estimates for the various silvicultural operations varied greatly by type of ownership and geographical area (Appendix A). The estimates for Coos Bay and Grants Pass State Forestry Districts were particularly aided by a report from the Oregon State Forestry Department (1978) in which capital costs of forest management for these districts were estimated.

Fertilization for all units within the County was assumed to be applied aerially and to have fairly uniform requirements for labor and capital. Most of the contacted owners were able to provide estimates for precommercial thinning, but estimates for regeneration and hardwood conversion were determined by inquiring as to the fraction of total land that would be treated and multiplying by the manpower and cost required for each treatment selected. Regeneration with genetically superior stock was assumed to require 20 percent more labor and capital because of the greater care involved in the planting and protection of the new forest crop.

The estimated labor and capital requirements for each silvicultural activity are listed according to ownership in Tables 2 and 3. Requirements for owners not contacted were assumed to correspond with those on contacted units of similar geographic location and type of administration. The Umpqua National Forest served as the standard for all other federal land in the Cascades. The South Umpqua unit of the Bureau of Land Management was assumed to be representative of the same agency's Jackson, Josephine, and Klamath units, all of which are in the lower hills and valleys of the County. The Coos Bay State Forestry District served as the standard for the Siuslaw National Forest, which is also located in the Coastal Range. However, because the contacted foresters indicated that labor and capital requirements were greater on federal than on state lands, estimates for the Siuslaw National Forest were increased by 20 percent over those for the Coos Bay District. Similarly, estimates for industrial units were lowered by 20 percent under those for nonindustrial units, primarily because industrial units have a competitive advantage with their larger parcels of contiguous lands and greater percentage of land of high site class. Comparison of the various estimates showed that the Siuslaw National Forest and the Coos Bay Forestry District had the highest requirements for capital and labor and that the Grants Pass State Forestry District had the lowest.

Although these estimates may not be precise for any specific acre of land, they do serve to generate the necessary data for comparing labor and capital required for silvicultural operations on the various ownerships in Douglas County. On the basis of the output from TREES, the silvicultural subunit generates estimates of future employment, earnings, and capital costs required by such operations. Figure 3 is the flow diagram for these calculations. The predictions are dependent on the level of management for each type of ownership and are assumed to result in future harvests of specific levels. Changes in the management intensity of any unit will, of course, alter the resulting harvest predictions.

TABLE 1.
FOREST OWNERSHIP UNITS IN DOUGLAS COUNTY

Unit	Geographical location	Fraction of unit lying within County	Area	Fraction of County's total land base
		Percent	Thousand acres	Percent
National Forests				
Rogue River	Cascade Mountains	11	897	34
Siuslaw	Coastal Mountains	10		
Umpqua	Cascade Mountains	84		
Willamette	Cascade Mountains	3		
Bureau of Land Management				
Siuslaw, Upper Willamette	Cascade Mountains	7	609	23
South Umpqua, Douglas	Valley	100		
South Coast, Curry	Southern Coastal Mountains	40		
Jackson, Josephine, and Klamath	Southern Valley	10		
State Forest Units				
Coos Bay District	Coastal Mountains	27	56	2
Grants Pass District	Southern Valley	45		
Private, industrial	Predominately Coastal Mountains and Valley	100	756	29
Private, nonindustrial	Predominately Coastal Mountains and Valley	100	324	12

TABLE 2.

ESTIMATED LABOR REQUIREMENTS FOR SILVICULTURAL ACTIVITIES IN DOUGLAS COUNTY ACCORDING TO OWNERSHIP UNIT

Unit	Regeneration	Regeneration with genetically superior stock	Pre-commercial thinning	Fertilization	Hardwood conversion
	- - - - - - -	- -	Man-days/acre	- - - -	- - - -
National Forests					
Siuslaw	2.28	2.25	2.0	0.01	2.80
Willamette	2.04	2.42	1.0	0.01	2.42
Umpqua	2.04	2.42	1.0	0.01	2.42
Rogue River	2.04	2.42	1.0	0.01	2.42
Bureau of Land Management					
Upper Willamette	2.04	2.42	1.0	0.01	2.42
South Umpqua	1.55	1.85	1.33	0.01	1.78
South Coast, Curry	1.90	2.21	2.0	0.01	2.80
Jackson, Josephine, and Klamath	1.55	1.85	1.33	0.01	1.78
State Forest Units					
Grants Pass	1.17	1.39	1.33	0.01	1.34
Coos Bay	1.90	2.21	2.0	0.01	2.33
Private, industrial	1.65	1.94	1.06	0.01	1.95
Private, nonindustrial	2.06	2.42	1.33	0.01	2.44

TABLE 3.

ESTIMATED CAPITAL REQUIREMENTS FOR SILVICULTURAL ACTIVITIES IN DOUGLAS COUNTY ACCORDING TO OWNERSHIP UNIT

Unit	Regeneration	Regeneration with genetically superior stock	Pre-commercial thinning	Fertilization	Hardwood conversion
	- - - - - - -	- -	1980 $/acre	- - - -	- - - -
National Forests					
Siuslaw	450	515	110	65	550
Willamette	365	415	110	55	550
Umpqua	365	415	110	55	550
Rogue River	365	415	110	55	550
Bureau of Land Management					
Upper Willamette	365	415	110	55	550
South Umpqua	350	400	100	55	550
South Coast	375	430	110	55	550
Jackson, Josephine, and Klamath	350	400	100	55	550
State Forest Units					
Grants Pass	205	230	95	55	255
Coos Bay	375	430	90	55	760
Private, industrial	324	376	80	45	420
Private, nonindustrial	405	470	75	55	420

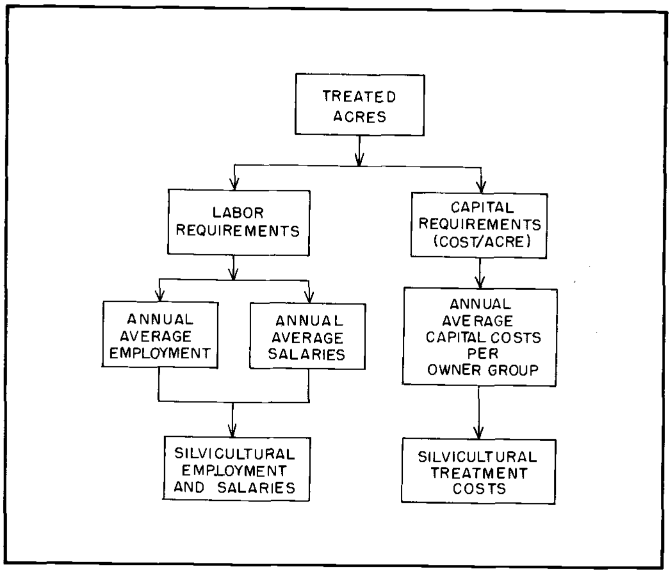


FIGURE 3.

FLOW OF CALCULATIONS NEEDED TO COMPUTE EMPLOYMENT, WAGE, AND CAPITAL COSTS OF SILVICULTURAL OPERATIONS.

