The Economic Consequences of Reserving Federal Land for Biodiversity Protection in the U.S. Pacific Northwest[@&]

by

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Abstract: We empirically investigate the effects of the Northwest Forest Plan on two widely-used economic indicators: employment growth and net migration. We find weak evidence that that setting aside 10 million acres of productive forest land for biodiversity protection had a large, but short-lived effect on employment growth.

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Introduction

For decades, the United States' goal of protecting endangered species has embroiled the U.S. Pacific Northwest (PNW) in controversy. Often, the controversies narrow to questions of allocations of public owned land and water to competing uses and the effects of these allocations on indicators of economic well-being. The often-heard phrase is "Jobs versus the Environment."

Spurred by the listing of the northern spotted owl as a threatened species under the Endangered Species Act and various federal court decisions, the PNW has embarked on a major experiment, representing dramatic shift from the use of federal land primarily of timber production to management for ecosystem services, especially biodiversity. Following WWII, federally owned land in the PNW was managed primarily for timber production. As timber harvests grew, large-scale conversions of old-growth forests to even-aged conifer stands occurred, until only 13 percent of the PNW's old-growth forests remained (Anderson and Olsen 1991).[1]

In the 1950's and 1960's, there was little scientific or public concern with the ecological implications of timber harvests. Subsequently evidence began to accumulate that conversion of old-growth forests to intensively managed tree farms threatened a variety of ecosystem functions and services, including biodiversity, habitat, energy flow, and nutrient and water cycling (Franklin et al. 1981; Forsman et al. 1977; National Research Council 2000). Much of this concern became focused on the northern spotted owl. In 1982, the U.S. Forest Service' regional planning guide designated the spotted owl as an indicator species of the region's old-growth forest and provided management

[1] The National Research Council (2000) reports that pre-European Pacific Northwest forests was probably composed of 60-70 percent old-growth forests, whereas this has been reduced to around 18 percent, nearly all on federal land.

guidelines and habitat objectives designed to preserve the species. However, appeals by many organizations of Forest Service and BLM proposed actions culminated in an April 1989 federal district court preliminary injunction against timber sales in spotted owl habitat and a June 1989 U.S. Fish and Wildlife Service proposal to place the spotted owl on the threatened list of the Endangered Species Act.[2] In April 1990, the Interagency Scientific Committee concluded that Forest Service and BLM owl management guidelines were a "prescription for [the bird's] extinction" and proposed 193 habitat conservation areas for owls, ranging from 50 to 676,000 acres (Thomas et al. 1990). In June 1990, the U.S. Fish and Wildlife Service listed the spotted owl as threatened throughout its range in Oregon, Washington, and Northern California.[3]

Under the umbrella of the Northwest Forest Plan[4] (Espy and Babbit 1994), nearly 50 percent (11.5 million acres) of federally owned land in western Washington, western Oregon, and northern California was reallocated from primarily the production of timber to the production of biodiversity protection and other ecosystem services. The reallocation was spread over six conservation land classifications and 67 counties in the three states. Brief definitions of the six classifications used in the Northwest Forest Plan (NWFP) are in Table 1, along with the number of acres allocated.

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[2] For more details, see Watson and Muraoka (1992).

[3] Other concerns included non-timber forest products, marbled murulets, and several salmon and steelhead stocks (Anderson and Olsen 1991).

[4] The Northwest Forest Plan was unambiguously designed to deliver biodiversity protection. Consider the statement from the Record of Decision: "We expect and intend that the management direction and land allocations in this decision will constitute the federal contribution to the recovery of the northern spotted owl. We expect that future recovery plans for any listed species associated with late-successional old-growth forest habitat in the Pacific Northwest (including the final recovery plans for the northern spotted owl and the marbled murrelet) will use the management plan direction adopted in this decision as a base from with to build a strategy for recovery" (Espy and Babbit 1994, p. 15). The Plan also recognized the potential impact on timber harvests. Whereas timber harvests from federal lands in Regions 5 and 6 averaged 4.5 billion board feed in 1980-89 and 2.4 billion in 1990-92, the expected harvest level during the first decade of the Northwest Forest Plan was expected to be 1.1 billion board feet (Espy and Babbit, 1994, p.19.) For a review of the natural science effort behind the NWFP see Noon and McKelvey (1996).

