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Public Conservation Land and Employment Growth in the Northern Forest Region

David J. Lewis
Department of Agricultural and Resource Economics
Oregon State University
213 Ballard Extension Hall
Corvallis, OR 97331-3601
Ph: 541-737-1396, Fax: 541-737-1441
DLewis10@hotmail.com

Gary L. Hunt
Department of Economics
University of Maine
Stevens Hall
Orono, ME 04469
Ph: 207-581-1861, Fax: 207-581-1851
Gary_Hunt@umit.maine.edu

Andrew J. Plantinga
Department of Agricultural and Resource Economics
Oregon State University
212B Ballard Extension Hall
Corvallis, OR 97331-3601
Ph: 541-737-1423, Fax: 541-737-1441
Plantinga@orst.edu

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The authors are, respectively, graduate research assistant in the Department of Agricultural and Resource Economics, Oregon State University, professor in the Department of Economics, University of Maine, and assistant professor in the Department of Agricultural and Resource Economics, Oregon State University. This paper was written while David J. Lewis was a graduate student in the Department of Resource Economics and Policy at The University of Maine. Financial support was provided by the Gloria Barron Wilderness Society Scholarship and The Graduate School at The University of Maine. The paper greatly benefited from presentations at Land Conservation Summit 2000 in Minneapolis, MN and a seminar at The University of Maine. We are indebted to Jonathan Rubin and two anonymous reviewers for valuable comments.

Public Conservation Land and Employment Growth in the Northern Forest Region

Abstract: We quantify the effect that public conservation lands have on employment growth in the Northern Forest region of the U.S. A model of simultaneous employment and net migration growth is estimated with data on non-metropolitan counties over the period 1990 to 1997. Exogenous variables include the 1990 share of the land base in public conservation uses. We find that net migration rates were higher in counties with more conservation lands, but the effects are relatively small. No significant effect on employment growth is detected. As well, variables measuring changes in public timber harvests have no effect on employment growth.

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I. INTRODUCTION

Stretching from northern Minnesota to Maine, the Northern Forest is one of the largest forested regions in the United States. The Northern Forest occupies a broad transition zone between temperate and boreal forests that supports a diverse array of animal and plant life. Most of the land in the region is used to grow timber for wood products production, the dominant manufacturing industry. In contrast to the western U.S. where a large share of the forestland base is owned by the federal government, most of the land in the Northern Forest region (78 percent) is privately owned. Although the Northern Forest region is sparsely populated, with only about one percent of the U.S. population living in the region, it is easily accessed from major metropolitan areas to the south. Almost 40 percent of the U.S. population lives in a Northern Forest state or a state bordering a Northern Forest state.

The Northern Forest region is a valuable source of recreational opportunities for local residents and the millions of people who live in nearby urban areas. For example, Acadia National Park in Maine has one of the highest visitation rates in the National Park System. Moreover, there are a number of important wilderness areas within the region (e.g., the Adirondack Forest Preserve in New York, the Boundary Waters Canoe Area Wilderness in Minnesota). Nevertheless, given that commercial timber production is the predominant use of the land, there are many who argue that non-market goods such as recreation and wildlife habitat are underprovided. A proposed solution to this problem is to increase the amount of public conservation land in the region. Environmental groups are promoting the creation of a national park in northern Maine and biodiversity reserve systems in New England and the Lake States region (Kennedy and Sant 2000). In recent years, voters in Maine and Michigan approved ballot initiatives providing funding for the acquisition of conservation lands and the federal government has funded land purchases in the region through the Land and Water Conservation Fund.

As with many environmental issues, debates about increasing public conservation lands in the Northern Forest region frequently center on a perceived tradeoff between jobs and the environment (Dobbs and Ober 1995). Opponents of more public conservation lands argue that reduction in the land available for timber production will adversely impact local economies, particularly employment in wood products manufacturing. Proponents of conservation lands emphasize the benefits from increased public access to recreational resources and the provision of public goods associated with wilderness preservation. Not surprisingly, support for land conservation efforts tends to be strongest in urban centers and opposition is mostly from rural residents from within the region (Dobbs and Ober 1995).

The objective of this paper is to analyze the impact of public conservation lands on employment growth rates in the Northern Forest region. Following Greenwood and Hunt (1984) and Greenwood *et al*. (1986), we estimate a model of simultaneous employment and net migration growth with county data for the period 1990 to 1997.[1] The county share of land in public conservation uses in 1990 is included in the set of exogenous variables. Our model structure allows us to test for direct and indirect effects of conservation lands on employment growth. In the first case, we evaluate the claim that diverting private forest lands to conservation uses has a direct negative impact on employment. Our model also provides insights into the employment impacts of conservation lands through their effect on migration. A consistent finding in the migration literature is that natural amenities positively influence migration decisions (e.g., Knapp and Graves 1989, Clark and Hunter 1992; Treyz *et al*. 1993; Mueser and Graves 1995; McGranahan 1999). We test if public conservation lands attract migrants and, thereby, have an indirect effect on employment growth.

The management of public conservation lands may influence the effect they have on employment and population. For our purposes, public conservation lands can be grouped into two broad categories—preservationist and multiple-use lands. On preservationist lands, which include national and state parks, wilderness areas, and wildlife refuges, timber harvesting is largely prohibited. Multiple-use lands, including national and state forests, are managed for timber in addition to non-commodity outputs such as recreation. Given these differences in timber management practices, we might expect preservationist and multiple-use lands to have differential impacts on employment and net migration growth. Accordingly, we test for separate effects of preservationist and multiple-use lands.

