

THE EFFECT OF THE ROADLESS AREA  
CONSERVATION RULE ON TIMBER EMPLOYMENT

by

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## **Abstract**

In 2001, the U.S. Forest Service issued the Roadless Area Conservation Rule: road construction and substantial timber harvesting were prohibited on over 58 million acres of roadless land, comprising 31% of the total National Forest acreage. Echoing previous public debate over National Forest preservation, concerns over the employment impact of this rule filled newspapers and political speeches.

National macroeconomic data was used in conjunction with county-specific employment figures, timber harvests, and roadless acreage to produce estimates of the effect of the Roadless Area Conservation Rule on timber employment. A fixed effects econometric model revealed that while there was no observable change in timber employment at the national level, some individual counties experienced a decrease in timber employment. The Forest Service could focus grants, stewardship contracts, and other policy tools on these counties to try to reconcile the goal of community stability with the goal of wilderness preservation.

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## I. Background

The U.S. Forest Service (USFS) has expressly tried to provide for community stability since the Sustained Yield Forest Management Act of 1944 (Burton 1997; Daniels 1991). At the same time, the Forest Service has preserved millions of acres as roadless primitive areas starting with the L-20 Regulation of 1929 and U-Regulations of 1939 (Forest History Society 2005). Vocal public debate would flare up whenever the desire of employment stability and the desire for wilderness protection competed for the same parcels of lands: local and national papers would run headlines about the economic cost of forest conservation while politicians would campaign on the issue (Layzar 2006).

In spite of the notoriety of the issue, there have been few ex post calculations of the impact of conservation of Forest Service lands on timber employment. As discussed in the *Literature Review*, nearly all of the academic work focuses on a small region or particular state and does not provide a complete picture of policy implications at the regional or national level. This literature deals primarily with the Northwest Forest Plan and is nearly silent on the latest conflict between timber employment and conservation of primitive areas: the Roadless Area Conservation Rule.

The Roadless Area Conservation Rule has implications for national and local employment. At the national level, the rule imposes the same level of prohibitions on timber harvesting and road construction on 58 million acres – comprising 31% of the National Forest acreage – across 38 states and Puerto Rico (Forest Service 2001a).<sup>1</sup>

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<sup>1</sup> Tongass National Forest accounts for 9.3 million acres of the total 58.5 million acres of Inventoried Roadless Areas and was exempt from immediate implementation of the 2001 Roadless Area Conservation Rule; this exemption was then extended in 2003 (Forest Service 2003). In the analysis, the counties containing the Tongass National Forest were treated as non-roadless counties since they were not affected by the policy change.

Issued in 2001, this policy can now be evaluated at the national level to determine the aggregate impact on timber employment. At the same time, these economic costs could be born by relatively few rural counties (Forest Service 2001b). Estimating this disproportionate impact requires a county-level analysis.

National macroeconomic data was used in conjunction with county-specific employment figures, timber harvests, and roadless acreage to produce estimates of the effect of the Roadless Area Conservation Rule on timber employment at both the aggregate and county level. As discussed in the *Methods and Results* section below, while there was no statistically observable trend in overall employment, a fixed effects model revealed that there were several counties that individually saw a decrease in employment. The Forest Service can focus grants, stewardship contracts, and other policy tools on these counties to try to reconcile the goals of community stability with wilderness preservation.

### *Early Legislative and Regulatory History of Wilderness and Community Stability*

The 1897 Organic Act first established public forests to provide a “continuous supply of timber” and preserve water quality (16 U.S.C. §§ 473-82, 551). Federal timber harvests were later viewed as providing more than simply timber for domestic consumption. The Sustained Yield Forest Management Act of 1944 explicitly linked harvests from the National Forests to the economic stability of local communities. (Burton 1997).

Conservation of roadless areas within U.S. National Forests began in 1929 with the L-20 Regulation for Primitive Areas which triggered the creation of 75 Primitive

Areas covering 14.2 million acres over the next decade (Forest History Society 2005). In 1939, the U-Regulations formalized policy in areas the regulation called Wilderness Areas, Wild Areas, and Canoe Areas: on 14.5 million acres, no roads, no motorized transportation, and no commercial timber harvesting would be permitted (Forest History Society 2005). When the well-known Wilderness Act was passed in 1964, the only areas to be initially designated were already protected by the L-20 Regulation and U-Regulations (Forest History Society 2005). Over the next decade, Congress designated most of the U-Regulation protected lands as wilderness and passed further laws – such as the Eastern Wilderness Act of 1975 and the Endangered American Wilderness Act of 1978 – to increase the acreage of National Forests that were designated as wilderness (Forest History Society 2005).

The implementation of these dual policy tracks came together under the National Forest Management Act of 1976. The goal of providing jobs for local communities through federal timber sales was reconfirmed (Burton 1997). At the same time, the act identified the “multiple uses” of National Forests including recreation and wilderness protection in addition to sustained yield of timber harvests (16 U.S.C. §§ 1600). The National Forest Management Act created a delicate balance of needs on paper; observers foresaw an inevitable conflict between the preservation of forest land and commercial timber harvests (Dietrich 1992).

#### *The Public Debate over “Owls vs. Jobs”*

Individual forest plans were slowly updated to balance these multiple uses according to the National Forest Management Act. Along the way, front page articles

began to chronicle the results. Disputes between environmentalists and industry began over plans to construct roads and subsequently harvest timber from roadless areas in order to support local mills (Harden 1980; Landers 1985; Hadley 1986). From Wyoming to Idaho to Michigan to California, “battle lines” were drawn in roadless areas over the amount of timber to cut; predictions of job loss due to timber restrictions on roadless areas ranged upwards of 45,000 (Louv 1986).