Subunits on the logging and forest products industries

The second and third subunits of the model calculate the employment and income generated by the logging and forest products industries in Douglas County. The two subunits were separated so that any fluctuations within them could also be kept separate. For the logging subunits, the labor and capital requirements for commercial thinning, mortality salvage, and regeneration harvests were aggregated because the data on volumes harvested and the workforce required for these operations are not reported separately. Combined data for Douglas County appear in Section 2411 of the Standard Industrial Code (U.S. Bureau of the Census 1977), which records all employment and earnings of workers in logging camps or under logging contract.

The forest products subunit represents the workforce defined by Sections 24 and 26 of the Standard Industrial Code. These two industrial sectors convert logs into lumber, plywood, and paper products and are the fundamental manufacturing sectors in the economy of Douglas County. When they undergo changes in employment, their revenues from exports are affected, in turn affecting the economy of the remainder of the County.

In Douglas County and other timbered areas open to logging, the annual harvest volume is affected by supply and demand. Because timber on public lands is usually purchased with contracts of 2 or more years' duration, supply is not a restriction for any particular year's harvest volume. Therefore, the market demand for forest products exerts the greatest pressure on the volume harvested in any particular year. Thus, the equations developed to model the interaction between employment, wages, and harvest flow in the logging and forest products subunits also include exogenous variables that attempt to indicate the market's demand for forest products.

The actual quantity of wood products annually produced is a function of labor, capital, mixture of raw materials used, and the market conditions influencing their costs and that of finished products. Raw material is measured in million board feet (MMBF) of annual harvest volume on the Scribner scale. Labor is defined as average annual employment in the industrial forest sector. Income, the cost of labor, is the sum of all wages earned by the workforce for the year.

The equations for the two subunits do not estimate total employment or wages directly. Instead, the dependent variables are employment per MMBF and total income per MMBF, a procedure in accordance with earlier work by Gustafson (1975), Wall and Oswald (1975), Connaughton and McKillop (1977), and Gillis and Butcher (1979). In the equations, these variables or ratios have been estimated as a function of time and total annual harvests.

These ratios actually represent the changes in the input of labor and raw material over nearly a decade and a half (from 1962-76), the data base from which the models are drawn. During this period, paper production was initiated in Douglas County, plywood production greatly increased, and smaller logs were utilized. Technological changes have enabled the industrial sector to adjust to the attendent fluctuations in the costs and prices of its raw materials, products, and workforce. The ratio of employment per MMBF is only a representation of the interaction of labor and raw materials as it has occurred in the past and may continue to do so in the future. Similarly, the ratio of earned income per MMBF represents the past and the predicted relationship between the costs of labor and the amount of raw material processed. Figure 4 depicts these relationships as they occurred in Douglas County over the past decade and a half.

A recursive, two-equation model was estimated separately for each subunit. The equations for the logging subunit were

	Coefficients	Standard error
Wages/ MMBF =	6.56223	2.363
	− 0.124345 (UNFPAV)	0.013
	+ 17.7002 (SLWPI)	1.112
	− 0.00064 (PNWLO)	0.0002
	− 0.15223 (LPP)	0.0177

(1)

$R^2 = 0.9511$
Durbin-Watson (DW) test = 2.1488

where Wages and MMBF are as defined previously, UNFPAV = harvest volume per acre from the Umpqua National Forest, SLWPI = relative softwood lumber wholesale price index (the change in the value of lumber in relation to that of other market goods), PNWLO = Pacific Northwest lumber output, and LPP = lumber production profitability (difference between the selling price and the production cost of lumber in the Pacific Northwest).

	Coefficients	Standard error
Employment/ MMBF =	0.77556	0.109
	+ 0.08969 (Wages/MMBF)	0.015
	− $0.187 \cdot 10^{-6}$ (HARVV)	$0.76 \cdot 10^{-7}$
	− 0.44928 (SLWPI)	0.275
	+ 0.00251 (LPP)	0.0024

(2)

$R^2 = 0.9489$
DW = 2.1071

where HARVV = harvest volume logged annually in Douglas County, and all other variables are as defined previously.

The equations for the forest products subunit were

	Coefficients	Standard error
Wages/ MMBF =	2.46177	4.51
	− 0.82599 (UNFPAV)	0.09
	+ 93.2219 (SLWPI)	6.03
	− 0.74813 (LPP)	0.09

(3)

$R^2 = 0.9561$
DW = 2.1941

where all variables are as defined previously.

	Coefficients	Standard error
Employment/ MMBF =	5.67847	0.30
	+ 0.07675 (Wages/MMBF)	0.01
	− $0.18 \cdot 10^{-5}$ (CONSV)	$0.26 \cdot 10^{-6}$
	− 2.63986 (SLWPI)	0.45
	+ 0.02367 (LPP)	0.003

(4)

$R^2 = 0.9946$
DW = 2.244

where CONSV = volume of logs converted into intermediate or finished products within Douglas County, and all other variables are as defined previously.

Note that, in each model, the first equation estimates wages per MMBF and the second estimates employment per MMBF as a function of wages per MMBF and several other exogenous factors. This model structure is based on two assumptions. First, the rate of growth in average annual wages for all employees in Douglas County and in average weekly wages for production workers throughout the United States were statistically equivalent from 1962 through 1978, the period of the data base for these two models. Therefore, it is assumed that the price of labor within a single county is unlikely to influence the price of labor throughout a region. The second assumption is that the quantity of labor in total hours per unit of production (consumption) is easier to reduce than are the labor wage rates. Concurrently, it is the cost of labor, relative to that of other factors of production, which ultimately determines the quantity of labor employed per unit. Thus, it was assumed that employment per MMBF is dependent upon wages per MMBF, but not vice versa.

The exogenous variables in the two models represent attempts to account for such market conditions as level of production, size of raw material processed, and the profitability of production. Statistics of Manock et al. (1968), Schuldt and Howard (1974), and Howard and Hiserote (1978) indicate that, within the period on which models are based, the volume of logs processed in Douglas County (CONSV) represented about 80 percent of the County's harvest volume (HARVV). During this period, the softwood lumber wholesale price index (SLWPI) showed a gradual but positive upward trend. Also