We also identify and explore a solution to a "timing" problem that has not been acknowledged in earlier studies (e.g., Duffy-Deno 1998). In most cases, public conservation lands were established long before the period for which we have data. Accordingly, we should not expect the effects of these conservation lands to be fully reflected in recent employment growth rates. For instance, the creation of the Adirondack Park in the late 19th century should not continue to have a negative effect on wood products employment a century later. This has implications for the interpretation of our results. In particular, a finding that public conservation lands have no effect on recent employment growth rates does not support the conclusion that the establishment of *new* conservation lands does not impact employment. In order to measure these effects, we model recent changes in management practices on national forests. Declines in national forest timber sales during the early 1990s provides a "natural experiment" that identifies the employment effects of diverting commercial forest land to conservation uses.

The next section provides an overview of the study region and a brief historical review of public land management in the region. In Section III, we present the econometric model of employment and net migration growth and, in Section IV, our estimation results. Section V is devoted to extensions of the analysis in which we explore potential differences in the effects of preservationist and multiple-use lands and a solution to the timing problem described above. Section VI presents discussion and conclusions.

II. PUBLIC CONSERVATION LANDS IN THE NORTHERN FOREST REGION

Overview of Study Region

For this study, the Northern Forest region is defined by 92 counties in the northern Lakes States region, northeastern New York, and northern New England (Figure 1). In all of our counties, a large share of the land base is forested and paper and lumber are the principal wood products produced. We include only non-metropolitan counties—those counties that do not contain a city qualifying as a Metropolitan Statistical Area (MSA)—in order to focus on employment that is largely based on the forest resource. Six counties[3] that contain small MSAs are also included because they have population densities and other characteristics similar to non-metropolitan counties. There are considerable differences within the region in amounts of public conservation lands.[4] Only about five percent of Maine's land within the Northern Forest region is in public conservation uses, compared to almost 37 percent in Michigan. The variation is even greater on a county level, ranging from zero to 82 percent. Approximately 30 percent of the public conservation land in the region is managed for preservationist uses and 70 percent is under multiple-use management.

History of Public Conservation Land Management in the Region

The timing of public land acquisitions and the adoption of conservation management practices on these lands has important implications for the specification of our econometric model and the interpretation of results. To place our analysis in proper context, we briefly review the history of public conservation land management in the Northern Forest region. More details are provided in Lewis (2001).

The late 19th and early 20th centuries mark a period of extreme forest degradation in the region due to over-harvesting and large-scale fires, and the beginning of public sector efforts to purchase land for conservation uses. Most of the large tracts of public conservation land were established prior to World War II (Figure 2). However, the transfer of land from private owners to the government did not always coincide with changes in management practices. While timber-harvesting restrictions were applied immediately on many preservationist lands (e.g., the Adirondack Forest Preserve and Acadia National Park), conservation management was not adopted on public forest lands until much later. The Weeks Act that created many of the national forests in the region carried with it no conservation mandate; rather, it specified that national forests were to be managed for a steady supply of timber and watershed protection, while no provisions were made for other non-timber benefits such as recreation and wildlife.

After World War II, timber harvesting on national and state forests increased dramatically in response to the housing boom of the early 1950s (Cubbage et al. 1993). At the same time, changing public attitudes towards the environment and an increased interest in outdoor recreation exerted pressure on public forest management agencies to broaden their management objectives to include non-timber outputs. In response, Congress passed the Multiple-Use Sustained-Yield Act (MUSYA) in 1960, to be followed by the National Forest Management Act (NFMA) in 1976. Despite the ostensible goals of MUSYA, national forests continued to be managed largely for timber production (Shands and Healy 1977, Alverson et al. 1994). In contrast, NFMA defined specific conservation objectives for the national forests and also required the Forest Service to provide for public participation in the development of management plans for each national forest.

Despite the passage of NFMA in 1976, management plans for the nine national forests in the Northern Forest region were not implemented until the end of the 1980s. Due to intense criticism leveled at the Forest Service during the first round of planning in the mid-1980s, the agency redesigned its multiple-use policies to better account for environmental concerns (Alverson *et al*. 1994). One feature of the reformulated NFMA plans is reductions in the volume of timber sold. On eastern national forests, timber sales began declining in the late 1980s. In the Lake States region, the drop in national forest timber sales occurred in the early 1990s. Between the 1980s and 1990s, average annual sales declined by 42 percent on eastern forests and 22 percent on Lake States forests.[5] In sum, the 1990s marks a shift towards conservation management on national forests in the region. In the case of state forests, we find no evidence of a similar shift towards conservation management practices. State forest harvests remained at historic levels throughout the 1990s.

III. AN ECONOMETRIC MODEL OF EMPLOYMENT AND NET MIGRATION IN THE NORTHERN FOREST REGION

Model Structure

We conduct an econometric analysis of the effects of public conservation lands on employment and net migration growth in the Northern Forest region. Following Greenwood and Hunt (1984) and Greenwood *et al*. (1986), we specify the system of simultaneous equations,

$$\begin{aligned} EG_{i,90-97} &= f_1(NM_{i,90-97}, CL_{i,90}, ED_{i,90}, A_{i,90}) \\ NM_{i,90-97} &= f_2(EG_{i,90-97}, CL_{i,90}, PD_{i,90}, B_{i,90}) \end{aligned} \quad [1]$$

where the two endogenous variables, $EG_{i,90-97}$ and $NM_{i,90-97}$, are employment and net migration growth rates, respectively, in county *i* over the period 1990 to 1997. $CL_{i,90}$ is the lagged share of total land in county *i* devoted to conservation uses, $ED_{i,90}$ and $PD_{i,90}$ are lagged employment and population densities, and $A_{i,90}$ and $B_{i,90}$ are sets of additional lagged exogenous variables. The equation system in [1] captures the simultaneous nature of employment and net migration. Positive employment growth increases the number of available jobs and attracts migrants to a county. At the same time, positive net migration increases the number of people in a county, which positively affects employment by increasing demand for goods and services and providing a larger workforce.