Sufficient time has elapsed to begin measuring the economic effects of reallocating PNW federal land from the production of nearly 4 billion board feet of softwood lumber annually to the provision of habitat for the northern spotted owl, the marbled murrelet, and several Pacific salmon stocks.[5]

Twenty years ago, few would have argued with the conclusion that the economic effects would be negative, certainly not most economists. The reasoning ran as follows: Traditional commodity production, especially timber harvests, from public land keeps mills running and yields high-wage jobs, an expanding regional workforce, and regional economic wealth. Conversely, "locking up" land for conservation purposes would shut down the mills and lead to unemployment, out-migrating workers, and a stagnating economy. Indeed, many predicted huge negative effects from land reallocation under the Northwest Forest Plan, with job loss predictions ranging from 13,000 (Anderson and Olsen 1991 to 130,000 (Beuter et al.1990).[6]

However, newer economic research has challenged this traditional view. The retrospective studies of Burton (1997), Burton and Berck (1996) and Daniels (1991) were unable to link traditional forest commodity production with improving economic indicators.[7] More recently, the traditional view has been challenged by a new paradigm of economic well-being in the western U.S. This paradigm posits that the use of public land for conservation, rather than commodity production, may be the best strategy for fueling economic growth. This process may work in any of three ways (Power 1996; Duffy-Deno 1998; Niemi, Whitelaw, and Johnson 1999; Power and Barrett 2001): 1)

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[5] Wear and Murry (2003) simulate the effects of the NWFP on the U.S. softwood industry. They do not report estimates of employment effects, although their models' results may contain such estimates for the wood products industry.
[6] McKillop (1993) projects the loss of 72,000 jobs. See also Niemi, Whitelaw and Johnson (1999)
[7] An extensive review of this literature appears in National Research Council (2000).

conservation lands may attract firms, whose managers value the resulting amenities;[8] 2) conservation lands may attract firms by providing direct production inputs, recreation based enterprises, such as fishing, kayaking, and rafting guides are common examples; and 3) firms may be attracted to a pool of relatively high-quality and low-cost workers, who have expressed their willingness to trade lower incomes for the amenities provided by conservation lands by migrating to the area. Niemi, Whitelaw, and Johnson (1999) apply this reasoning to partially explain a putative small economic impact of the NWFP. Further, Power and Barrett (2001) and Niemi, Whitelaw, and Johnson (1999) argue that subsidized commodity production from federal lands may be responsible for poor economic performance in the western U.S. because of the negative externalities and inefficient subsidies involved.

These challenges entice an empirical discussion on whether managing land for non-commodity ecosystem services involves economic costs or benefits. In other words, how much and in what direction are widely-used economic indicators influenced by allocating public land to conservation uses? Some evidence has emerged. Duffy-Deno (1998) examined the effect of wilderness land on population and employment density growth between 1980 and 1990 for 250 rural counties in the U.S. intermountain west. He found essentially that wilderness had no effect on either economic indicator. Lewis, Hunt, and Plantinga (2002 and 2003) found that conservation land designation had no effect on population, employment, or wage growth in the Northern Forest.

A potential reason for the failure of these studies to find significant or substantive negative effects of taking land out of commodity production is that the wilderness and

[8] Johnson and Rasker (1993) and Crompton et al. (1997) find survey evidence that some firms base relocation decisions more on "quality of life" considerations, including the amenities provided by public land, than on business-related factors.

conservation lands studied were so designated because they are not especially commodity productive (Duffy-Deno 1998). The study of lands classified by the NWFP will not suffer from this potential failure. Much of the re-classified land is among the most productive timberland on the planet.

Modeling Northwest Forest Plan Effects on Economic Indicators

We empirically analyze the impact of the NWFP on two widely used economic indicators: employment growth and net domestic migration. We estimate a cross-section sample of county-level data for the for the 67 Oregon, Washington, and Northern California counties with lands reclassified by the NWFP and the seven counties adjacent to such counties.

Time Periods

We simultaneously estimate equations of employment growth and net domestic migration for three time- periods: 1980-1990, 1990-1994, and 1994-2001. The first period was one of large and sustained timber harvests, but with declining harvests toward the end due to successful legal challenges to federal land management plans and proposed timber sales. Although, NWFP reclassifications had not yet occurred, some conservations lands had been set aside in the form of wilderness and recreation area, and wild and scenic river designations. To provide benchmark results for comparison with later periods and with previous studies, we investigate the effect of state forests, wilderness areas, and (non-wilderness) lands managed by the U.S. Forest Service, the Bureau of Land Management, and the National Park Service.

The second period, 1990-1994, was one of upheaval in the PNW timber industry including legal decisions, U.S. Fish and Wildlife Service' listings of the spotted owl, and a 90 percent reduction in timber harvests from federal land. It culminated in the release of the Northwest Forest Plan in 1994. The final time-period represents one of more complete economic adjustment of the region's economy to the NWFP (Niemi, et al. 1999).