These early public debates would be dwarfed by the media and political attention given to the Northwest Forest Plan; the diminutive Northern Spotted Owl would soon be found on covers of newsmagazines and on television (Dietrich 1992). The public debate eventually became framed as a choice between owls and jobs (Layzer 2006; Freudenberg 1998).

Experts for environmental groups as well as industry produced numerous projections of job loss from Northern Spotted Owl protection. Most of the figures used in the public relations campaigns revolved around the indirect employment effect to the entire regional economy; these predictions ranged from 0 to over 100,000 jobs (Dietrich 1992; Niemi 1999; Layzer 2006). Less popularized in the media and in Congress were projections of the effect of preserving over 7 million acres on direct timber employment effect; still significant, these estimates ranged from 7,225 to 23,000 jobs (Niemi 1999). However, as will be explored in the *Literature Review* section, few academic articles exist that take a look back at the actual observed impact.

### *The Roadless Area Conservation Rule*

In January 1998, the Forest Service issued a notice in the Federal Register that the agency was considering the suspension of road construction and reconstruction in certain areas (Forest Service 1998). The Forest Service cited several reasons for proposing the rule. Fiscally, the agency noted that there was an enormous backlog of deferred maintenance and reconstruction projects for its existing network of 380,000 miles of roads; later, this backlog would be estimated at \$8.4 billion (Forest Service 1999). A majority of the roads had been constructed for timber harvesting; however, resource uses had “shifted substantially towards recreation” (Forest Service 1998). Ecologically, new scientific information revealed a greater impact of forest roads on watershed health. Older roads contributed to erosion, sedimentation in streams, and flooding (Forest Service 1998). Though newer roads were better engineered than before, they still negatively impacted watershed health through increased runoff, pollution, and changes in hydrology (Forest Service 2001b). The Forest Service also categorized inventoried roadless areas as “biological strongholds and refuges for a number of species and [they] play a key role in maintaining native plant and animal communities and biological diversity (Forest Service 2001b). By contributing to habitat fragmentation, the spread of invasive species, and the impingement of migration corridors, roads diminished the biodiversity value of National Forests (Forest Service 1998; Forest Service 2001b).

Following a speech at the George Washington National Forest in October 1999, President Clinton directed the Forest Service to engage in rulemaking to restrict road construction and timber harvests on the National Forest lands that had been classified as Inventoried Roadless Areas under the Roadless Area Review and Evaluation Inventory

(RARE) process in 1972 and 1979 (Forest Service 2000a). The Forest Service ultimately identified 58.5 million acres of Inventoried Roadless Areas, roughly 31% of the total USFS acreage (Forest Service 2001a).

Under the final Roadless Area Conservation Rule, issued in 2001, all Inventoried Roadless Areas would be afforded the same protection: road construction and reconstruction would be limited to public safety concerns (e.g. plowing fire lines for wildland fire suppression) and timber harvests were permitted only for forest health purposes and would not be supported by new road construction (Forest Service 2000b).

Though all Inventoried Roadless Areas would receive the same treatment under the rule, the parcels were under different management schemes at the time the rule was passed. The Forest Service categorized this prior management into three categories: 1B, 1B-1, and 1C. The proposed forest land under the Roadless Area Conservation Rule included 20 million acres were Category 1B lands were already being managed to prohibit road construction (Forest Service 2001a). An additional 4 million acres had previously been proposed as Wilderness Areas and were labeled 1B-1 (Forest Service 2001a). The remainder of the Inventoried Roadless Areas – 34 million acres – fell into Category 1C. These lands were potentially the biggest change from the status quo: whereas their individual forest plans called for “allowing road construction and reconstruction” in these areas, these activities would now be prohibited under the national rule (Forest Service 2001a).

With the conflicts over logging in roadless areas in the 1980s and the Northwest Forest Plan in the late 1980s and early 1990s, it is no surprise that the potential for employment impacts was brought into the policy debate on the Roadless Area

Conservation Rule. Without a definitive or accepted evaluation of these previous National Forest conservation policy changes, the vocal refrain from competing groups was the same as previous years and past decades. Within months of the original Forest Service announcement, conservationists argued that the plan would have an overall positive economic impact while Western politicians and industry groups cited figures of timber job loss ranging from 6,000 nationwide to 20,000 in Idaho alone (Sonner 1998a; Sonner 1998b; Drumheller 1998).

## **II. Literature Review**

While numerous front page articles have been written on the conflict between preservation of National Forest lands and timber harvesting and several employment projections have been made by all sides, few academic papers have taken a retrospective view and calculated the actual effect of broad-scale federal timber restrictions on employment. The papers have generally focused on individual cities, regions, or states, while only one paper attempts a national analysis. In addition, there has been little work done on the Roadless Area Conservation Rule; currently, only one paper explores the economic effect of roadless designation and does so only for the eastern part of Washington. Though limited in geographic scope, these papers contain econometric models that can applied to a national set of local observations.

### *Forest Service Model*

During the rulemaking phase, the Forest Service used a model known as IMPLAN (IMPact analysis for PLANning) to estimate that 250 direct timber jobs would

be lost as a result of the prohibition on road construction (Forest Service 2000a). An input-output model, IMPLAN looks at the availability of timber supply to predict timber employment (Burton 1997).