Our specific interest is in how conservation lands affect employment and net migration growth.[6] For many people, conservation land is an amenity because it provides recreational opportunities and may act as a greenbelt, preventing land development considered undesirable by current residents. In this way, conservation land contributes directly and positively to net migration. Conservation land may also directly affect employment growth, negatively by removing land from commercial uses or positively by attracting new businesses to an area. Power (1996) suggests that conservation land enhances the attractiveness of the surrounding area as a place to do business. Roback (1982) argues that, all else equal, high levels of amenities will entice some people to accept lower wages, leading to a lower-cost labor force. Given the simultaneity of employment and net migration growth, conservation lands also have indirect effects on employment and population. For instance, if conservation lands reduce employment growth, there is an associated decline in net migration rates. Similarly, employment growth increases when conservation lands attract migrants to a county.

As noted in the preceding section, conservation management practices were adopted on preservationist lands well before 1990. In these cases, the growth rate model does not capture initial changes in employment and net migration associated with the designation of these lands. Consider a hypothetical county in which a large tract of conservation land was established at the turn of the 20th century. If the county had a large number of wood products firms, one might expect a loss in employment resulting from the diversion of commercial forest to conservation uses. By 1990, however, the adjustment would be complete, and the initial impact on jobs would not be reflected in employment growth data for 1990 to 1997. The effects of conservation land should still be present in the *levels* of employment and population. Our hypothetical county would have a lower level of employment, all else equal, than a county with no conservation land. Accordingly, we include measures of lagged employment and population density in [1] to “absorb” the earlier effects of conservation land. This ensures that our model isolates the impacts of conservation land on growth in employment and population during the 1990s.

The principal goal of the econometric estimation is to obtain consistent and precise estimates of the parameters on the conservation land variables. Accordingly, we include as many potentially relevant regressors in [1] as possible in order to minimize bias in the parameter estimates of interest. These additional exogenous variables measure factors that make an area more attractive to firms considering expansion or relocation and to potential migrants. Following Clark and Murphy (1996), the variables in vector A measure local business and fiscal conditions. Variables in vector B measure amenities other than conservation land, fiscal conditions, and economic opportunities beyond employment growth.

A number of features of the Northern Forest region facilitate the proposed analysis. Given our use of cross-sectional data, the role of the exogenous variables is to control for differences across counties that explain the spatial variation in employment and net migration growth. There are large differences across counties in shares of conservation lands, however, the region is homogeneous in terms of land cover, forest species, manufacturing activities, population densities, climate, and proximity to major urban areas. Thus, we find large variation in the exogenous variable of interest but little variation in a number of factors that, otherwise, we would need to model explicitly.

Empirical Model

For estimation, we used a linear specification of [1],

$$\begin{aligned} EG_{i,90-97} &= \alpha_0 + \alpha_1 NM_{i,90-97} + \alpha_2 CL_{i,90} + \alpha_3 ED_{i,90} + \sum_j \alpha_j a_{i,90} + \varepsilon_{i,90-97} \\ NM_{i,90-97} &= \beta_0 + \beta_1 EG_{i,90-97} + \beta_2 CL_{i,90} + \beta_3 PD_{i,90} + \sum_j \beta_j b_{i,90} + \mu_{i,90-97} \end{aligned} \quad [2]$$

i=1,…,92, where α and β are vectors of unobserved parameters and $\varepsilon_{i,90-97}$ and $\mu_{i,90-97}$ are assumed to be spherical disturbances with zero means. Variable definitions and data sources are reported in Table 1. *EG* is the percentage change in total employment in county *i* between 1990 and 1997. *NM* is percentage change in population net of natural changes due to births and deaths. The net migration rate measures population changes resulting from migration to (+) or from (-) the county. *CL* equals the area of land in conservation uses in 1990 divided by the total land area of the county. *ED* and *PD* equal the 1990 levels of employment and population, respectively, divided by the total land area of the county.

The first set of exogenous variables in the employment growth equation measure local business conditions. Work-force quality is measured by the percentage of county residents older than 25 years who graduated from high school (*HG*) and the share of local government expenditures on education (*EE*). The unemployment rate (*UE*) is used to proxy for general conditions in the local labor market. Accessibility to markets is an important component of costs for some firms and is measured in our model by interstate highway mile density (*IH*). All of these variables are expected to have a positive direct effect on employment growth.

In the Northern Forest region, forest products manufacturing is the dominant resource-based industry and the principal source of employment in some counties. To measure the dependence of the local economy on the forest products industry, we include the share of total county employment in forestry, paper and allied products, lumber and wood products, and furniture and fixtures (*FP*). Ski resorts are found throughout the Northern Forest region and may influence local business conditions. *ES* is a dummy variable indicating the presence of one or more destination ski resorts in the county.[7]

Local business conditions may also be influenced by spillover effects from urban areas and the presence of a relatively large city within the county that provides services for surrounding communities. We include a dummy variable (*UA*) indicating whether or not the county is adjacent to a metropolitan county (i.e., a county with an MSA). *CT* is a dummy variable that accounts for the presence of a city within the county with a population greater than 25,000. Finally, to account for income injected into the local economy from external sources, we include a variable measuring the percentage of personal income from dividends (*DV*).

Fiscal conditions may have a direct effect on employment growth. To capture the relative tax burden in the county, we include a variable measuring the ratio of local government expenditures to local taxes (*ET*). *ET* includes payments to counties and towns from the state government, which are often an important component of local expenditures. Income tax policies, regulations, and other factors specific to individual states may also affect employment growth. A set of state-level dummy variables is included in the employment and net migration equations to control for these fixed effects. (Minnesota is the omitted category.)