For 1990-1994 and 1994-1999, the proportion of each county's land allocated to the NWFP's late success ional reserves, adaptive management areas, administratively withdrawn areas, or managed late successional, or riparian reserves is used as a measure of the exposure of counties' economies to NWFP impacts on employment growth and net migration (see Table 1). The inclusion of these 11.68 million acres allows us to test for both direct and indirect effects of conservation lands on the endogenous economic indicators. The combinations of these two effects allow us to estimate the positive or negative benefits of re-allocating public land to provide the ecosystem service of biodiversity protection. Congressionally reserved areas and matrix lands are not included in the sum because the former were created well before the NWFP and the latter classification did not preclude timber harvesting.[9]

We follow Lewis, Hunt, and Plantinga (2002 and 2003) and by estimating an econometric model of the effects of public conservation lands on employment growth and net migration for the 67 counties whose lands lie in the Northwest Forest Plan. The equations are specified as:

[9] The NWFP also constrained harvesting on matrix lands by specifying forest structure (50% of the area with tree diameter >28 cm and canopy closure >40%, 40 ha reserves around known owl sites, retention of 15 % of the trees in a cutting unit and 46-91m riparian buffers along all streams (Noon and McKelvey 1996)

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\begin{aligned}
EG_{j,s-t} &= f_1(NM_{j,s-t}, WG_{j,s-t}, CL_{j,h,s}, X_{i,s} \mid \alpha_t) + \varepsilon_{j,s-t} \\
NM_{j,s-t} &= f_2(EG_{j,s-t}, WG_{j,s-t} CL_{j,h,s}, X_{i,s} \mid \beta_t) + \lambda_{j,s-t} \quad ,
\end{aligned}
\tag{0.1}
$$

where the two endogenous variables, $EG_{j,\,s-t}$, $NM_{j,s-t}$, are the percentage change in total employment and percentage change in population from net domestic migration, respectively in the jth county over the period s-t, j=1,2,…, 74, s=1980, 1990, 1994 and t=1990, 1994. $CL_{j,h,s}$ is the proportion of land in the jth county allocated to conservation classification h, at time period s, where h varies with s. $X_{j,s}$ are vectors of exogenous variables influencing the economic indicators, α_t, β_t, δ_t are vectors of time-period-specific parameters to be estimated, and $\epsilon_{j,s-t}$, $\gamma_{j,\,s-t}$, and $\lambda_{j,s-t}$ are disturbance terms, assumed to have zero means, but non-zero spatial and temporal autocorrelation parameters (see Bailey and Gattrell 1995). Equations 1.1 are estimated using Three Stage Lease Squares.

Variables in Net Migration Equation

Employment Growth is measured as the percentage change in total county employment over the corresponding period and Net Migration is the percentage change in county population, net of changes in births and deaths. These natural changes are excluded so that Net Migration reflects population changes due to in- and out-migration. Data sources for these and the exogenous variables discussed below are provided in Table 2.

The goal of the econometric estimation is to obtain consistent and precise estimates of the effects of the NWFP and other public land classifications. As such, we include many potentially relevant exogenous variables in the model to minimize the potential of biases in the parameter estimates of interest. We include in the Employment

Growth equations a set of variables to control for factors affecting production costs. Interstate 5 is the major north-south highway route on the west coast and much of the Pacific Northwest's economic activity has been concentrated in this corridor (Anderson and Olson 1991), so we include an indicator variable, Interstate-5, which takes on the value 1 if this highway is in the county. To control for other transportation costs, we include Road Density, the ratio of interstate and other major arterial miles to county land area. To control for agglomeration economies (cost reductions resulting from spatial proximity to other firms), we include the indicator variable MSA, taking on a value of 1 if the county is part of a metropolitan statistical area, and zero otherwise. Finally, because agglomeration effects may be greater in larger urban areas, we include a separated indicator variable, Big msa, for counties that are part of the Portland or Seattle metropolitan statistical areas, the two major urban centers of the region.

The next set of variables included in the Employment Growth equation includes factors affecting local labor market conditions. Lagged (start of period) high school and college graduation rates are used to measure the educational attainment of the local labor force. Specifically, Highschool% and College% are the percentages of the counties' populations over 25 years of age who have completed high school and college, respectively. Unemployment% measures the lagged unemployment rate and Forestearnings% measures the lagged contribution of wood products manufacturing to total county earnings. Some counties in our study area are heavily dependent on wood products manufacturing and so may experience greater direct employment effects from the NWFP than counties without substantive wood products employment. Forest Earnings% is computed as payroll for SIC 24 (sawmills, logging, etc) divided by total

county payroll. Finally, Dividend% is the share of total personal income derived from dividends. This variable controls, to some degree, for external income injected into the local economy.