A private company – the Minnesota Implan Group, Inc. – provides both raw county-level economic data and analysis software to the Forest Service for estimating employment impacts (Forest Service no date). Because it relies upon information from a private company, “any IMPLAN data from MIG [Minnesota Implan Group, Inc.] and models derived from the data using MIG's software cannot therefore be released under FOIA [Freedom of Information Act] requests” (Forest Service no date). As a result, researchers outside of the Forest Service are unable to know exactly which variables are used to construct the coefficients that, in turn, estimate how many board feet translate into how many jobs.

Rather than critiquing data and variables – which are unknown – Burton (1997) challenges the underlying assumption of older forestry models – such as IMPLAN – that assume “timber supply translates directly into jobs.” Primarily, these models fail to account for changes in demand (Burton 1997). Instead, Burton creates an astructural model of timber employment in Oregon based on harvests from National Forests and private lands. The model adjusts for real Gross National Product (GNP) and housing starts to capture demand shifts. She finds that harvesting activities in National Forests are not driving factors for employment: private timber companies change their behavior in response to changing demand (Burton 1997). The analysis stops at 1989 because the author was concerned with the Forest Service trying to stabilize job levels rather than the exogenous shock of Northern Spotted Owl restrictions (Burton 1997).

Burton's conclusion is that the IMPLAN model failed to be an accurate policy tool for stabilizing timber employment in the 1980s because it failed to address demand for wood products and the response of the private timber sector (Burton 1997). The same critiques could be made about its applicability to the Roadless Area Conservation Rule.

Other critiques of the IMPLAN model look at the interactions between sectors of the economy. Input-output models argue that changes in derivate sectors, such as retail sales, should not influence employment in the basic sectors, such as forest products; this assumption fails an empirical test of data from Montana (Connaughton 1985). The implication is that the multipliers between sectors could be incorrectly estimated in an input-output model such as IMPLAN (Connaughton 1985).

Daniels et al. (1991) test a best case scenario: there are no private sector timber harvests, the Forest Service is able to maintain a perfectly even harvest, and there are large exogenous timber price shocks. Under these conditions, while employment in the timber sector would be slighter higher, the gains would be more than offset by larger losses from other sectors in the form of unrealized gains (Daniels 1991). In actuality, the Forest Service managers "intend to effect community stability through timber sale timing, but the flexibility in private timber supplies and the various inventories override their intentions" (Daniels 1991).

### *Literature on the Northwest Forest Plan*

The Northwest Forest Plan is the basis for most of the empirical literature that estimates the employment effects of timber restrictions. The plan set aside 7.4 million acres of late-successional and old growth forest to protect the Northern Spotted Owl;

harvests from these forests subsequently declined (USFS 1994). In the one exception to regional empirical work, Freudenberg et al. (1998) analyzes national timber employment and the nationwide timber harvest from National Forests as well as employment changes in Washington and Oregon. Freudenberg et al. look at national-level data from 1947 to 1993 to explore the relationship between environmental regulations – the Wilderness Act of 1964, the National Environmental Policy Act in 1970, and the 1989 listing of the Northern Spotted Owl – and timber employment. An ordinary least squares regression is used with timber employment as the dependent variable and USFS harvest levels, net exports, dummy variables for the years after the policy change, and individual year dummies. At the national level, the variables representing the policy changes of NEPA and the Northern Spotted Owl listing were insignificant and the “1965 to 1993” dummy standing in for the Wilderness Act had a positive and significant coefficient (Freudenberg 1998).

The model was then repeated, restricting the sample to only Washington and Oregon. The USFS harvest level no longer was statistically significant but net log exports became significant and positive. Otherwise, the results were qualitatively the same: the “1990 to 1993” time dummy representing the time period under Northern Spotted Owl restrictions was insignificant (Freudenberg 1998). The authors conclude that “there is simply no quantitative evidence of any statistically credible increase in job losses associated with the federal listing of the northern spotted owl as a ‘threatened’ species” (Freudenberg 1998). In turn, this article has been cited as providing evidence that spotted owl restrictions caused no significant change in timber employment (Layzer 2006).

However, this paper might be overly simplistic. By failing to delineate a control group, ignoring demand variables such as housing starts and overall economic health, and obscuring any localized effects, Feudenberg et al. fail to establish a causal link between policy change and employment (Carroll 1999).

Niemi et al. (1999) also rejects the simple input-output theory that ties employment simply to available supply. In analyzing the Northwest Forest Plan, the authors find a smaller-than-predicted impact to jobs in the timber industry in Washington and Oregon (Niemi 1999). Of particular interest is the authors' use of local geography: they look at direct employment effects within counties that contained timber harvest restrictions (Niemi 1999).

Berck et al. (2002) also rely upon county-level economic data in their paper on rural poverty in California. In part of their paper, they use county data to examine if decreases in timber employment trigger further job losses in other occupations in the county (Berck, 2002). However, the authors do not address the cause of changing timber employment, such as changes in demand or changes in harvest levels from National Forests.

### *Literature on Wilderness Designation*

The effect of wilderness designation on county employment has been the subject of two papers at the regional level. Lewis et al. (2002) examine the overall employment impacts of land conservation in the Northern Forest region of the United States and use the percent change in National Forest timber sales as one of the explanatory variables.

However, the authors are concerned with economic growth at the county level so they do not model the direct effect on timber employment (Lewis 2002).

Similarly, Duffy-Deno (1998) looks at the impact of designated wilderness areas on employment and population growth in rural counties in the Intermountain West and finds no significant relationship between percent of wilderness and county-level employment. However, the Duffy-Deno paper fails to establish a causal link because the author does not examine differences before and after designation (Duffy-Deno 1998).