The exogenous variables in the net migration equation measure the attractiveness of the county to potential migrants and current residents. A set of variables are included to capture amenities. Community stability is a potential amenity, which we measure as the percentage of people who own their own homes (*HO*). The availability of transportation infrastructure may enhance the attractiveness of the county and is measured by interstate highway mile density (*IH*). The income of a county, measured by median family income (*IN*), proxies for a number of factors, including the range of consumer and cultural offerings and the extent of social problems stemming from poverty. Finally, large water bodies are an amenity to many people and we include a dummy variable indicating whether or not the county has shoreline on either the Atlantic Ocean or one of the Great Lakes (*SH*).

A set of fiscal variables are used to measure government taxation and spending. We hypothesize that individuals prefer living in counties with the greatest difference between the provision of services by the government and the taxes paid to provide these goods. This is measured as the ratio of local government expenditures to local taxes (*ET*). People may have preferences for categories of government-provided goods and services (e.g., education). The percentage of government expenditures on education (*EE*), police protection (*PP*), and health and hospitals (*HH*) are used to account for the mix of local government spending. *A priori*, the effect of government expenditures on police protection is uncertain since large expenditures may indicate high or low rates of crime.

Counties with better economic opportunities are more likely to attract net migrants. Since economic opportunities are often greater in larger population areas, we account for potential spillover effects from urban areas with the dummy variable *UR* indicating adjacency to a metropolitan county. As well, *CT* is included to account for a relatively large city within the county.

Variable Measurement Issues

Observations of the area of conservation land by county and the year 1990 are available for federal lands managed by the U.S. Forest Service, the U.S. Fish and Wildlife Service, and the National Park Service. Corresponding data on state conservation lands is available for Minnesota, New Hampshire, and Wisconsin. County-level conservation land data for 1990 are not available for Maine, Michigan, New York, and Vermont; however, there are county data for years ranging from 1996 to 1999. Statewide increases in public land area were only two percent in Maine between 1990 and 1999, one and one-half percent in Michigan, and less than three percent in New York. We use 1999 values as proxies for the 1990 values. The total area of state-owned public lands in Vermont increased approximately 24 percent over this time period. We form county-level estimates for 1990 by reducing the more recent county measures of state-owned public land by 24 percent.

Data on interstate highway miles in 1999 were obtained from the U.S. Department of Transportation. There were no additions to the interstate highway system in our set of counties between 1990 and 1999; therefore, 1999 values are identical to 1990 values. Only 1992 values of the government tax and expenditure variables (*ET*, *EE*, *PP*, *HH*) were available.

IV. ESTIMATION RESULTS

The equation system in [2], hereafter Model I, is estimated using three-stage least squares (3SLS). 3SLS is a consistent estimator for systems of simultaneous equations and is more efficient than two-stage least squares because it accounts for cross-equation correlation of the error terms. Heteroskedasticity is often present in studies with cross-sectional data and we use White's (1980) test to evaluate the null hypothesis of homoskedasticity against the alternative that the errors have a general heteroskedastic structure. We failed to reject the null at the 5 percent level for each of the model equations (Table 2). Our use of some observations for years after 1990 raises the possibility that these variables are endogenous. We use Hausman's (1978) specification test to test for the endogeneity of each regressor, using the remaining set of variables as instruments. We fail to reject the null hypothesis that the least squares and instrumental variables estimates are the same, indicating that the regressors are exogenous.

Given our use of cross-sectional data, we also test for spatial autocorrelation of the residuals. Since we model only within-county effects of conservation lands, a potential source of spatial autocorrelation is cross-county effects of conservation lands on employment and net migration growth. For the two sets of residuals, we compute Moran's *I* statistic using a "rook" measure of proximity that indicates if counties share a common border (Bailey and Gattrell 1995). Moran's *I* ranges in value from +1 (strong positive autocorrelation) to –1 (strong negative autocorrelation), and takes a 0 value if the pattern is random. The computed values are small (less than 0.05 in absolute value) for each equation and one to five spatial lags. By assuming that $I^{(k)}$ has an approximately normal sampling distribution, we can formally test the null hypothesis of no spatial autocorrelation, and we fail to reject the null at the five percent level for each equation and spatial lag.

The estimated equations explain approximately 32 percent and 50 percent of the variation in employment and net migration growth rates, respectively (Table 2). The coefficients on the endogenous variables (*EG* and *NM*) are significantly different from zero at the five percent level and indicate the interdependence of employment and net migration growth. The coefficient estimates reveal that, all else equal, a one percentage point increase in net migration rates yields approximately a one percentage point increase in employment growth, and a five percentage point increase in employment growth yields roughly a one percentage point increase in the net migration rate. These findings are qualitatively consistent with those in previous regional economics studies (e.g., Greenwood et al. 1986; Carlino and Mills 1987) and support the notion that migration is more stimulative of job creation than job creation is of migration.

In the employment growth equation, eight of the coefficient estimates (*FP*, *EE*, and the six state dummies) are significantly different from zero at the 10 percent level or higher. Employment growth was lower, all else equal, in counties with a higher percentage of forest products employment (*FP*). In some counties as much as 70 percent of total employment is in forest products and, at least over the period 1990 to 1997, fewer jobs were created in counties highly dependent on this industry. In Section V, we test whether this negative relationship between job trends and relative size of the forest products industry is due to conservation land effects operating indirectly through this industry. We find evidence that this is not the case. Consequently, the effects of a larger forest products industry on county employment growth is reflecting some other aspect of the industry. Educational spending is also found to have a significant effect on employment growth. Counties with a higher share of total expenditures allocated to education (*EE*) experienced higher job growth, all else equal. Finally, all of the coefficients on the state dummies are negative and signficantly different from zero, indicating systematically higher employment growth in Minnesota compared to the other Northern Forest states.