In the Employment Growth equation, variables measuring public land management classifications and climatic factors represent production amenities, or perhaps disamenities in the case of federal forests with logging restrictions. The public lands variables included the lagged percentage of the counties' land in wilderness areas (e.g. land so designated under the Wilderness Act of 1964), Wild%; national parks, National Park%, national forest, National Forest%, Bureau of Land Management, BLM%, and state forests, State%. In the 1990-1994 and 1994-1999 models, we include the percentage of county land reclassified by the NWFP, Northwest Forest Plan%. We exclude National Forest% and BLM%, because Northwest Forest Plan% is composed entirely of land previously classified as managed by the USFS and BLM. It is important to note that some conservation lands in the study region were designated well before the periods we analyze. For example, Mount Rainer and Crater Lake National Parks were established in 1899 and 1902, respectively.[10] The initial employment effects associated with the designation of these lands would probably not be reflected in current employment growth rates, but would be present in employment levels. We include lagged Employment density in the model, defined as total county employment divided by county land area, to control for the historical effects of conservation lands on employment levels and to ensure that our model isolates the impacts on employment growth during subsequent periods.

[10] Other national parks in the region were established more recently. Redwood National Park, in northern California, was initially designated in 1968 and expanded in 1978. Most of the region's wilderness areas were initially designated in 1964, but many were expanded in 1984.

There are considerable climatic differences in our region, particularly along an east-west gradient and McGranahan's (1999) work suggests these natural amenities (of disamenities) may influence employment growth and migration decisions. Coastal areas tend to be cool and wet. Interior regions have a similar climate during the winter, but are warmer, drier, and sunnier during the rest of the year. Finally, the high desert regions east of the Cascade Range are colder in winter and sunnier and drier overall. Our climate variables include the mean January and July temperatures, January temp and July temp, mean hours of sunshine in January (January sun) and mean July humidity (July humid), all means taken over the period 1941-1970. To capture potential differences between areas on the coast, the interior valleys, and east of the Cascade Range, we include mean rainfall in January (January rain).

The exogenous variables in the Net Migration equation measure the attractiveness of the county to potential migrants and current residents. The transportation cost variables (Interstate-5 and Road Density) are used to control for accessibility, which is expected to positively influence migration decisions. The agglomeration variables (MSA, and Big metro) may indicate better employment prospects for individuals. We include all the land management variables (Wild%, National Park%, National Forest%, BLM%, State%, and Northwest Forest Plan%) and climate variables (January temp, July temp, January sun, July humid, and January rain). In the Net Migration equation, these variables represent consumption amenities or dis-amenities for residents and potential migrants. Similar to the employment growth equation, we include lagged Population Density (total population divided by county land area) to "absorb" the earlier effects of public land management on population.

Additional variable, all in lagged form, are constructed to control for community characteristics. The expenditure-to-tax ratio (Expenditure/Tax Ratio), measured as the ratio of local government expenditures to local taxes, proxies for the provision of public sector goods, relative to the tax burden imposed on residents. The composition of government spending is indicated by the shares of government expenditures allocated to health care and hospitals (Health%) and education (Education%). We include a variable, Crime Rate, measured as the number of serious crimes per 100,000 population. To control for the stability of the community, we include a variable indicating the percent of owner-occupied homes (Home ownership). Finally, median household income (Household Income) proxies for a number of factors, such as the extent and nature of the consumer and cultural opportunities and characteristics of the local housing market.

In both the Employment Growth and Net Migration equations, we include indicator variables for Oregon and Washington (California is the reference category) to control for unmeasured differences between states, such as tax rates, land-use regulations, and state-level government expenditures.

Results

1980-1990

The parameter estimates for 1980-1990 appear in Table 3. The overall explanatory power of the regressions is quite high, with an R^2 of .782 for Employment Growth and .806 for Net Migration. As expected, we find Net Migration to be a significant driver of Employment Growth, with a 1.48 parameter estimate (t-statistic=4.45). In addition, the positive coefficient for MSA suggests urban counties experienced higher employment

growth than their non-urban counterparts. Yet, controlling for MSA, the results indicate Employment Growth is negatively, and significantly, correlated with employment density. We also find counties with more a higher percentage of residents with college degrees have higher Employment Growth, probably reflecting the quality of the work force. Of the climate variables, only January rain is statistically significant, with a negative coefficient. The results indicate that neither wilderness classification, nor state forest, U.S.F.S. or BLM management have significant effects on Employment Growth during this pre-NWFP period. Although all these parameter estimates are negative, none is statistically significant at conventional levels. However, the parameter estimate for National Park% is negative and marginally significant ($\alpha<.07$), indicating that job growth was retarded in counties with land designated as wilderness. This result differs from the result obtained by Duffy-Deno in his study of counties in the intermountain west and may reflect the relatively recent creation and addition to national parks in the study region.