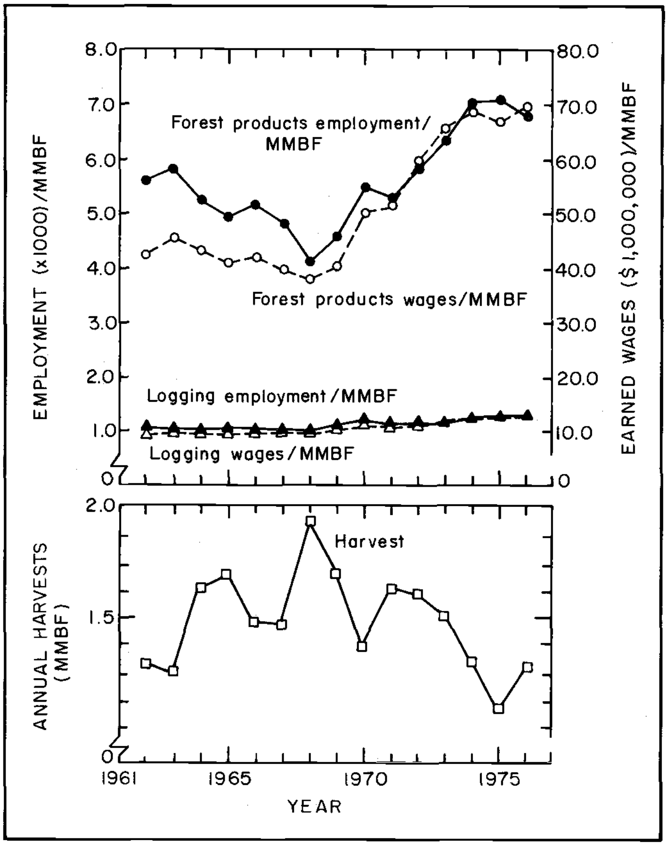


FIGURE 4.

RECENT TRENDS IN HARVESTS AND IN EMPLOYMENT AND WAGES WITHIN THE LOGGING AND FOREST PRODUCTS INDUSTRIES IN DOUGLAS COUNTY.

during this period, data of Adams et al. (1979) indicate that the lumber production profitability factor (LPP), whose strong positive fluctuations define strong market periods and whose negative fluctuations define poor periods, maintained a highly variable but declining trend. The Pacific Northwest's lumber output (PNWLO) also declined during this period, largely because of the increasing importance of plywood, particleboard, and paper, all of which require different levels of labor from that of lumber production, which has traditionally been a major index of the health of the forest industry. Finally, average log size also declined as old-growth material diminished and more volume was removed by mortality salvage and commercial thinning. As Tedder (1979) has demonstrated, declining log size requires that more logs be harvested and processed to maintain the same output. [Declining log size is represented in the model by harvest volume per acre from the Umpqua National Forest (UNFPAV), a variable that also attempts to account for possible changes required in the ratio of labor to MMBF.]

The multipliers in the equations were estimated from the time-series data illustrated in Figure 4. These multipliers attempt to correlate future harvest levels (supply) with future activity in the industrial forest sectors.

Many other factors important in assessing market conditions are omitted from the models because of lack of data: annual inventories of logs at mills, capital investments, technological changes, and final mixture of products. If the model is misspecified because one or more of these missing variables is correlated with the included variables, then the resulting coefficients will be biased and inefficient (Kmenta 1971). Although this is an inherent problem with time-series analysis, the results of estimation can still be used to study the relationships if the bias and inefficiencies are minor.

Subunit on local economic impact

The fourth subunit of the model predicts local (county-wide) employment and income as they are affected by intensified forest management. It represents the summation of three sectors: forestry-related activities and industries (subunits 1, 2, and 3), other basic industries, and the service sector (those businesses such as stores that provide a service to the public). The sector consisting of other basic industries includes non-local government, agriculture, miscellaneous manufacturers, and other miscellaneous industries. The various components of the subunit and their connections are depicted in Figure 5.

An economic-base differential-multiplier model consisting of two equations was estimated for the service sector:

	Coefficients	Standard error
Service Sector Wages (WSERV) =	2,980.82	4,192.42
	+ 0.358470 (WFOR)	0.0715
	+ 0.332656 (WBAS)	0.0225

(5)

$R^2 = 0.9657$
DW = 1.6978

where WSERV (the dependent variable) = annual wages of the service sector, WFOR = annual wages of the forest-related sector, and WBAS = annual wages of the sector for other basic industries.

	Coefficients	Standard error
Service Sector Employment (ESERV) =	13,070.6	2,405.34
	+ 0.936325 (EFOR)	0.391
	+ 3.30579 (EBAS)	0.387

(6)

$R^2 = 0.9423$
DW = 1.9649

where ESERV (the dependent variable) = employment (total number of people) in the service sector, EFOR = employment in the forest-related sector, and EBAS = employment in the sector for other basic industries.

Historical data on county-wide employment and earned income within the service sector and the sector for other basic industries were obtained from the Oregon Department of Human Resources (1960-79). These data, particularly those on agricultural wages and employment in educational institutions, were adjusted in accordance with figures from the U.S. Bureau of Economic Analysis. The historical data (see Fig. 6) were used to estimate the equations, which in turn predict future employment and income within the service sector on the basis of changes within the forest-related sector and the sector for other basic industries. Data from all three sectors are then summed to calculate total employment and wages at some future date within Douglas County.

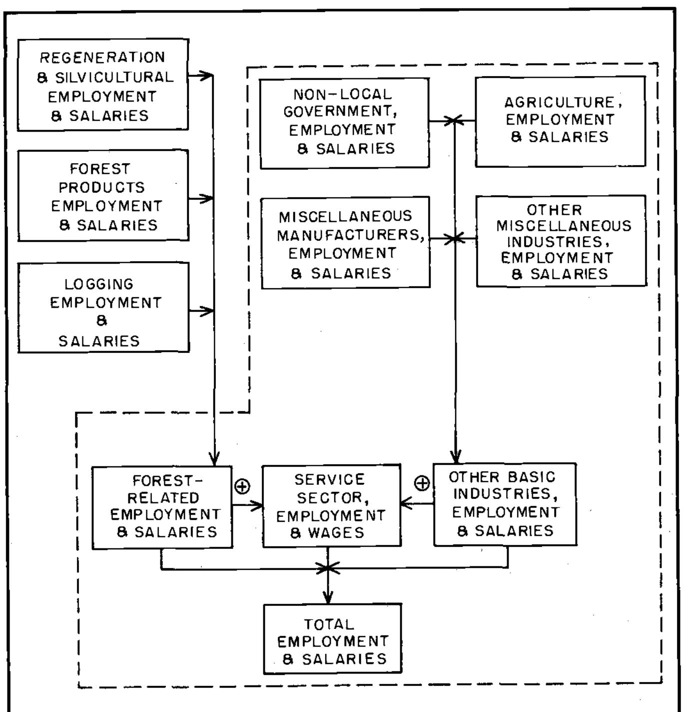


FIGURE 5.

SUBUNIT ON LOCAL ECONOMIC IMPACT (DOTTED OUTLINE) AND ITS RELATION TO THE OTHER SUBUNITS OF THE OVERALL MODEL.

Assumptions and data bases

Appendix B contains information from Beuter et al. (1976) on the data base and the assumed intensities of forest management for the TREES model. Since the "Beuter Report" was written, however, changes in land use have affected the inventories of the private industrial and non-industrial sectors. These changes are accounted for in some of the model runs described below. In all runs, only those acres actually in Douglas County were included in the inventories of the two State Forest Districts, Coos Bay and Grants Pass. Acres that have been removed from timber production because of land-use decisions on the National Forests and districts of the Bureau of Land Management were deleted from the inventories.