The remaining variables in the employment equation did not have a significant effect on the rate of employment growth during the period analyzed. Of particular interest, the percentage of the county in conservation land (*CL*) did not have a significant effect on employment growth. It should be noted that these coefficients measure direct effects of the exogenous variables on employment growth. Below, we derive indirect and reduced-form effects of conservation land on employment growth.

In the net migration equation, five of the coefficients on the exogenous variables (*PD*, *CL*, *HO*, *ET*, and *HH*) are significantly different from zero at the five percent level. Of particular interest is the positive sign on the *CL* variable, indicating that counties with more conservation land in 1990 experienced higher net migration over the following seven-year period. One explanation is that people view conservation land as an amenity, and conservation land has the effect of attracting new residents or retaining current residents. The magnitude of the coefficient suggests that, all else equal, counties whose conservation land share is 10 percentage points higher experience a one percentage point higher net migration rate.

The negative sign on the expenditure-to-tax ratio variable (*ET*) is contrary to expectations, and points out the difficulties of constructing tax measures. A shortcoming of this variable is that it cannot capture the relative tax burdens on local businesses and residents (or the relative expenditures). In some counties with high levels of taxes, residents may face low tax rates if a large proportion of taxes are collected from businesses. Such a county may be attractive to potential migrants, even though expenditures relative to total taxes may be relatively low. Also, a county might have high taxes if it anticipates high population and employment growth in the future together with greater demand for public services.

The other significant variables have expected signs and suggest that migrants are attracted to counties with higher percentages of people who own their own homes (*HO*) and higher government expenditures on health and hospitals (*HH*). Net migration rates are also higher in counties with larger population densities (*PD*). The remaining coefficient estimates are not significantly different from zero at the five percent level, indicating that the corresponding variables are not important in explaining cross-county variation in rates of net migration.

From above, the conservation land variable (*CL*) was found to have a positive direct effect on net migration. Because net migration and employment growth are positively related, an increase in *CL* indirectly affects employment growth through its effect on net migration. For the conservation land variable, the indirect effects are given by $\partial EG / \partial CL = \hat{\alpha}_1 \hat{\beta}_2$ and $\partial NM / \partial CL = \hat{\beta}_1 \hat{\alpha}_2$, where hats indicate estimates. We can also solve the structural equations to express *EG* and *NM* in terms of the exogenous variables. The solved structure effects of *CL* are then given by $dEG / dCL = (\hat{\alpha}_1 \hat{\beta}_2 + \hat{\alpha}_2) / (1 - \hat{\alpha}_1 \hat{\beta}_1)$ and $dNM / dCL = (\hat{\alpha}_2 \hat{\beta}_1 + \hat{\beta}_2) / (1 - \hat{\alpha}_1 \hat{\beta}_1)$. These expressions measure the effects of *CL* after all adjustments in the endogenous variables are complete.

The indirect effect of conservation land on employment growth is positive and significantly different from zero at the 10 percent level (Table 3, Model I).[8] In this case, conservation lands increase net migration to a county, which increases employment growth. The magnitude of the estimate indicates that a 10 percentage point increase in the county share of conservation land yields a one percentage point increase in the employment growth rate, all else equal. The indirect effect of conservation land on net migration is not significantly different from zero; however, the solved structure effect is significant at the five percent level. The estimate indicates that an approximate nine percentage point increase in the county share of conservation land results in a one percentage point increase in the net migration rate, all else equal. The solved structure effect of conservation land on employment growth is not significantly different from zero.

V. EXTENSIONS

In this section, we consider two extensions of the model presented in the previous section. The first extension (Model II) examines the separate effects of preservationist and multiple-use lands on employment and net migration growth. We re-estimate [2] with the conservation land variable (*CL*) separated into variables measuring the shares of county land in preservationist uses (*PR*) and under multiple-use management (*MU*) as defined in Table 1. The results for Model II (and Model III, presented below) are almost identical to those in Table 2 and so we report only the direct, indirect, and solved structure effects of *PR* and *MU* on employment and net migration in Table 3.[9] Preservationist lands are found to have no significant effects on employment or net migration. In contrast, the direct and solved structure effects of multiple-use lands on net migration rates are significantly different from zero at the five percent level. The estimates are positive, indicating that net migration rates are higher in counties with greater shares of public lands under multiple-use management.

In the second extension (Model III), we investigate the timing problem alluded to above. Since conservation lands in the region were designated long before 1990 as shown in Figure 2, our results do not yield insights into the employment effects of designating *new* conservation lands, which is the issue of greatest policy interest.[10] Changes in national forest management in the early 1990s, however, provide a natural experiment that allows us to examine this issue. We exploit the variation in national forest sales reductions—declines were larger on northeastern national forests than Lake States forests—to identify the effects of diverting land from commercial uses to conservation uses.

In Model III, we separate the multiple-use share (*MU*) into the shares of county land in state forests (*SF*) and national forests (*NF*) and include a variable (*CS*) measuring the percentage change in national forest timber sales[11] in each county as defined in Table 1. Data on national forest timber sales are available only at the state level. We apportion state-level sales growth to each county based on the county's share of total national forest land in the state. *CS* is the percentage change in total sales between the 1983 to 1989 period and the 1990 to 1996 period. The results reported in Table 3 reveal that changes in timber sales had no significant effect on employment or net migration growth. On the other hand, the solved structure effects of national and states forest shares on the net migration rate are positive and significantly different from zero at the five percent level.

As well, the solved structure effect of the national forest share on employment growth was found to be positive and significantly different from zero at the 10 percent level.