#### *Literature on the Roadless Area Conservation Rule*

Only one paper has estimated the impact of the Roadless Area Conservation Rule on employment (Power 2000). While Power is concerned primarily with overall employment in counties that are affected by restrictions of timber harvests on federal lands, the paper is notable for the use of acreage and county-level employment data. Limited to a few counties in Washington, the paper creates a model for timber employment based on data from the 1990s and then applies the coefficients to the acreage of roadless area in the study area (Power 2000).

### **III. Data**

#### *Employment Data*

The Bureau of Labor Statistics compiles total employment and wage figures for each industry classification in their Quarterly Census of Employment and Wages. County-level data for the timber industry were downloaded, by state, for the time period 1997 to 2005. This time period encompasses several years prior to and after the

implementation of the Roadless Area Conservation Rule. Because of the timber industry is relatively small, data were only available on an annual basis rather than a quarterly basis.

The academic literature typically focuses on a broad industry code – SIC 24 – to delineate workers in the timber industry (Burton 1997; Niemi 1999; Freudenberg 1998). This classification includes people employed in logging, sawmills, and manufacturing of wood products such as doors or kitchen cabinets (Census Bureau 1998). The following analyses will use only the subset of SIC Code 24 that pertains to logging operations (SIC Code 241). This subset was chosen because these jobs are more likely to be tied directly to the geographic availability of harvest opportunities (Niemi 1999). Practical purposes also governed this choice: industry classification changed in 2001 to a new set of definitions. SIC Code 241 is a perfect equivalent to the NAICS classification 1133 (Census Bureau 1998). Other sections of SIC Code 24 are partially included in several other NAICS codes; trying to reconcile the differences would lead to noise in the data that would be difficult, if not impossible, to penetrate.

The change in reporting standards in 2001 also led to another complication. The Bureau of Labor Statistics will not publish data at the county level if there are so few companies that revealing the data would violate disclosure standards. It appears that the standards became more stringent in 2001 along with the change in industry classification. The percent of counties with non-disclosed data jumped from 47% in 2000 to 56% in 2001. However, this does not mean that the actual employment fell in those counties. National trends reveal the impact of this change. Aggregating the county-level data would reveal a nationwide drop of 31% in logging employment from 2000 to 2001

because many more counties no longer can disclose data. However, timber employment did not actually fall so drastically. State-level data, which is not as prone to non-disclosure, shows a nationwide drop of only 7% in 2000 (See Figure 1).

As a result of this inconsistency, the analyses will exclude counties that have non-disclosed data in any time period and have 10 or fewer timber employees in every year. This results in a dataset of 177 counties. This should reflect the major logging employment centers in the nation, but does obscure any employment effects on counties with only a handful of loggers. In addition, this may result in an underestimate of the impact of the Roadless Area Conservation Rule if a county experienced actual employment contraction instead of simply failing to meet new reporting standards. Finally, this data only includes employees covered by unemployment insurance so changes in employment for self-employed loggers or undocumented workers would probably not be reflected in the numbers.

#### *Acreage of National Forests and Inventoried Roadless Areas, by County*

In preparing the Roadless Area Conservation Rule, the U.S. Forest Service created GIS maps of boundaries of National Forests, Inventoried Roadless Areas, and special designated areas (such as National Wild and Scenic Rivers). These GIS coverage files were used to calculate the acreage of the different types of Forest Service land in each county (Forest Service 2001d).

The maps of National Forests in the continental United States and Puerto Rico needed to be prepped before analysis. First, geographic coordinates were defined in accordance with the provided metadata. Next, the resultant polygons were projected

using the Albers Equal Area Conic Projection with the North American Datum 1983. This layer included National Parks, so these areas were then removed. A raster grid was created based on the boundaries of the National Forests using a cell size of 1 hectare (2.47 acres). This projection and raster creation process was repeated for the boundaries for each of the types of Inventoried Roadless Areas and Special Designated Areas. The result was a national map of the National Forests that delineated the Inventoried Roadless Areas that were regulated by the rule.

County and state boundaries were then downloaded from the Census Bureau website. This data also required similar pre-processing: the geographic coordinates had to be defined and then projected using the same Albers Equal Area Conic Projection with NAD 1983. These boundaries were then drawn over each of the National Forest rasters (see Figures 2 and 3). Overlying polygon features on top of rasters allowed the Zonal Statistics Tool to be used to calculate the area of the different types of national forest contained within each county.

A similar process was duplicated for Alaska. The geographic coordinates of county boundaries and National Forest boundaries were projected according to an alternate 1983 datum for accuracy. Subsequent steps were identical to the data from the lower 48 states and Puerto Rico.<sup>2</sup>

### *Timber Harvest Data*

A complete census of timber harvest data is collected on a county-level basis by the Forest Service to support Resources Planning Act assessments. This data is publicly

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<sup>2</sup> Hawaii was excluded from this spatial analysis because the state has less than 500 acres of Forest Service Land and has no counties reporting employment of loggers.

available through their Timber Products Output database retrieval system. For each county, the volume of timber harvested is totaled for each ownership class: national forests, other public lands, and private lands (Forest Service no date). Further detailed information is available down to the individual species or product, though the analysis relied only on overall totals. Unfortunately, this information is not collected annually; rather, data is only available for 1997 and 2002.

#### *Macroeconomic Data*

Following Burton's (1997) recommendation, macroeconomic data was collected to help explain the supply and demand changes that would invalidate a simpler input-output model. Historical time series of real Gross National Product and the Federal Funds Rate was available at the Federal Reserve Bank of St. Louis (Federal Reserve 2007a; Federal Reserve 2007b). Annual housing starts were downloaded from the Census Bureau (Census Bureau 2007). The demand variable included by Freudenberg et al. (1998) was also included: annual imports and exports of wood products were accessed through the International Trade Administration (Department of Commerce 2007).