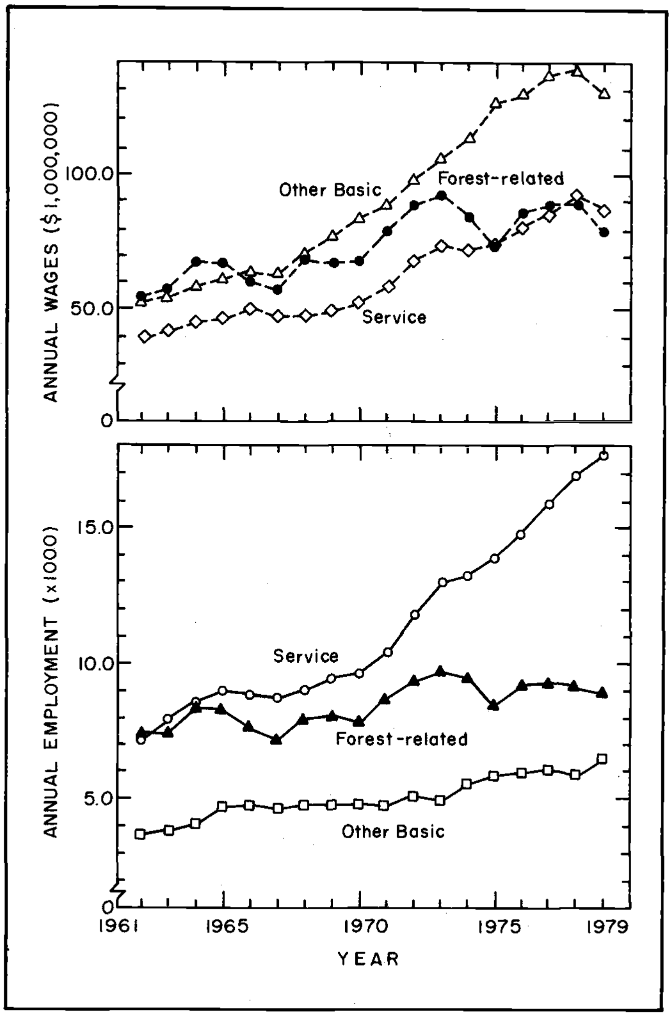


FIGURE 6.

RECENT TRENDS IN ANNUAL WAGES AND EMPLOYMENT WITHIN THE SERVICE AND FOREST-RELATED SECTORS AND THAT FOR OTHER BASIC INDUSTRIES IN DOUGLAS COUNTY.

Five data bases, generated by TREES, were run through each of the four subunits of the model. These five simulation runs allowed us to compare results based on different forest inventories, management intensities, and forest management policies. The five data bases are briefly described below.

Run 11 is a projection with the old inventory (from the "Beuter Report"), a low intensification of management, and the assumption that the public sector will maintain current harvest policies for the first three decades while the private sector attempts to maintain a total harvest of 2,900 million cubic feet (MMCF) per decade. This projection corresponds to Run A-1 in the "Beuter Report," the harvest simulation that demonstrated that adverse declines in future harvests are possible if current management and harvest policies continue.

Run 14 is a projection with the old inventory, a low intensification of management, and the assumption that non-declining evenflow is changed to sequential sustained yield. [*Non-declining evenflow* mandates that no future harvest be at less than current levels; *sequential sustained yield* allows future harvests to deviate from current levels.] The rotation length is assumed to be seven decades on public lands and five decades on private lands.

Run 24 has the same data base and assumptions as Run 14 except that a high intensification of management is assumed. Runs 14 and 24 correspond with Runs A-2 and B-2, respectively, in the "Beuter Report" and were generated to test the effects of management intensifiction and changes in harvest policy on the local economy.

Runs 34 and 44 utilize the same assumptions as Runs 14 and 24, respectively, except that they incorporate the new inventory. The new inventory has less initial acres and total volume available for harvest than the "Beuter" inventory.

The harvest schedules generated by the various data bases and management intensities are presented by owner group in the following section. Comparisons are drawn between the labor and capital requirements for low and high intensities of management and the effect of those requirements on the local economy.

How increases in investment affect production will also be reviewed. In a subsequent section, several variations will be estimated by assuming alternative future values for some of the exogenous variables in the logging and forest products models.

RESULTS AND IMPLICATIONS

Silviculture

Table 4 shows the average annual harvest in Douglas County by decade from 1925 through 1974 and the harvest volumes predicted by the various model runs through the year 2024. Note that harvests increased to a high of 1,534 MMBF, Scribner Scale, for the decade 1965-74. However, Run 11, which is based on the old inventory and roughly represents maintaining the status quo in management, predicts that harvest volumes will drop over the next five decades to a level far below that for the decade 1945-54. And Runs 34 and 44, which are based on the new inventory and opposite extremes of management, each predict that this critical drop will occur in the fourth instead of the fifth decade and that harvest levels in the fifth decade will be even lower than predicted by Run 11 (or either of the other two runs).

Because of recent improvements in mill technology and the increasing use of diverse raw materials, measurement of harvest volume in Scribner Scale can be misleading. Table 5 shows that when the predicted harvest volumes are measured in cubic feet rather than board feet, the decline of harvests for all runs is much smaller. Note that all runs based on the assumption that non-declining evenflow will be changed to sequential sustained yields predict that there will be more harvest volume available in the latter three decades than is predicted by Run 11. This overage applies even to Runs 34 and 44, whose new inventories are smaller than the old inventory used for Run 11. The actual drop in usable volume as a result of inventory reduction is less than 10 percent when Runs 14 and 24, which used the old inventory, are compared to Runs 34 and 44. Regardless of the assumed harvest policy and management intensity, however, the average annual harvest of the Douglas County timbershed is predicted to decline. How substantial the decline actually is will depend on the management level in which the owner groups are willing to invest.

TABLE 4.

HISTORICAL AND PROJECTED HARVEST VOLUMES IN DOUGLAS COUNTY ACCORDING TO THE VARIOUS MODEL RUNS, IN RELATIVE PERCENTAGES WITH THE AVERAGE FOR 1965-74 AS THE BASIS FOR COMPARISON. BASED ON SCRIBNER SCALE MEASUREMENT.

Decade	Historical data	Projection from Run[a]--				
		11	14	24	34	44
		- - Relative percent - -				
1925-34	4	--	--	--	--	--
1935-44	16	--	--	--	--	--
1945-54	74	--	--	--	--	--
1955-64	96	--	--	--	--	--
1965-74	100[b]	--	--	--	--	--
1975-84	--	105	100	103	85	88
1985-94	--	102	94	97	83	87
1995-04	--	64	90	96	77	78
2005-14	--	70	78	84	65	66
2015-24	--	64	74	76	61	61

[a]Assumptions for the various runs were as follows:

Run 11--old inventory, low intensification of management, public sector to maintain current harvest levels for 3 decades while private sector maintains a total harvest of 2,900 MMCF per decade.

Run 14--old inventory, low intensification of management, harvests based on sequential sustained yield.