As alluded to above, the muted effects that we find for various measures of conservation land on county employment growth may be a statistical artifact of including a measure of the significance of the forest products industry (*FP*) in the model. It is possible that our conservation land measures are indirectly affecting county employment growth rates through their effect on *FP*. To test for such an effect, we re-estimated each of the three models excluding *FP*. The results for the key parameter estimates related to the various conservation land measures are not materially impacted in either their magnitude or their statistical significance. We also re-estimated Model III adding an interaction effect for timber sales and *FP* (i.e., *CS***FP*). If the impact of timber sales (our "natural experiment") on county employment growth rates is really operating through *FP*, then we should see a significant and negative coefficient estimate on the interaction term. The estimated coefficient is –2.14 in value with an estimated standard error of 2.95 and a corresponding asymptotic *t*-ratio of –0.73. None of the estimated coefficients on the other measures of timber sales or conservation lands are materially affected either in terms of their magnitudes or statistical significance. We conclude that the negative employment effect of the *FP* variable is related to some factor other than inter-county variation in timber sales or conservation lands that operates to lower employment growth during the 1990 to 1997 period in the forest products industry (e.g., substitution of capital for labor).

VI. DISCUSSION AND CONCLUSIONS

The first set of results (Model I) reveals that employment growth in Northern Forest counties between 1990 and 1997 did not vary systematically with the county share of public conservation lands in 1990. The solved structure effect of conservation lands (*CL*) on employment growth was not significantly different from zero at any reasonable confidence level (Table 3). In contrast, the solved structure effect of public conservation lands on the net migration rate, all else equal, is positive and significantly different from zero at the five percent level. Moving to Model II, we see that this result is driven largely by effects of multiple-use lands. The solved structure effect of the multiple-use share (*MU*) is positive and significantly different from zero, while the solved structure effect of the preservationist use share (*PR*) is insignificant.

Two explanations emerge for the significant effect of multiple-use lands on net migration and the insignificant effect of preservationist lands. First, the positive effect of multiple-use lands on net migration may reflect a response to the recent changes in management practices on these lands. Population shifts in response to preservationist lands would have been completed by the 1990s, as these lands have been managed for conservation uses since the time of establishment. Second, if the higher net migration rates are the result of structural change in other sectors of the economy (e.g., tourism, telecommunications), it is plausible that net migration would occur in counties with multiple-use lands rather than preservationist lands. In the Northern Forest region, many of the preservationist lands (e.g., Boundary Waters Canoe Area Wilderness, Allagash Wilderness Waterway) offer multiple-day wilderness experiences that people are unlikely to participate in on a regular basis. Multiple-use lands, in contrast, tend to have easier vehicular access and offer a broader range of day-use activities.

Model III employs a "natural experiment" to further clarify these results. We find that declines in national forest timber sales in the early 1990s do not have a significant effect on employment or net migration growth. Since the diversion of commercial forests to conservation uses involves a similar decline in timber production, we interpret this result as evidence that the establishment of *new* conservation lands does not impact employment over the range of timber reductions that are observed in our sample.[12] This is an important new result that enables us to extend previous results to include any *initial impacts* of public conservation land designation. It should be emphasized that we measure net effects on employment and not the components of employment change. It is possible that timber sale reductions cause employment declines in one sector (e.g., wood products) and increase it in another (e.g., tourism), with no net effect on employment.[13] These findings are consistent with studies for other regions. Burton and Berck (1996) apply Granger causality tests to forest sector data for Oregon and find no causal relationship between national forest harvests and forestry employment. Further, Burton (1997) finds that in Oregon neither national forest harvests nor sales explain employment transitions between the forestry sector and other sectors. In a study of western Montana, Daniels et al. (1991) conclude that national forest harvests can do little to stabilize employment.

The Model III results also reveal that national and state forests have positive effects on employment and net migration growth. The national forest share (*NF*) has a positive and significant effect on employment and net migration, after controlling for changes in timber sales. This result suggests that the higher employment and net migration growth in counties with more national forests is attributable to factors other than changes in national forest policy, such as structural change in other sectors and rising incomes leading to more expression over time of amenity demands by households. Alternatively, we may be measuring a general response to the policy changes on the part of tourists and migrants whose decisions are not sensitive to the magnitude of the changes in timber sales. If policy is the driving factor, then we would expect no effects of state forests on employment and net migration, since there was not a similar shift in management practices on state lands. However, we find that the state forest share (*SF*) has a positive and significant effect on net migration, suggesting that structural change in other sectors and rising household demand for amenities is at least part of the explanation. In any event, we note that these effects are relatively small. An eight percentage point increase in the county share of national or state forest land is needed to raise net migration rates by one percentage point, all else equal. A four percentage point increase in the county share of national forest land increases employment growth by approximately one percentage point.

In conclusion, the decision to increase the amount of public conservation land in the Northern Forest region depends on the net benefits this provides to society as a whole as well as the distribution of benefits and costs among members of society. For instance, the recreational and ecological benefits of conservation lands would be a key input to the policy process. In addition, an important consideration is the way in which conservation lands might transform the character of rural communities. The results of our study suggest, however, that economic development should not be the primary factor driving the decision process. We find no evidence that conservation lands have negatively impacted employment growth during the 1990s, despite the considerable decline in national forest timber sales. By the same token, we find little evidence to support the conclusion that conservation lands should be viewed as a tool for promoting job growth in rural communities.

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Endnotes

[1] Other studies of the impacts of conservation lands on employment and population include Clark and Hunter (1992), Rudzitis and Johansen (1992), Duffy-Deno (1998), and Deller et al. (2001). Our study is distinguished by our consideration of the effects of all conservation lands rather than a single category of conservation land (e.g., federal wilderness areas) or a composite amenity measure, our focus on the Northern Forest region, and our use of a natural experiment.