#### **IV. Methods and Results**

In constructing an empirical ex post evaluation of the Roadless Area Conservation Rule, it is necessary to compare outcomes from a treatment and control group. The treatment group in this case is the set of counties that had Inventoried Roadless Areas which became areas with prohibitions on road construction and most forms of timber harvesting. The control group is the set of the remaining counties. As noted in Carroll et

al. (1999), this failure to delineate a treatment and control group was a major problem with the Freudenberg et al. (1998) study on Northern Spotted Owl restrictions.

Figure 4 shows the trend in county employment over time for the treatment group (counties affected by the Roadless Area Conservation Rule) and the control group (counties without Roadless Areas). Though average county level employment fell for the treatment group after the implementation of the Roadless Area Conservation Rule (by 15%), it also fell for the control group (by 10%). See Table 1 below.

<b>Group</b>	<b>Average 1997 - 2001</b>	<b>Average 2002 - 2005</b>	<b>Difference</b>	<b>Percent Change</b>	<b>Sample Size</b>
Counties Without Roadless Areas	95.2	86.6	-8.6	-9.1%	136
Counties With Roadless Areas	168.4	142.6	-25.8	-15.3%	41
Difference between Groups	73.2	56.0	-17.2	-6.2%	

Note: Because the sample was restricted to counties with more than 10 logging employees in each year, the sample sizes are the same for both time periods.

*Model 1: Difference- in-Differences*

The first model, difference-in-differences, starts with Table 1 above. If the counties had identical characteristics, then the effect of the Roadless Area Conservation Rule is simply the difference between the outcomes for the two groups or, in this case:

(Employment in Counties with Roadless Areas after the Rule was issued –  
Employment in Counties with Roadless Areas before the Rule)

– (Employment in Counties without Roadless Areas after the Rule was issued –  
Employment in Counties without Roadless before the Rule)

This can be written more concisely as:

$$[(\text{Empl}|C=1, t=1) - (\text{Empl}|C=1, t=0)] - [(\text{Empl}|C=0, t=1) - (\text{Empl}|C=0, t=0)]$$

Substituting in values gives:

$$[(142.6 - 168.4) - (86.6 - 95.2)] = - 17.2 \text{ employees}$$

So, if the two groups were identical, the difference could be estimated at an average loss of 17.2 employees. Comparing percent changes allows for an adjustment based on the average size of the counties; counties with roadless areas saw a 15.3% decline while counties in the control saw a 9.1% decline for a difference of 6.3%.

However, it would be erroneous to stop the analysis at this point because the counties are almost certainly not identical between the groups (Angrist 1999). It is important to account for observed differences in the counties that could have changed during this time period (Angrist 1999). Timber harvest data at the county level is the only observed variables that differ across counties other than the size of roadless areas. Unfortunately, data is restricted to only 2 years: 1997 and 2002. A differences-in-difference calculation for those two years – without controlling for county characteristics – results in Table 2.

<b>Group</b>	<b>Average 1997</b>	<b>Average 2002</b>	<b>Difference</b>	<b>Percent Change</b>	<b>Sample Size</b>
Counties Without Roadless Areas	97.6	86.8	-10.8	-11.1%	136
Counties With Roadless Areas	184.7	148.3	-36.4	-19.7%	41
Difference between Groups	87.1	61.5	-25.6	-8.6%	

Note: Because the sample was restricted to counties with more than 10 logging employees in each year, the sample sizes are the same for both time periods.

But again, this calculation of differences in means is only a first step. In this first economic model, the difference between 2002 employment and 1997 employment is calculated for each county. This change in employment is then explained by several

factors: the change in harvests from USFS land, the change in harvests from private lands, and the amount of new land that is set aside under the Roadless Rule, written simply as:

$$\Delta\text{Employment}_i = \alpha + \beta_1(\Delta\text{Federal Harvest})_i + \beta_2(\Delta\text{Private Harvest})_i + \beta_3(\text{Roadless Acres})_i + \varepsilon_i$$

The other nationwide macroeconomic variables suggested in Burton (1997) – such as housing starts, GNP, etc. – are the same between counties with roadless lands and those without. By taking the difference across the years, these and any other unobservable national trends are implicitly controlled for.

The results of this difference-in-differences equation are found in Table 3 below. The effect of the Roadless Area Conservation Rule can be read from the coefficient *roadless\_acres*. For the full sample, this coefficient indicates that designating 10,000 acres would lead to the loss of .471 logging jobs on average; however, this coefficient is not significant, even at the 10% level. Restricting the treatment group to only counties that have more than 5,000 roadless acres might give a cleaner distinction by eliminating borderline cases. Results are very similar, with the coefficient barely changing.