Run 24--old inventory, high intensification of management, harvests based on sequential sustained yield.

Run 34--new inventory, low intensification of management, harvests based on sequential sustained yield.

Run 44--new inventory, high intensification of management, harvests based on sequential sustained yield.

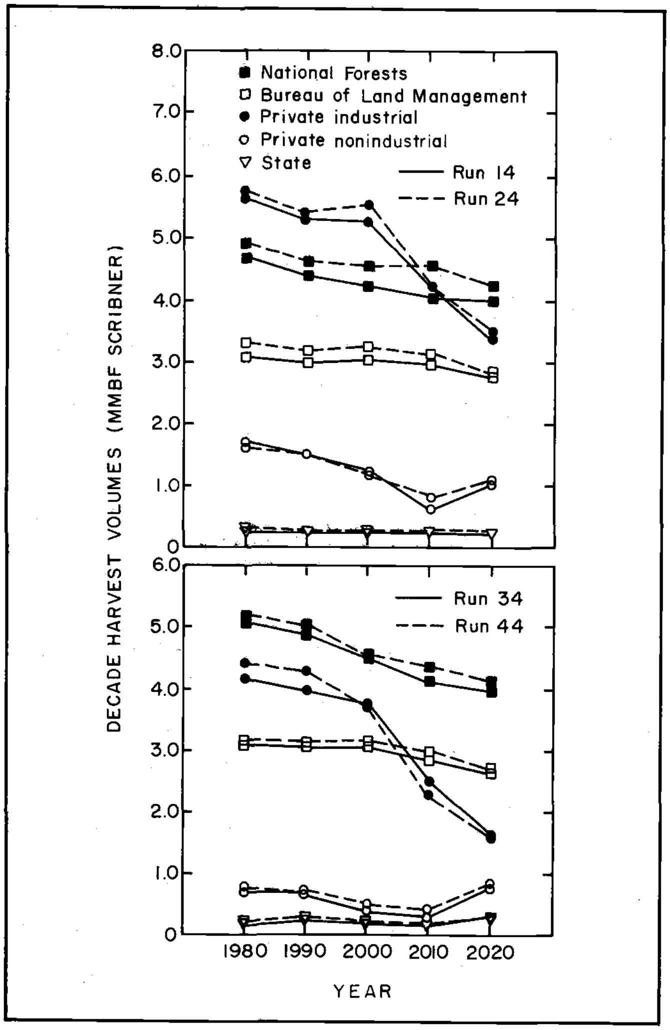
[b]Annual average for 1965-74, the base period, is 1,534 MMBF, Scribner Scale.

TABLE 5.

PROJECTED HARVEST VOLUMES IN DOUGLAS COUNTY ACCORDING TO THE VARIOUS MODEL RUNS, IN RELATIVE PERCENTAGES WITH THE AVERAGES FOR 1965-74 AS THE BASIS FOR COMPARISON. BASED ON CUBIC-FOOT MEASUREMENT.

Decade	Projection from Run[a]-- 11	14	24	34	44
	- - Relative percent - -				
1975-84	100	96	99	89	92
1985-94	100	92	95	89	93
1995-04	78	91	97	86	90
2005-14	79	90	96	84	89
2015-24	76	90	96	82	88

[a]Assumptions for the various runs are listed in footnote a of Table 4.



The impact made by the change in inventory is apparent in Figure 7. Note that the new inventory reduces the available harvest volumes from the private industrial and the private nonindustrial owner groups but increases harvests from the National Forests and the Bureau of Land Management. Nevertheless, total harvest volumes are less from the new than from the old inventory.

Although all four simulations shown in Figure 7 incorporate levels of forest management greater than present levels, they do not predict any major increases in available harvest volumes. This lack of response occurs because of the shortness of the simulation. The five decades of the study are considerably briefer than the rotation lengths of most administrative units. It will take more than five decades to harvest, plant, and treat the necessary acreages and then to harvest the additional volumes generated by the new management regime. Thus, the long-term effects of management intensification are beyond the scope of this analysis.

It is apparent, however, that the predicted availability of harvest volume from Runs 34 and 44 (both based on the new inventory) is due to the investment of labor and capital by the separate owner groups. Without planned investment for management intensification, the future harvest volume would be decreased below its predicted level. The relative differences between the low (Run 34) and high (Run 44) ranges of management intensification are shown in Table 4.

In general, the differences in harvest volume with the two levels of management are not large; however, the differences in labor and capital investment per decade are large and will increase as time goes on. The necessary changes in the level of silvicultural treatments cannot be translated into immediate gains in harvest volume as long as the different ownerships are separately managed. But

FIGURE 7.

HARVEST VOLUMES IN DOUGLAS COUNTY BY OWNER GROUP AND DECADE AS PREDICTED BY RUNS 14 AND 24 (BASED ON THE OLD INVENTORY) AND RUNS 34 AND 44 (BASED ON THE NEW INVENTORY).

the timing and completion of the scheduled management activities are crucial for the attainment of projected harvests. Therefore, one method of estimating the likelihood of each owner group meeting its own management and harvest goals is to analyze the relative changes in investment requirements. Decades which require substantial increases represent weak links, since budgets may be incapable of changing sufficiently to ensure proper forest management.

Under Run 34, the National Forests would incur a 69 percent increase in labor and an 84 percent increase in capital requirements for the second decade (1985-94); thereafter, the labor and capital demands would decline. This second decade would be crucial in determining whether the National Forests could adjust their budgetary process sufficiently to reach their management and harvest goals. Nonindustrial private owners would also incur a major increase in their capital and labor requirements for the second decade, while State Forests would have only a modest increase in such requirements. On the other hand, requirements for both the Bureau of Land Management and industrial owners would generally decline during this period.

The predicted investment requirements of any owner group are dependent on the site class and age distribution of the forest base and the long-term management, treatment, and policy goals involved. A weakness of this analysis is that the current (1975-84) levels of management investment by owner group are difficult to obtain. Thus, we can only assume that the management required for this decade is already in progress. If this assumption does not hold, future harvest levels will be reduced below those estimated by Runs 34 and 44.

Future harvest levels and labor and capital requirements under Runs 34 and 44 are shown in Table 6. Note that harvest levels under high intensification of management (Run 44) are initially higher than those under low management intensification (Run 34) but that by the final decade the two become nearly equal. Thus, over the next five decades, the increases in capital and labor investments under high management intensity would be greater than the resulting increases in harvest levels. This projection should not be construed as evidence that such investment is uneconomical in the long run. Rather, it demonstrates only that highly intensive management will not result in commensurately higher harvests over the next few decades.

Table 7 shows the projected distribution of labor and capital requirements by the five owner groups. The capital required by the public sector will probably be supplied by non-local markets, whereas the private sector will have to compete for capital within regional or even local (county) markets. Whether the local economy is capable of supplying the labor and capital demands of the various owner groups will determine, in part, its future health. The more of each demand, especially labor, that is supplied from the local markets, the more likely the earnings from labor and capital are to be spent locally also.