The results for Net Migration show that Employment Growth is a significant determinate of Net Migration, with a parameter estimate of .391 (t-statistic=8.72). Net Migration responds positively and significantly to employment growth. The results suggest Net Migration is significantly related to household income in a negative fashion, the percentage of public funds spent on health care positively, and the percentage of owner-occupied homes, positively. Of the climate variables, Net Migration appears to be positively related to January temperatures and negatively related to July humidity. We find for this period that Net Migration is not directly driven by public lands management as none of the parameter estimates for these variables are statistically significant, although all but BLM% are positive.

1990-1994

The results for 1990-94 appear in Table 4. Compared to the earlier period, the overall explanatory power of the regressions is lower, but still quite high, with an R^2 of .529 for Employment Growth and .482 for Net Migration equation. The findings are that, during the tumult culminating in the NWFP, Employment Growth was still driven by Net Migration, although the estimated effect is smaller than for 1980-1990 (.842 vs. 1.48) and statistically significant only at $\alpha<.06$. As in the earlier period, January Rain appears to retard employment growth in a statistical significant manner.

Most importantly, the Northwest Forest Plan% parameter estimate is negative and quite statistically significant ($\alpha<.03$), suggesting that counties with more land re-classified for spotted owl protection experienced a direct effect of lower employment growth, *ceterius paribus*. Neither wilderness nor national park designation (National Park%) nor state forest management (State Forest%) of land appears to influence Employment Growth. As with the 1980-1990 period, the national park parameter (National Park%) parameter estimate is negative, although not statistically significant at conventional levels (p-value=.23).

Net Migration from 1990-94 is related to Employment Growth in a positive and significant manner. The parameter estimate is roughly equal to that of the previous period and highly significant (t-statistic=3.81). The results show that Net Migration was higher into MSA counties and migrants are attracted to (or residents induced to stay in) counties in with higher levels of owner-occupied homes (Home Ownership). As in the previous period, migrates appear to be attracted to counties spending a higher proportion of public funds on health care (Health%), although the parameter estimate is not

statistically significant at conventional levels for this period. Notably, we find Net Migration is positively and significantly correlated with Northwest Forest Plan%; the parameter estimate is both positive (.096) and statistically significant (T-statistic=2.106). This result suggests an offsetting effect for Northwest Forest Plan%. Its direct effect on Employment Growth is negative; yet Employment Growth is positively affected by Net Migration, which, in turn, is positively driven by Northwest Forest Plan%. The net effect is discussed below. For the other land management variables, we find that Net Migration is not directly affected by either national park designation nor state forest management nor wilderness designation.

1994-1999

The results for 1994-99 appear in Table 6. The overall explanatory power of the regressions still quite high, with an R^2 of .498 for Employment Growth equation and .599 for Net Migration. The findings suggest that Employment Growth is still driven by Net Migration, with a parameter estimate to that of 1980-1990 (1.571 vs. 1.48) and larger than that of 1990-1994 (1.571 vs. .842), which is statistically significant (α<.02). Few of the individual coefficients are statistically significant in the Employment Growth equation, although most of their signs are as expected and the same as for previous periods. A skilled workforce, as indicated by College%, may contribute to Employment growth and the presence of retirement income, as measured by Dividend%, may augment the demand for labor. Of the climate variables, Employment Growth appears to be positively and significantly related to July Temp. The results for this period suggest a return to the long run relationship between employment growth and public land use found during 1980-1990. Specifically, the Northwest Forest Plan% direct effect parameter

estimate, although negative, is not statistically significant. Neither Wild% nor National Park% nor State% appearsto directly influence employment growth. As in the two previous periods, the Nation Park% parameter estimate is negative, although not statistically significant at conventional levels.

Net Migration from 1994-99 is related to Employment Growth in a positive and significant manner, with a somewhat larger and more significant parameter estimate than the one for 1990-94. The statistically significant, positive coefficients for the Oregon and Washington indicator variables probably reflect the pervasive out-migration experienced by California counties during this period. In addition, net migration was higher to MSA counties and migrants are attracted to counties with higher levels of owner-occupied homes. As in the previous period, migrates appear to be attracted to counties spending a higher proportion of public funds on health care, although the parameter estimate is not statistically significant. Of the climate variables, higher July temperature and humidity appear to repel Net Migration, with the statistical evidence weaker for the latter effect. The results suggest migrants were not attracted to counties with high Northwest Forest Plan%. The parameter estimate is negative, but not statistically significant. Neither wilderness nor national park designation nor state forest management has statistically significant direct effect parameter estimates.