**Table 3**  
**Model 1 Results**

Variable	Full Sample	> 5000 acres
roadless_acres	-0.0000471 (-1.61)	-0.0000482 (-1.61)
diff_national_forest_harvest	0.00000886*** (4.38)	0.00000882*** (4.24)
diff_private_harvest	-0.000000377 (-1.45)	-0.000000400 (-1.49)
Constant	-12.23*** (-3.36)	-11.52*** (-2.97)
Observations	177	164
R-squared	0.12	0.13
t statistics in parentheses		
*** p<0.01, ** p<0.05, * p<0.1		

There are several limitations to this model using this data. First, this causal effect assumes that the employment trends would be similar for the treatment and control group if the policy change never happened (Angrist 1999; Card 1990). Exploring the trends prior to the policy change can give an indication if this assumption holds for the data (Angrist 1999; Card 1990). While both groups see a decrease in employment from 1997 to 2001, employment is falling much more rapidly in roadless counties (See Figure 4). So, the difference-in-differences approach might not be valid. Second, only two observed county-level variables are controlled for. To improve the model's validity, either more explanatory county-level variables would be used in the regression or county-level fixed effects would be used to control for the unobservable (Angrist 1999). However, with only two years of data, county-level fixed effects cannot be used. Finally, there is most likely to be significant endogeneity between employment and timber harvest. In other words, the amount of timber harvested in a county might not be independently determined: it could depend on the number of loggers. Correcting for this

endogeneity would require more data than available at a national level for this given time period.

*Model 2: County Fixed Effects and a one-time policy change*

The limitations of the difference-in-differences model – divergent trends in employment between the treatment and control groups prior to the policy change as well as the limited ability to control for county level variation– call for an additional estimation using a different specification. A fixed effects model can correct for some of the problems: “the main idea behind fixed-effects identification strategies is to use repeated observations on individuals [or, in this case, counties] to control for unobserved and unchanging characteristics that are related to both outcomes and causing variables” (Angrist 1999). With so many unobserved county characteristics, a fixed effects model is a good fit for the data.

Mechanically, a dummy variable is created for each county in the sample. This variable now stands in for unobserved variables such as average site index, size of the county, average population size, and average timber harvest. The two years of timber harvest data is lost; instead, the unobserved variable – average timber harvest over the decade – takes its place inside the county dummy variable. Another created dummy variable indicates if the county had any roadless acreage included in the Roadless Area Conservation Rule of 2001. Interacting the two dummies gives reveals the county-by-county effect of roadless designation, controlling for the other supply and demand factors placed into the regression. These supply and demand factors were compiled from the literature, drawing heavily on Burton (1997).

The estimation can be written as:

$$\text{Employment}_{i,j} = \alpha + \beta_1(\text{Roadless Dummy})_{i,j} + \beta_2(\text{GNP})_i + \beta_3(\text{Housing Starts})_i + \beta_4(\text{Fed Funds Rate})_i + \beta_5(\text{Net Timber Imports})_i + \beta_j(\text{County Effects}) + \beta_{ij} (\text{Roadless*County Effects}) + \varepsilon_{i,j}$$

Table 4 lists the estimates for the coefficients B<sub>1</sub> through B<sub>5</sub> of this fixed effects regression. The first set of results – Model 2a – includes all of the supply and demand factors suggested in the literature. The second set of results – Model 2b – includes only those supply and demand factors that are significant. There are two columns of results for each model. As in the difference-in-differences regression, one column gives the results for the full sample while the second column lists the coefficients for a sample that excludes counties with a small amount of roadless acreage (under 5000 acres). This allows for a brighter line to be drawn between groups.

Variable	Model 2a		Model 2b	
	Full Sample	>5000 acres	Full Sample	>5000 acres
Constant	103.7*** (4.32)	101.9*** (4.00)	124.5*** (8.62)	124.8*** (8.19)
Roadless_dummy	-9.997 (-0.66)	-14.68 (-0.95)	14.65 (0.97)	-14.84 (-0.96)
real_gnp	-0.0109*** (-4.83)	-0.0106*** (-4.41)	-0.00964*** (-4.96)	-0.00922*** (-4.46)
housing_starts	0.0352* (1.89)	0.0346* (1.75)	0.0167** (2.22)	0.0143* (1.79)
fed_funds	1.202** (2.47)	1.142** (2.22)	0.989** (2.22)	0.910* (1.93)
net_imports	-8.47e-09 (-1.09)	-9.29e-09 (-1.12)		
Observations	1593	1476	1593	1476
R-squared	0.97	0.97	0.97	0.97
t statistics in parentheses				
*** p<0.01, ** p<0.05, * p<0.1				

Under 3 of these specifications, the roadless dummy is negative (counties with roadless acreage had, on average, a decline in employment after the rule was passed), but

for all of the specifications, the estimates of the roadless dummy variable are statistically insignificant. As expected, housing starts increase timber employment, as timber demand increases. Increases in the federal funds rate also increase timber logging activity, as timber owners rush to sell timber to convert their forest assets into cash in the bank to earn higher returns. The sign on GNP is opposite of what was expected; as real GNP increases, employment in the timber sector falls. This might be an artifact of including the federal funds rate, housing starts, and real GNP: these three macroeconomic factors might move similarly. The net imports variable is insignificant and is dropped in Model 2b.

The coefficients for the interaction between the Roadless Area Conservation Rule dummy variable and the individual county dummy variable give the change in employment for each county under the new policy. These results are listed in Table 5 below. The changes in timber employment were not uniform across all counties. In Model 2b, there are 40 counties with at least 10 logging jobs in each year from 1997 – 2005 and have any roadless acreage. Of the 40 counties, 9 counties saw a statistically significant decrease in employment at the 5% level (and one was significant for  $p=0.1$ ); the average employment decline was 100.9 workers per county. There were two counties that had a statistically significant increase in logging employment (one at the 5% level, the other at 10%); the average gain was 73.7 workers per county.