In general, the public and private sectors have equal demands for labor and capital. But as demonstrated in Figure 7, the public sector is projected to supply a growing proportion (62-75 percent) of the timber harvested. The net result may be that the private sector, which owns all of the forest products mills, will increase the bid prices of stumpage in the public sector as harvest volume drops while demand for finished products remains constant. If so, the increased competitiveness of the stumpage market may reduce the private industrial sector's ability to invest capital in long-term forest management and thus reach the projected level of intensification, which is the highest of any owner group.

Logging and forest products industries

Run 34 (based on the new inventory and a low intensity of management) served as the data base for examining how alternative assumptions in subunits 2 and 3 affect the logging and forest products industries and how these industries in turn affect the local economy. Accordingly, four alternative runs were devised, in each of which the assumptions in the logging and forest products subunits varied from those in Run 34.

In Run 34A, the exogenous variables (which are not generated by the TREES model) were

TABLE 6.

PROJECTED HARVEST VOLUMES AND LABOR AND CAPITAL REQUIREMENTS FOR THE VARIOUS OWNERSHIPS IN DOUGLAS COUNTY ACCORDING TO MODEL RUNS 34 AND 44, IN RELATIVE PERCENTAGES WITH THE AVERAGE FOR 1975-84 UNDER RUN 34 AS THE BASIS FOR COMPARISON.

Model run[a] and decade	Harvest volume	Acres harvested	National Forests		BLM		State Forests		Private: Industrial		Private: Nonindustrial	
			Labor	Capital	Labor	Capital	Labor	Capital	Labor	Capital	Labor	Capital
	Relative percent											
Run 34												
1975-84	100	100	100	100	100	100	100	100	100	100	100	100
1985-94	98	108	169	184	108	107	120	118	88	93	123	136
1995-04	91	113	130	160	96	112	135	136	105	118	90	109
2005-14	76	151	115	152	79	100	92	111	89	123	63	82
2015-24	72	165	102	146	66	91	80	106	93	141	81	115
Run 44												
1975-84	104	104	115	117	118	112	178	130	127	117	100	101
1985-94	102	119	197	222	141	131	167	142	132	127	127	142
1995-04	92	142	150	198	118	137	163	155	169	176	94	112
2005-14	78	180	142	214	102	134	147	158	116	169	82	102
2015-24	72	190	121	208	89	132	129	157	124	195	98	131

[a]Assumptions for Runs 34 and 44 are listed in footnote a of Table 4.

TABLE 7.

PROJECTED PERCENT DISTRIBUTION OF LABOR AND CAPITAL REQUIREMENTS BY THE VARIOUS OWNERSHIPS IN DOUGLAS COUNTY ACCORDING TO MODEL RUNS 34 AND 44.

Model run[a] and decade	Capital required by--: National Forests	BLM	State Forests	Private owners: Industrial	Private owners: Nonindustrial	Labor required by--: National Forests	BLM	State Forests	Private owners: Industrial	Private owners: Nonindustrial
	Percent distribution									
Run 34										
1975-84	20	25	3	29	23	23	24	2	28	23
1985-94	29	22	3	21	25	32	22	2	21	23
1995-04	26	23	3	27	21	28	22	3	28	19
2005-14	27	22	3	31	17	30	22	2	29	17
2015-24	24	19	3	33	22	27	19	2	31	22
Run 44										
1975-84	21	25	3	30	21	22	24	3	30	21
1985-94	29	22	3	24	22	30	23	3	25	20
1995-04	25	22	3	32	17	25	21	3	35	16
2005-14	28	22	3	31	16	30	22	2	29	17
2015-24	25	20	3	34	19	25	20	2	32	21

[a]Assumptions for Runs 34 and 44 are listed in footnote a of Table 4.

held at their average values for 1975-79. With this procedure, silvicultural employment and earnings will remain constant.

In Run 34B, two of the exogenous variables--SLWPI (softwood lumber wholesale price index) and PNWLO (Pacific Northwest lumber output)--were estimated according to the projections of Adams et al. (1979) about the future timber situation in the United States. The estimates for LLP (lumber production profitability) were set at zero because the projected future values of the variables used in estimating LLP resulted in negative dollars per MMBF of lumber, an untenable assumption. Runs 34B and 34A both assume that increases in productivity will reduce employment by 7 percent per decade in the logging sector and by 9 percent per decade in the forest products and silvicultural sectors.

Runs 34C and 34D were based on the same assumptions as Runs 34A and 34B, respectively, except that the productivity assumption was removed in both. Thus, with these varied assumptions in the four alternative runs, future employment and earnings in the logging and forest products industries and in the other economic sectors can be estimated. (As the effects of the assumptions on employment and earnings are the same, only employment will be discussed.)

The consequences of these various assumptions are evident in Table 8. Run 34A shows that a decline in future harvests results in reduced employment in the logging and forest products industries. However, if the values of the exogenous variables are assumed to increase, as in Run 34B, then the decline in employment in these industries is much less.

Runs 34C and 34D demonstrate the impact that the productivity estimates have on employment. If there were no increases in productivity, employment in the forest-related industries would not drop appreciably below current levels and in the case of Run 34D would even increase. Of course, the rate of job loss stemming from increased productivity may actually be greater in the future, resulting in even fewer jobs as the harvest levels decline. The actual rate of change in employment in the forest-related industries will be dependent on both the rate at which production becomes mechanized and the rate at which increased utilization of wood residues as new products takes place.

Local economic impact

The effect of changes in the forest-related sectors on the service sector of Douglas County's economy is also shown in Table 8. Local county-wide totals were estimated by fixing the values for the other (non-forestry) basic industries at their 1979 level, which presumably approximates their average for the first decade (1975-84). Such a procedure should pinpoint any dependency of the service sector on the forest-related sectors.

Regardless of the assumptions used for the projection, the level of employment in the service sector changes much less over time than does that of the forest-related sectors. This disparity is primarily due to the different-sized coefficients of the two equations in the service model. Although the forest-related sectors collectively employ nearly 50 percent more than do the other basic industries, organizations such as non-local government and small exporting industries have exhibited a more stable growth base. The net effect is that as forest-related sectors decline, the service sector will probably also decline, but it may be more dependent on changes that affect the other basic industries.

In Douglas County, total employment in the forest-related sectors has been fluctuating between 8,000 and 9,000 during the past decade. Concurrently, employment in the other basic industries has grown from 4,700 to 6,400 and that in the service sector has grown from 9,000 to 18,000. Thus, it appears that, for the last decade at least, the forest-related industries have not been the primary growth inducers in the County's economy. The estimates from Run 34A apparently indicate that the declines in employment in the forest-related sectors could be offset by increases in employment in the other basic industries. Of course, if these industries suffer a decline, so will the entire local economy.