Total Effects

Estimation of equation (1.1) allows Employment Growth and Net Migration to be determined simultaneously, with each a determinant of the other. Consequently, the total effect of any public land management variable is the sum of the direct and indirect

effects. In Table 6, we show the calculated total effects for the three periods as well as their t-statistics. The pattern that emerges is one in which public land management policies are not generally significant drivers of Employment Growth and Net Migration, although there may be some exceptions. The estimated total effects of Wilderness% and State Forest% are positive for both Employment Growth and Net Migration in all three periods, although no single parameter estimate differs significantly from zero at conventional levels. The estimated total effect for National Park% is negative for both economic indicators in all periods. However, it is marginally significant only for 1980-1990. Notably, the results provide weak evidence that the NWFP had a negative effect on Employment Growth during 1990-94, as the total effect estimate is -.167 with a t-statistic of 1.683. This effect appears to have been short-lived as the estimate for 1994-1999 is an order of magnitude smaller and does not differ statistically from zero.

TABLE 1 NORTHWEST FOREST PLAN LAND CLASSIFICATIONS		
CLASSIFICATION	DEFINITION*	ACRES
CONGRESSIONALLY RESERVED AREAS@	RESERVED BY ACT OF CONGRESS, E.G. WILDERNESS AREAS, WILD AND SENIC RIVERS.	7.320.600
LATE SUCCESSIONAL RESERVES	DEDICATED TO MAINTAINING A FUNCTIONAL, INTERACTIVE, LATE-SUCCESSIONAL AND OLD-GROWTH FOREST. DESIGNED TO SERVE AS HABITAT FOR OLD-GROWTH RELATED SPECIES INCLUDING THE NORTHERN SPOTTED OWL.	7,430,800
ADAPTIVE MANAGEMENT AREAS	DESIGNED TO DEVELOP AND TEST NEW MANAGEMENT APPROACHES TO INTEGRATE AND ACHIEVE ECOLOGICAL, ECONOMIC, AND OTHER SOCIAL AND COMMUNTY GOALS.	1,521,800
ADMINISTRATIVELY WITHDRAWN AREAS	IDENTIFIED IN CURRENT FOREST AND DISTRICT PLANS, OR DRAFT PLAN PREFERRED ALTERNATIVES AND INCLUDE RECREATION AND VISUAL AREAS, BACK COUNTRY, AND OTHER AREAS NOT SCHEDULED FOR TIMBER HARVEST.	1,477,100
MANAGED LATE SUCCESSIONAL RESERVES	EITHER DELINEATED FOR MAPPED, KNOWN SPOTTED OWL ACTIVITY CENTERS OR UNMAPPED PROTECTION BUFFERS, OR DESIGNATED TO PROTECT CERTAIN RARE AND LOCALLY ENDEMIC SPECIES.	102,200
RIPARIAN RESERVES	AREAS ALONG ALL STREAMS, WETLANDS, PONDS, LAKES, AND UNSTABLE AREAS WHERE CONSERVATION OF AQUATIC AND RIPARIAN-DEPENDENT TERRESTRIAL RESOURCES RECEIVES PRIMARY EMPHASIS.	2,627,500
MATRIX	FEDERAL LAND OUTSIDE OF THE SIX CATEGORIES ABOVE. THE AREA IN WHICH MOST TIMBER HARVEST AND OTHER SILVICULTURAL ACTIVITIES WILL BE CONDUCTED. ALSO CONTAINS NON-FORESTED AREAS AND FORESTED AREAS NOT TECHNICALLY SUITED FOR TIMEBER PRODUCTION.	3,975,300
*QUOTED FROM OR A SUMMARY OF EPSY AND BABBIT (1994) @NO NEW LANDS IN THIS CLASSIFICATION WERE ALLOCATED BY THE NORTHWEST FOREST PLAN		

TABLE 2 Variable Names, Definitions, and Sources			
Name	Variable definition	Source	Years
Employment Growth	% change in employment	County Business Patterns	1980-1990,1990-1994, 1994-1999
Net Migration	% Net domestic migration	U.S. Bureau of Census	1980-1990,1990-1994, 1994-1999
Oregon	Indicator variable equal to 1 for Oregon counties.		
Washington	Indicator variable equal to 1 for Washington counties.		
HG	% OF PEOPLE >25 WHO GRADUATED FROM HIGH SCHOOL	City and County Data Book	1990
Interstate-5	Indicator variable equal to 1 four counties containing Interstate 5	Rand McNally Road Atlas	2000
MSA	Indicator variable equal to 1 for counties in a metropolitan statistical area	U.S. Bureau of Census	
Household Income	Median Household Income	City and County Data Book	1979, 1989, 1993
Health%	Percentage of government expenditures on health and hospitals	U.S.A. Counties	1977, 1987, 1992
Education%	Percentage of government expenditures on education	U.S.A. Counties	1977, 1987, 1992
Population Density	Population per square mile	City and County Data Book	1980, 1990, 1993
Expenditure/Tax ratio	Ratio of local government expenditures to local tax revenue	U.S.A. Counties	1977, 1987, 1992
Home ownership	Percentage of households owning their homes	U.S.A. Counties	1977, 1987, 1992
Road density	Arterial interstate miles plus primary arterial miles/county land area.	U.S. Department of Transportation	2000(?)
Crime rate	Serious crimes per 100,000 population	U.S.A. Counties	1979, 1989, 1993
High School%	Percentage of population over 25 years of age with 12 or more years of education minus College%.	U.S.A. Counties	1977, 1987, 1992
College%		U.S.A. Counties	1977, 1987, 1992
Forest Earnings%	Earnings from forestry, fisheries, and agricultural services as a percentage of total earnings.	U.S.A. Counties	1980, 1989, 1993
Dividend%	% of personal income derived from dividends	Regional economic information systems	1980, 1990