**Table 5**  
**Employment Changes between 1997 - 2001 & 2002 - 2005**  
**Model 2b: Counties with any roadless acreage**

<b>County Name</b>	<b>Coefficient</b>	<b>T-Stat</b>	<b>Roadless Acreage</b>
Mendocino County, California	-271.3***	(-12.7)	59,233
Grays Harbor County, Washington	-161***	(-7.55)	16,903
Lewis County, Washington	-142.9***	(-6.70)	73,146
Snohomish County, Washington	-113.3***	(-5.31)	175,128
Clearwater County, Idaho	-74.80***	(-3.51)	539,962
Natchitoches County, Louisiana	-57.90***	(-2.71)	4,287
Kenai Peninsula County, Alaska	-56***	(-2.63)	1,236,216
Yamhill County, Oregon	-51.05**	(-2.39)	3,066
Trinity County, California	-44.40**	(-2.08)	222,195
El Dorado County, California	-36.20*	(-1.70)	86,910
Lane County, Oregon	-29.50	(-1.38)	118,964
Price County, Wisconsin	-29.50	(-1.38)	9,580
Shoshone County, Idaho	-28.65	(-1.34)	515,066
Clackamas County, Oregon	-24.35	(-1.14)	63,976
Forest County, Wisconsin	-24.30	(-1.14)	292
Tuolumne County, California	-24.25	(-1.14)	104,070
Iron County, Michigan	-22.40	(-1.05)	91
Union County, Oregon	-22.30	(-1.05)	70,911
Pocahontas County, West Virginia	-22.10	(-1.04)	65,824
Grant County, Oregon	-21.70	(-1.02)	178,645
Sanders County, Montana	-21.05	(-0.99)	412,834
Chelan County, Washington	-16.75	(-0.79)	369,723
Beltrami County, Minnesota	-15.80	(-0.74)	12
Hood River County, Oregon	-15.40	(-0.72)	25,537
Jefferson County, Oregon	-14.85	(-0.70)	26,325
Calhoun County, Alabama	-14.40	(-0.68)	662
Rockbridge County, Virginia	-12.65	(-0.59)	13,427
Clark County, Washington	-9.500	(-0.45)	35
Park County, Montana	-9.100	(-0.43)	216,916
Vilas County, Wisconsin	-8.700	(-0.41)	289
Wasco County, Oregon	-8.400	(-0.39)	4,043
Berkeley County, South Carolina	-6.750	(-0.32)	897
Columbia County, Florida	-5.750	(-0.27)	4,642
Shasta County, California	-3.600	(-0.17)	161,550
Tazewell County, Virginia	-2.100	(-0.098)	2,441
Madison County, Arkansas	0	(0.00)	440
Yancey County, North Carolina	2.600	(0.12)	14,709
Pennington County, South Dakota	9.500	(0.45)	24,607
Pierce County, Washington	38.35*	(1.80)	23,101
Josephine County, Oregon	109.7***	(5.14)	140,263

The results are similar when counties with a small amount of roadless acreage (less than 5000 acres) are excluded. Only 27 counties have more than 10 logging jobs each year and also have 5000 roadless acres. Under this revised specification, 5 of the 27 counties have statistically significantly fewer jobs after the implementation of the

Roadless Area Conservation Rule. The average employment loss per county was 123 workers. There were 3 counties with a statistically significant increase in timber employment, averaging 82 workers per county. The full results are given in Table 6 below.

**Table 6**  
**Employment Changes between 1997 - 2001 & 2002 - 2005**  
**Model 2b: Counties with >5000 roadless acres**

<b>County Name</b>	<b>Coefficient</b>	<b>T-Stat</b>	<b>Roadless Acreage</b>
Mendocino County, California	-241.7***	(-11.0)	59,233
Grays Harbor County, Washington	-131.5***	(-6.01)	16,903
Lewis County, Washington	-113.4***	(-5.18)	73,146
Snohomish County, Washington	-83.80***	(-3.83)	175,128
Clearwater County, Idaho	-45.30**	(-2.07)	539,962
Kenai Peninsula County, Alaska	-26.50	(-1.21)	1,236,216
Trinity County, California	-14.90	(-0.68)	222,195
El Dorado County, California	-6.700	(-0.31)	86,910
Lane County, Oregon	8.51e-11	(0.00)	118,964
Price County, Wisconsin	0	(0.00)	9,580
Shoshone County, Idaho	0.850	(0.039)	515,066
Clackamas County, Oregon	5.150	(0.24)	63,976
Tuolumne County, California	5.250	(0.24)	104,070
Union County, Oregon	7.200	(0.33)	70,911
Pocahontas County, West Virginia	7.400	(0.34)	65,824
Grant County, Oregon	7.800	(0.36)	178,645
Sanders County, Montana	8.450	(0.39)	412,834
Chelan County, Washington	12.75	(0.58)	369,723
Hood River County, Oregon	14.10	(0.64)	25,537
Jefferson County, Oregon	14.65	(0.67)	26,325
Rockbridge County, Virginia	16.85	(0.77)	13,427
Park County, Montana	20.40	(0.93)	216,916
Shasta County, California	25.90	(1.18)	161,550
Yancey County, North Carolina	32.10	(1.47)	14,709
Pennington County, South Dakota	39.00*	(1.78)	24,607
Pierce County, Washington	67.85***	(3.10)	23,101
Josephine County, Oregon	139.2***	(6.36)	140,263

## V. Discussion

### *Policy Implications*

When the Forest Service first indicated that the Roadless Area Conservation Rule was being considered, the reaction was typical of previous agency attempts to restrict timber harvests. Dramatic job losses were predicted by industry groups. The models presented in the *Methods and Results* section show no significant nationwide impact. Though the data in the models are not ideal, these regressions – based on a dataset of counties with more than 10 loggers – should have shown some impact if the predicted massive job losses did occur. This empirical ex post analysis indicates that substantial preservation of National Forests does not necessarily lead to substantial job losses for the timber industry.