CONCLUSIONS

Runs 34 and 44, both based on the new inventory of Douglas County's forests but with opposite extremes of management intensity, were designed to answer several questions. The first was how increased future harvests resulting from intensified management would compare with the increased capital and labor required. As the projections showed, the increased harvests from such a program would not be completely evident until decades beyond the study period. Furthermore, the capital requirements for each owner would change for each decade. Such changes could not be implemented unless they were reflected in each ownership's budgetary process. And if the silvicultural treatments were not applied as scheduled, future harvest volumes (beyond five decades) might be significantly decreased.

Another question that Runs 34 and 44 were designed to answer was whether the jobs lost in the logging and forest products sectors as a result of declining harvests and improved technology could be offset by increased employment in the silvicultural sector as a result of management intensification. Such offsetting seems unlikely because the number

TABLE 8.

PROJECTED EMPLOYMENT AND INCOME FOR ALL SECTORS OF DOUGLAS COUNTY ACCORDING TO FOUR ALTERNATIVES TO MODEL RUN 34, IN RELATIVE PERCENTAGES WITH THE AVERAGE FOR 1975-84 UNDER RUN 34A AS THE BASIS FOR COMPARISON.

Model run[a] and decade	Employment in sector for--					Earned income in sector for--				
	Silviculture	Logging	Forest products industries	Service	Local countywide (total)	Silviculture	Logging	Forest products industries	Service	Local countywide (total)
	Relative percent									
Run 34										
1975-84	100	100	100	100	100	100	100	100	100	100
1985-94	120	92	95	97	97	120	94	102	99	99
1995-04	106	81	85	92	92	106	84	93	97	97
2005-14	87	65	70	84	83	87	69	79	96	94
2015-24	85	56	62	80	78	85	59	70	89	89
Run 34B										
1975-84	100	134	121	112	113	100	161	169	122	122
1985-94	120	150	128	117	118	120	198	207	135	135
1995-04	106	147	124	115	116	106	203	218	138	138
2005-14	87	121	107	105	105	87	172	197	130	130
2015-24	85	109	99	100	100	85	158	190	127	127
Run 34C										
1975-84	100	100	100	100	100	100	100	100	100	100
1985-94	120	101	102	101	101	120	103	106	102	102
1995-04	106	98	99	100	100	106	101	107	102	102
2005-14	87	87	87	94	93	87	91	99	99	99
2015-24	85	82	83	91	91	85	86	94	97	97
Run 34D										
1975-84	100	134	121	121	113	100	161	169	122	122
1985-94	120	165	138	123	124	120	218	222	140	140
1995-04	106	177	144	126	128	106	245	252	150	150
2005-14	87	160	133	120	121	87	228	245	147	147
2015-24	85	159	133	120	121	85	230	253	149	149

[a]Assumptions for the four alternative runs are outlined in text in the Results section on "Logging and Forest Products Industries."

of lost jobs may number in the thousands, whereas the total number of silvicultural jobs is less than 300. It is also important to note that the silvicultural jobs are defined in the model on an annual basis. Workers, however, are rarely employed for such seasonal labor as planting, burning, and spraying for 12 consecutive months. Thus, most of the people performing these activities are likely to be employed for only part of the year. If so, it may be that the additional revenue to low-income families from this part-time work would serve as an important financial supplement.

To compound the difficulty of projecting employment in the forest-related industries, the logging and forest products sectors are now undergoing important changes. In the last decade, more poeple have been employed for every million board feet processed than ever before, despite technological improvements that have increased the productivity of the individual worker. Furthermore, the large old-growth stands are nearly gone; consequently, more and more of the harvest volume must come from thinning and salvage operations or from harvesting younger stands perhaps on more difficult sites. Such labor-intensive practices may be the force that maintains employment in the logging sector as harvest volumes decline.

In the forest products sector, major changes have also occurred in the types of wood products produced and the materials used. During the decade 1962-76 (the data base for this study), wood chips became a fuel and raw material rather than a waste byproduct. Thus, lumber, which is still the primary product, must share its place with paper and plywood products. It remains to be seen whether the projected decrease in harvest volume can be compensated for by increased production through greater utilization of raw material, but the initial progress has already begun.

Runs 34 and 44 also indicated that future harvest volumes will be lower than Beuter et al. (1976) predicted. Moreover, it should be recalled that Runs 34 and 44 assume that harvest policy will be changed from non-declining even-flow to sequential sustained yields. If this policy change is not made, future harvest volumes may be even less than predicted. But if this change plus additional investments are made, the projections indicate that future annual harvests could be maintained at levels within the lower bounds of annual harvest fluctuations that have occurred within the past two decades.

The extent to which Douglas County's economy is adversely affected by the predicted decline in harvest volume is dependent on many factors. Although forest-related industries are the primary source of employment, not all of their employees would be lost by reduced harvest levels. The manner in which these industries adapt to future harvests will have a tremendous impact on the local economy. In addition, the health of the other basic industries will be important in determining how Douglas County's economy reacts to declining harvests and management intensification

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APPENDIX A: ESTIMATED LABOR AND CAPITAL FOR SILVICULTURAL OPERATIONS, ACCORDING TO OWNERSHIP UNIT, IN DOUGLAS COUNTY

COOS BAY: STATE FORESTRY DISTRICT

Operation and technique	Percent of total land on which technique will be applied	Acres/ man-day	1980 $/ acre
Regeneration			
Trapping	10	100	40
Preburn spraying	20	25	35
Burning	60	70	85
Planting	100	1.25	80
Tubing	80	1.0	150
Spray release	40	25	25
Spray release after 1 year	40	25	45
Replanting after 3 years	20	1.25	173
Trapping	20	100	40
Hand release after 3 years	7.5	1.5	128
Hardwood conversion			
Slashing	100	2.6	66
Aerial spraying	100	25	35
Burning	70	50	184
Tractor scarification	5	6.8	210
Yum yarding	25	6	340
Preplant trapping	10	100	40
Planting	100	1.25	80
Tubing	80	1	150
Spray release	40	25	25
Spray release after 1 year	40	25	45
Replanting after 3 years	20	1.25	173
Post-plant trapping	20	100	40
Hand release after 3 years	7.5	1.5	128

SUMMARY: WEIGHTED AVERAGES

Operation	Man-days/acre	1980 $/acre
Regeneration	1.903	410
Regeneration with genetically superior stock	2.205	465
Precommercial thinning	2.0	90
Fertilization	0.01	55
Hardwood conversion	2.333	730

GRANTS PASS: STATE FORESTRY DISTRICT

Operation and technique	Percent of total land on which technique will be applied	Acres/ man-day	1980 $/ acre
Regeneration			
Burning	20	70	50
Herbicide spraying	10	4	30
Slash and stump treatment	5	25	45
Planting	100	1.25	80
Spray release	30	25	30
Spray release after 1 year	40	25	55
Interplanting after 3 years	35	1.25	71
Hand release after 3 years	5	1.5	113
Hardwood conversion			
Stem ejection	60	4	35
Slash and stump treatment	10	1.5	50
Aerial spraying	20	25	30
Browning and burning	10	50	120
Tractor scarification	10	6.8	210
Planting	100	1.25	80
Spray release	40	25	30
Spray release after 1 year	30	25	55
Interplanting after 3 years	30	1.25	71
Hand release after 3 years	5	1.5	113