Employment density	Total employment divided by county land area.	City and County Data Book	1979, 1989, 1994.
Unemployment	Unemployment rate	City and County Data Book	1979, 1989, 1994
January temp.	Average daily high temperature in January	McGranahan, 1999.	1943-1980
January sun	Average daily hours of sunlight in January	McGranahan, 1999.	1943-1980
July temp	Average daily high temperature in July	McGranahan, 1999.	1943-1980
July humid	Average daily high humidity in July	McGranahan, 1999.	1943-1980
January rain	Average January rainfall in the largest city/town in the county	Western Regional Climate Center, Western U.S. Climate Historical Summaries, at http://www.wrcc.dri.edu/climsum.html, accessed May 12, 2004	
Big metro	Indicator variable equal to 1 if the county is in Portland or Seattle MSA.	Rand McNally Road Atlas	2000
Wilderness%	Percentage of county land classified as wilderness	U.S. Forest Service, Forest Inventory and Analysis Map Maker, at http://ccrs2.fs.fed.us/4801/fiadb, accessed October 22, 2003.	Various years, depending on location
State Forest%	Percentage of county land managed by state forestry department	U.S. Forest Service, Forest Inventory and Analysis Map Maker, at http://ccrs2.fs.fed.us/4801/fiadb, accessed October 22, 2003.	Various years, depending on location
National Forest%	Percentage of county land managed by U.S. Forest Service, not counting acres in wilderness areas (?)	U.S. Forest Service, Forest Inventory and Analysis Map Maker, at http://ccrs2.fs.fed.us/4801/fiadb, accessed October 22, 2003.	Various years, depending on location
BLM%	Percentage of county land managed by Bureau of Land Management, not counting acres in wilderness areas	U.S. Forest Service, Forest Inventory and Analysis Map Maker, at http://ccrs2.fs.fed.us/4801/fiadb, accessed October 22, 2003.	Various years, depending on location
National Park%	Percentage of county land managed by National Park Service	U.S. Forest Service, Forest Inventory and Analysis Map Maker, at http://ccrs2.fs.fed.us/4801/fiadb, accessed October 22, 2003.	Various years, depending on location
NORTHWEST FOREST PLAN%	Percentage of county land classified as late success ional reserve, adaptive management area, managed late success ional reserves, or riparian reserves.	Northwest Forest Plan Regional Ecosystem Office, at http://www.reo.gov/, accessed November 12, 2003	1995

TABLE 3 THREE STATE LEAST SQUARES PARAMETER ESTIMATES FOR EMPLOYMENT GROWTH AND NET MIGRATION 1980-1990				
	EMPLOYMENT GROWTH		NET MIGRATION	
	PARAMETER ESTIMATE	ABSOLUTE T-STATISTIC	PARAMETER ESTIMATE	ABSOULTE T-STATISTIC
Intercept	-.038	.449	-.179	.815
Net Migration Rate	1.480	4.453**		
Employment Growth			.391	8.720**
Oregon	-.095	.667	-.052	.962
Washington	.059	.449	-.037	.706
Interstate-5	-.009	.216	.012	.686
MSA	.093	2.272**	-.008	.374
Household Income			-.00001	3.334**
Health%			.159	1.784*
Education%			-.033	.371
Population Density			.0244	.437
Expenditure/Tax Ratio			-.003	.306
Home Ownership			.005	3.349**
Road Density	425.886	1.572	11.810	.094
Crime Rate			.000001	.427
High School%	.006	1.186		
College%	.007	2.272**		
Forest Earnings%	-1.222	1.206		
Dividend%	.238	.465		
Employment Density	-.432	1.912**		
Unemployment	-.014	1.583		
January temp.	-.001	.281	.003	1.718*
January sun	-.00002	.016	-.176	.425
July temp	-.001	.258	-.001	.709
July humid	.001	.501	-.002	1.978**
January rain	-.015	2.611**	.004	1.394
Big metro	-.033	.492	.025	.917
Wilderness%	.289	1.114	.003	.029
State Forest%	.009	.034	.074	.642
National Forest%	.160	1.311	-.038	.637
BLM%	.167	.438	-.155	.951
National Park%	-.683	1.774*	.071	.405
Mean (S.D)of Dependent Variable	.30(.258)		.074(.112)	
R-Squared	.782		.806	