[2] We selected our counties based on survey unit definitions used by the U.S. Forest Service. Survey units are county groupings that the Forest Service defines for use in conducting forest inventories. Survey units are relatively homogeneous in terms of land-use patterns and characteristics of the forest resource. We include counties in the Northern Pine and Aspen-Birch units (MN), the Northwest and Northeast units (WI), the Western and Eastern Upper Peninsula units (MI), and the Western, St. Lawrence, and Eastern Adirondack units (NY). We include counties in all of the Vermont, New Hampshire, and Maine survey units, with the exception of metropolitan counties (see below).

[3] Penobscot (ME), Franklin (VT), Herkimer and Warren (NY), Douglas (WI), and St. Louis (MN).

[4] In this study, we consider only federal- and state-owned conservation lands. In most states, municipal governments are not significant owners of conservation lands. In Minnesota and Wisconsin, municipal governments are responsible for managing tax-forfeited lands, however, there is no indication that these lands provide conservation-related benefits and we exclude them from our analysis. We also exclude conservation lands managed by private land trusts. While there has been considerable growth in land trusts during the 1990s, according to the Land Trust Alliance they still manage less than 1% of all conservation lands in the region.

[5] To arrive at these figures, we compute the average annual sales between 1984 and the last year before sales decline sharply (1987 in Maine, 1994 in Michigan, 1993 in Minnesota, 1990 in New Hampshire, 1988 in Vermont, 1991 in Wisconsin). We exclude data for the early 1980s because sales were low due to the nationwide recession. The average annual sales for the 1990s decade are calculated from the year when sales declined through 1998.

[6] For various reasons, we might expect conservation lands to have nonlinear effects on employment and net migration growth. Unfortunately, the available data do not allow us to examine the time profile of these effects.

[7] ES applies to destination resorts in the northeastern states. Destination resorts are those ski areas ranked in the top 60 by Ski magazine.

[8] Standard errors for the indirect and solved structure effects are estimated using the delta method (see Greene, 1993).

[9] All results not reported in the paper are available from the authors upon request.

[10] Some effects from the initial period of designation of lands could be observed as late as the 1990s if such effects require a separate mediating factor to express themselves. For example, if designation raises the supply of natural inputs useful for producing tourism services, but the demand for tourism is expressed later when incomes grow sufficiently to increase tourism demand substantially, then a long lag between designation and the observed effect can occur. Similarly, advances in computer technology that increase opportunities for telecommuting might increase migration to counties with more public conservation lands, or amenity-oriented, footloose firms may follow labor to such areas.

[11] We measure changes in sales rather than changes in harvests because the former better captures the timing of the shift in national forest management practices. Purchasers of national forest timber are allowed to delay harvest up to five years past the time of sale. As with sales, national forest timber harvests declined in the early 1990s, but the data provide a less clear signal of the shift in management practices.

[12] Stronger conclusions could be drawn from a similar analysis using time-series data covering periods during which public conservation lands were actually designated. Unfortunately, our efforts to assemble long-term historical data on the area of public conservation lands have, as yet, proved unsuccessful.

[13] A common objection to more public conservation lands is that they will cause high-wage manufacturing jobs to be replaced with low-wage service sector jobs. We have not examined the composition of employment change in this study, and leave this issue for future research.

Table 1. Variable Definitions and Data Sources

Variable	Description (Year)	Data Source
EG	% Change in Employment ('90 - '97)	County Business Patterns
NM	Net Migration Rate ('90 - '97)	USA Counties
ED	Employment Per Sq. Mi. ('90)	City & County Data Book,
PD	Population Per Sq. Mi. ('90)	City & County Data Book,
CL	Percentage of Total County Land in Conservation ('90)	State/Federal Land Management Agencies
PR	Percentage of Total County Land in Preservationist Uses ('90)	State/Federal Land Management Agencies
MU	Percentage of Total County Land under Multiple-Use Management ('90)	State/Federal Land Management Agencies
SF	Percentage of Total County Land in State Forest ('90)	State Land Management Agencies
NF	Percentage of Total County Land in National Forest ('90)	U.S. Forest Service
CS	Percentage Change in National Forest Timber Sales (83-89 to 90-96)	U.S. Forest Service
HG	Percentage of People > 25 who graduated from High School ('90)	City & County Data Book
UE	Unemployment Rate ('90)	City & County Data Book
IH	Interstate Highway Miles Per Sq. Mi. ('99)	U.S. Dept. of Transportation
FP	Percentage of County Employment in Forest Products ('90)	County Business Patterns
SK	Dummy (1= Destination Ski Area in Northeast, 0 = no)	Ski Magazine
UR	Dummy (1= Adjacent to Urban, 0 = no)	City & County Data Book
CT	Dummy (1= City > 25K, 0 = none)	City & County Data Book
DV	Percentage of Personal Income from Dividends ('90)	Regional Economic Information System
ET	Ratio of Local Gov't Expenditures to Local Taxes ('92)	USA Counties
EE	Percentage of Gov't Expenditures on Education ('92)	USA Counties
PP	Percentage of Gov't Expenditures on Police Protection ('92)	USA Counties
HH	Percentage of Gov't Expenditures on Health and Hospitals ('92)	USA Counties
HO	Percentage of people who own their own homes ('90)	City & County Data Book
IN	Median Household Income ('90) (in Thousands of Dollars)	City & County Data Book
SH	Dummy (1=Adjacent Shoreline, 0 = no)	

Table 2. Estimation Results for the Employment and Net Migration Growth Model (Model I)