SUMMARY: WEIGHTED AVERAGES

Operation	Man-days/acre	1980 $/acre
Regeneration	1.171	190
Regeneration with genetically superior stock	1.387	215
Precommercial thinning	1.333	95
Fertilization	0.01	55
Hardwood conversion	1.343	240

UMPQUA NATIONAL FOREST

Operation and technique	Percent of total land on which technique will be applied	Acres/ man-day	1980 $/ acre
Regeneration			
Slash burning	100	50	70
Site preparation, aerial	40	25	75
Site preparation, hand	20	4	20
Planting	100	1	88
Tubing	60	0.75	250
Replanting and tubing after 3 years	15	1.25	80
Hand release after 3 years	5	0.5	113

SUMMARY: WEIGHTED AVERAGES

Operation	Man-days/acre	1980 $/acre
Regeneration	2.039	360
Regeneration with genetically superior stock	2.423	410
Precommercial thinning	1.0	90
Fertilization	0.01	55
Hardwood conversion	2.42	550

SOUTH UMPQUA: BUREAU OF LAND MANAGEMENT

Operation and technique	Percent of total land on which technique will be applied	Acres/ man-day	1980 $/ acre
Regeneration			
Slash burning	60	70	85
Herbicide spraying	40	25	75
Planting	100	1.25	94
Tube and leader protection	40	3.0	351
Replanting after 3 years	15	1.25	80

SUMMARY: WEIGHTED AVERAGES

Operation	Man-days/acre	1980 $/acre
Regeneration	1.544	325
Regeneration with genetically superior stock	1.848	975
Precommercial thinning	1.333	85
Fertilization	0.01	55
Hardwood conversion	1.78	550

APPENDIX B: CURRENT AND PROJECTED DISTRIBUTION OF FORESTED ACRES BY MANAGEMENT INTENSITY AND OWNERSHIP UNIT IN DOUGLAS COUNTY

Ownership unit	Management intensity[a]	Current distribution[b]	Target A[c] 1975-2005	Target A[c] 2005+	Target B[d] 1975-2005	Target B[d] 2005+
National Forests						
Rogue River	2	--	--	--	--	--
	3	100	6	6	15	15
	4	--	69	69	30	30
	5	--	25	25	14	14
	6	--	--	--	36	35
	7	--	--	--	5	6
Siuslaw	2	--	2	2	--	--
	3	100	--	--	13	13
	4	--	--	--	5	5
	5	--	98	98	16	16
	6	--	--	--	61	33
	7	--	--	--	5	33
Umpqua	2	--	--	--	--	--
	3	100	11	11	7	7
	4	--	59	59	25	25
	5	--	30	30	30	30
	6	--	--	--	31	29
	7	--	--	--	5	7
Willamette	2	--	--	--	--	--
	3	100	6	6	17	17
	4	--	75	75	16	16
	5	--	19	19	21	21
	6	--	--	--	41	38
	7	--	--	--	5	8

Ownership unit	Management intensity[a]	Current distribution[b]	Target A[c] 1975-2005	Target A[c] 2005+	Target B[d] 1975-2005	Target B[d] 2005+
Bureau of Land Management Units						
Siuslaw and Upper Willamette	2	3	3	3	--	--
	3	91	5	5	17	17
	4	--	41	41	16	16
	5	6	51	51	21	21
	6	--	--	--	41	38
	7	--	--	--	5	8
South Umpqua and Douglas	2	6	2	2	--	--
	3	93	11	11	7	7
	4	1	61	61	25	25
	5	--	26	26	30	30
	6	--	--	--	33	31
	7	--	--	--	5	7
South Coast and Curry	2	10	3	3	--	--
	3	88	7	7	23	23
	4	2	59	59	26	26
	5	--	31	31	28	28
	6	--	--	--	18	18
	7	--	--	--	5	5
Jackson, Josephine, and Klamath	2	10	2	2	--	--
	3	90	29	29	15	15
	4	--	22	22	30	30
	5	--	47	47	14	14
	6	--	--	--	36	35
	7	--	--	--	5	6
Coos Bay State Forest District; other public land in Douglas County	2	11	5	5	--	-
	3	86	82	82	23	23
	4	2	2	2	26	26
	5	1	11	11	28	28
	6	--	--	--	18	18
	7	--	--	--	5	5

Ownership unit	Management intensity[a]	Current distribution[b]	Target A[c] 1975–2005	Target A[c] 2005+	Target B[d] 1975–2005	Target B[d] 2005+
Grants Pass State Forest District; other public land in Douglas County	2	--	2	2	--	--
	3	99	86	86	15	15
	4	1	12	12	30	30
	5	--	--	--	14	14
	6	--	--	--	36	35
	7	--	--	--	5	6
Private, industrial owners	2	10	2	1	--	--
	3	50	36	30	7	7
	4	17	40	40	25	25
	5	16	15	15	30	30
	6	7	7	9	33	31
	7	--	--	5	5	7
Private, nonindustrial owners	2	32	7	3	2	1
	3	68	70	65	36	30
	4	--	23	23	40	40
	5	--	--	9	15	15
	6	--	--	--	7	9
	7	--	0	--	--	5

Adapted from Beuter et al. (1976).

[a]Management intensities are defined in detail in Beuter et al. (1976, p. 87–89). Brief definitions are as follows:

1 is for softwood species with no management intensification.
2 is for hardwood species with no management intensification.
3 is for softwood species with no management intensification, but growth is adjusted to take into account the present stocking of the stand.
4 is for softwood species and includes commercial thinning.
5 is for softwood species and includes stocking control (precommercial thinning) and commercial thinning.
6 is for softwood species and includes stocking control, commercial thinning, and fertilization.
7 is for softwood species and includes regeneration with genetically improved stock, stocking control, commercial thinning, and fertilization.

[b]Current distribution of acres by management intensity reflects the starting inventory as of January 1, 1975.

[c]Target A was intended to be a moderate intensification of current management practices and was based on interviews with land managers.

[d]Target B was intended to be a highly accelerated intensification of current management practices except by private, nonindustrial owners. It was based on interviews with managers of private, industrial land. Distribution for private, nonindustrial land was arbitrarily set at a lower level than was used for the other ownership classes.

DIPPON, DUANE R., AND PHILIP L. TEDDER. 1983. PREDICTING THE ECONOMIC IMPACT OF INTENSIFIED FOREST MANAGEMENT: DOUGLAS COUNTY, OREGON, AS A CASE STUDY. Forest Research Laboratory, Oregon State University, Corvallis. Research Bulletin 41. 30 p.

A model consisting of a linked series of equations is presented for estimating the future effect of various intensities of forest management on the economy of a region. The model, in conjunction with the most recent inventory of the USDA Forest Service, is then applied to data from Douglas County, Oregon. Results indicate that intensive forest management will have little economic impact on Douglas County over the next five decades.

KEY WORDS: forest economics, regional economics, harvest scheduling, supply and demand, policy analysis.

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