TABLE 4
THREE STATE LEAST SQUARES PARAMETER ESTIMATES FOR EMPLOYMENT GROWTH AND NET MIGRATION
1990-1994

	EMPLOYMENT GROWTH		NET MIGRATION	
	PARAMETER ESTIMATE	ABSOLUTE T-STATISTIC	PARAMETER ESTIMATE	ABSOULTE T-STATISTIC
Intercept	.118	.264	-.413	2.322**
Net Migration Rate	.842	1.65*		
Employment Growth			.384	3.806**
Oregon	.104	1.388	-.0186	.582
Washington	.007	.085	.256	.702
Interstate-5	-.038	1.022	.019	1.150
MSA	-.003	.069	.0332	1.978**
Household Income			-.0000008	.101
Health%			.090	1.408
Education%			.059	1.018
Population Density			-.005	.125
Expenditure/Tax Ratio			.390	1.339
Home Ownership			.006	4.162**
Road Density	351.343	1.566	-18.359	.180
Crime Rate			.000006	2.047**
High School%	-.003	.808		
College%	.002	.507		
Forest Earnings%	.073	.420		
Dividend%	.551	1.524		
Employment Density	-.235	1.384		
Unemployment	.002	.261		
January sun	-.00002	.017	.0002	.661
July temp	-.001	.338	-.002	1.227
July humid	-.002	.898	-.002	.268
January rain	-.001	2.072**	.003	1.331
Big metro	.033	.617	-.014	.649
Northwest Forest Plan%	-.247	2.154**	.096	2.106**
State Forest%	.255	1.025	.0127	.130
National Park%	-.349	.989	.107	.781
Wilderness%	.339	1.538	-.116	1.292
Mean (S.D)of Dependent Variable	.105(.145)		.060(.051)	
R-Squared	.529		.482	

TABLE 5 THREE STATE LEAST SQUARES PARAMETER ESTIMATES FOR EMPLOYMENT GROWTH AND NET MIGRATION 1994-1999				
	EMPLOYMENT GROWTH		NET MIGRATION	
	PARAMETER ESTIMATE	ABSOLUTE T-STATISTIC	PARAMETER ESTIMATE	ABSOULTE T-STATISTIC
Intercept	-.494	1.409	-.017	.116
Net Migration Rate	1.571	2.937**		
Employment Growth			.515	4.918**
Oregon	-.072	1.216	.045	2.054**
Washington	.087	1.229	.062	2.497**
Interstate-5	.006	.214	.004	.370
MSA	-.020	.612	.024	2.154**
Household Income			-.000002	1.556
Health%			.048	1.085
Education%			.076	1.282
Population Density			-.032	1.063
Expenditure/Tax Ratio			-.0004	.634
Home Ownership			.002	2.042**
Road Density	-27.510	.170	-61.656	.719
Crime Rate			.000003	.813
High School%	.002	.698		
College%	.004	1.65*		
Forest Earnings%	.048	.404		
Dividend%	-.665	1.575		
Employment Density	-.055	.465		
Unemployment	-.007	.141		
January temp	-.0009	.390	.001	1.434
January sun	-.00008	.129	.0002	.835
July temp	.006	2.114	-.003	2.689**
July humid	.001	1.021	-.0009	1.601
January rain	.002	.616	-.002	1.076
Big metro	.033	.833	-.009	.588
Northwest Forest Plan%	-.050	.646	-.0388	1.073
State Forest%	.083	.470	-.020	.267
National Park%	-.084	.337	.022	.215
Wilderness%	.072	.461	-.020	.298
Mean (S.D)of Dependent Variable	.099(.103)		.033(.047)	
R-Squared	.498		.599	

TABLE 6 Total Effects (Absolute T-Statistics) of Public Land Management Classifications						
Variable Name	1980-1990		1990-1994		1994-1999	
	Employment Growth	Net Migration	Employment Growth	Net Migration	Employment Growth	Net Migration
Wilderness%	.294 (1.447)	.116 (1.291)	.241 (1.252)	.014 (.213)	.039 (.383)	.017 (.289)
State Forest%	.119 (.639)	.078 (.924)	.265 (1.316)	.111 (1.482)	.051 (.387)	.022 (.354)
National Forest%	.103 (1.099)	.025 (.549)				
BLM%	-.062 (.218)	-.089 (.746)				
National Park%	-.578 (1.893)	-.197 (1.43)	-.259 (.898)	-.028 (.252)	-.049 (.295)	-.021 (.231)
Northwest Forest Plan%			-.167 (1.683)	.001 (.032)	-.011 (.017)	-.013 (.473)

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