	Employment Equation		*Net Migration Equation*	
	Coefficient	*t-stat*	*Coefficient*	*t-stat*
Intercept	0.241	0.60	-0.291	-2.12
Net Migration Rate (*NM*)	1.05**	1.98		
Employment Growth (*EG*)			0.189**	2.32
Conservation Land Share (*CL*)	-0.050	-0.44	0.098***	2.65
Population Density (*PD*)			0.0008**	2.60
Employment Density (*ED*)	-0.0020	-0.99		
High School Graduation Rate (*HG*)	-0.002	-0.36		
Unemployment Rate (*UE*)	0.003	0.39		
Highway Density (*IH*)	-0.108	-0.12	0.033	0.13
Forest Products Employment (*FP*)	-0.296**	-2.12		
Destination Ski Area (*SK*)	0.026	0.57		
Adjacent to Metropolitan County (*UR*)	0.026	0.78	-0.017	-1.61
City > 25,000 Population (*CT*)	-0.023	-0.32	0.024	1.05
Dividend Income (*DV*)	0.139	0.32		
Expenditures to Tax Ratio (*ET*)	-0.004	-0.19	-0.019***	-2.77
Expenditures on Education (*EE*)	0.363*	1.77	-0.031	-0.38
Expenditures on Police (*PP*)			-0.148	-1.05
Expenditures on Health (*HH*)			0.168**	2.06
Home Ownership (*HO*)			0.005***	4.15
Median Family Income (*IN*)			-0.0035	-1.39
Shoreline (*SH*)			0.011	0.91
Maine	-0.221**	-2.41	-0.025	-0.59
New Hampshire	-0.222*	-1.92	-0.004	-0.10
Vermont	-0.307***	-3.04	0.021	0.43
New York	-0.272***	-2.79	-0.012	-0.26
Michigan	-0.161**	-2.18	-0.047	-1.29
Wisconsin	-0.137**	-2.44	0.036	1.41
Adj R^2	0.324		0.497	
F Value	3.291		5.728	
Prob>F	0.0001		0.0001	
White Test Statistic = 0.451				
# Obs.	92		92	

Note: Since we expect positive coefficients on the endogenous variables (EG and NM), we conduct one-tailed *t*-tests for the coefficient estimates; all other *t*-tests are two-tailed.
* Significance at the 10% level
** Significance at the 5% level
*** Significance the 1% level

Table 3. Effects of Conservation Land on Net Migration and Employment Growth

Variable	--- Employment Equation --- Direct	Indirect	Solved	-- Net Migration Equation -- Direct	Indirect	Solved
Model I						
All Conservation	-0.05	0.10*	0.07	0.10**	-0.01	0.11**
Lands (*CL*)	(-0.44)	(1.64)	(0.55)	(2.65)	(-0.01)	(2.60)
Model II						
Preservationist	-0.20	0.07	-0.16	0.07	-0.04	0.04
Lands (*PR*)	(-0.96)	(1.04)	(-0.72)	(1.05)	(-0.86)	(0.53)
Multiple-Use	0.01	0.10	0.13	0.11**	0.002	0.13**
Lands (*MU*)	(0.08)	(1.48)	(0.97)	(2.62)	(0.07)	(2.86)
Model III						
Preservationist	-0.32	-0.05	-0.28	0.10	0.08	0.05
Lands (*PR*)	(-1.50)	(-1.44)	(-1.22)	(1.42)	(1.04)	(0.68)
State Forest	-0.13	0.11	-0.03	0.14**	-0.02	0.13**
Lands (*SF*)	(-0.75)	(1.29)	(-0.15)	(2.55)	(-0.71)	(2.38)
National Forest	0.17	0.07	0.28*	0.08	0.03	0.13**
Lands (*NF*)	(1.07)	(1.08)	(1.73)	(1.56)	(0.94)	(2.58)
Change in National	0.33	0.05	0.34	-0.05	-0.04	0.01
Forest Sales (*CS*)	(0.85)	(0.79)	(0.82)	(-0.38)	(-0.37)	(0.09)

t-statistics are in parentheses
* Significance at the 10% level
** Significance at the 5% level

FIGURE TITLES

Figure 1. The Northern Forest Region

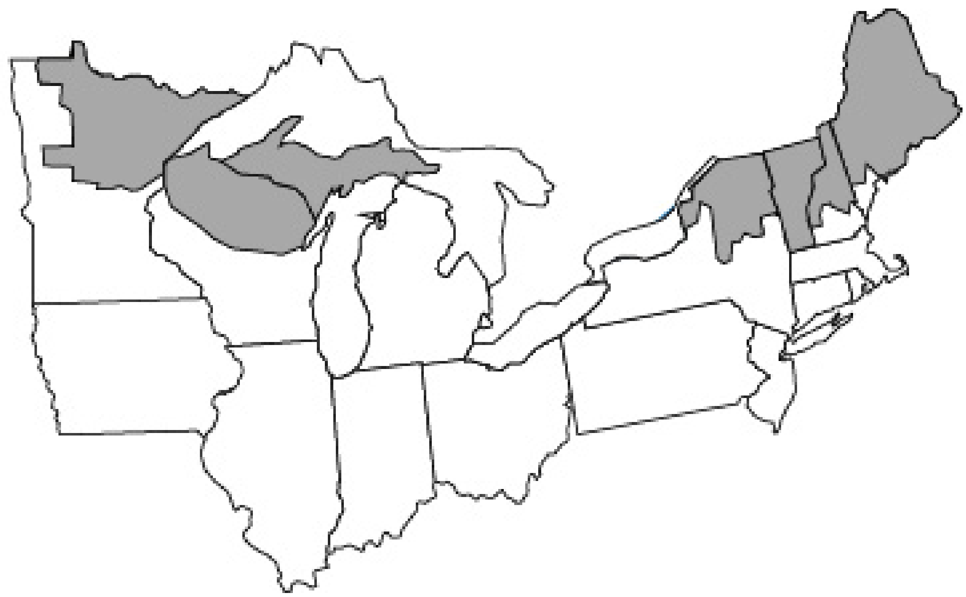

Figure 2. Public Conservation Land Timeline for the Northern Forest Region