At the same time, the fixed effects regressions allow for individual county estimates to be generated. The results indicate that, after holding other factors constant, some counties with roadless acreage saw a decrease in employment after the Roadless Area Conservation Rule, while even fewer saw an increase. Daniels (1991) observes that “Forest Service options in pursuit of community stability are limited because it is a land management agency, not a social welfare agency.” However, the Forest Service has recently begun implementing stewardship contracts. Small contracts for fuels management, restoration, and similar forest management activities are given out to local timber companies or even individual loggers. This is another tool for the Forest Service to use in pursuit of community stability. The identification of negatively affected counties provides an opportunity for the Forest Service to target its limited budget

resources on these counties and provide timber employment opportunities through stewardship contracts.

### *Internal v. External Validity and Further Research*

Often in econometric program evaluations, attempts to increase the external validity of the paper come at a cost of a loss of internal validity. In other words, by trying to broaden the observations to cover more area, the analysis loses precision. This analysis is no different. Assembling a nationwide data set of county observations meant that a few compromises had to be made. For example, assembling a set of county-specific variables, such as local stumpage prices, over the past decade for every county was beyond the reach of this analysis.

Further research should focus on improving the data quality and internal validity of these models. For example, a handful of counties with and without roadless acreage could be randomly sampled. Then, an in-depth investigation could be launched into the precise market forces at work in these locales such as counting self-employed loggers, researching timber harvests over time, and calculating wages. By turning unobserved variables into explanatory variables, the precision of the analysis will be increased.

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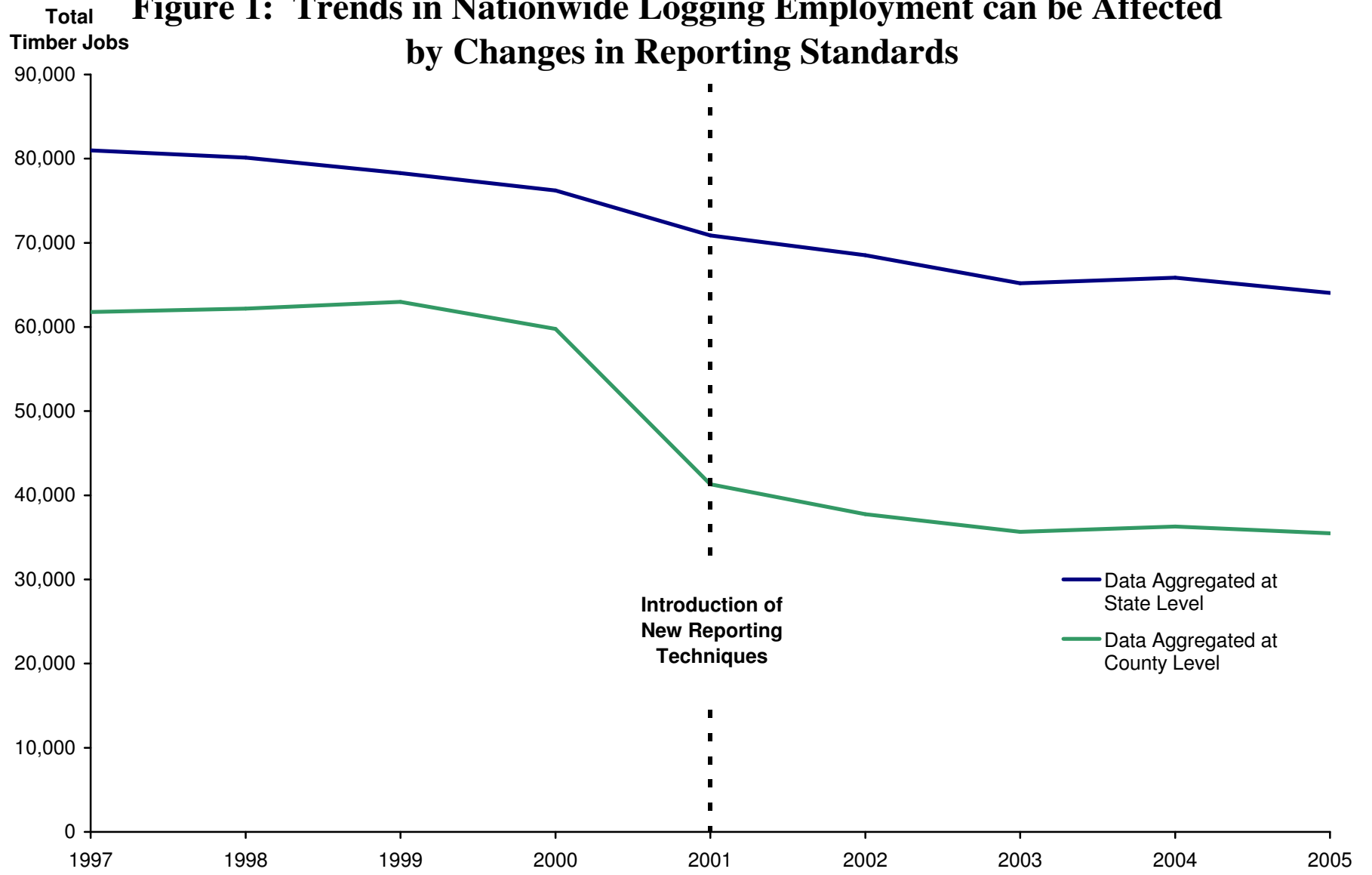
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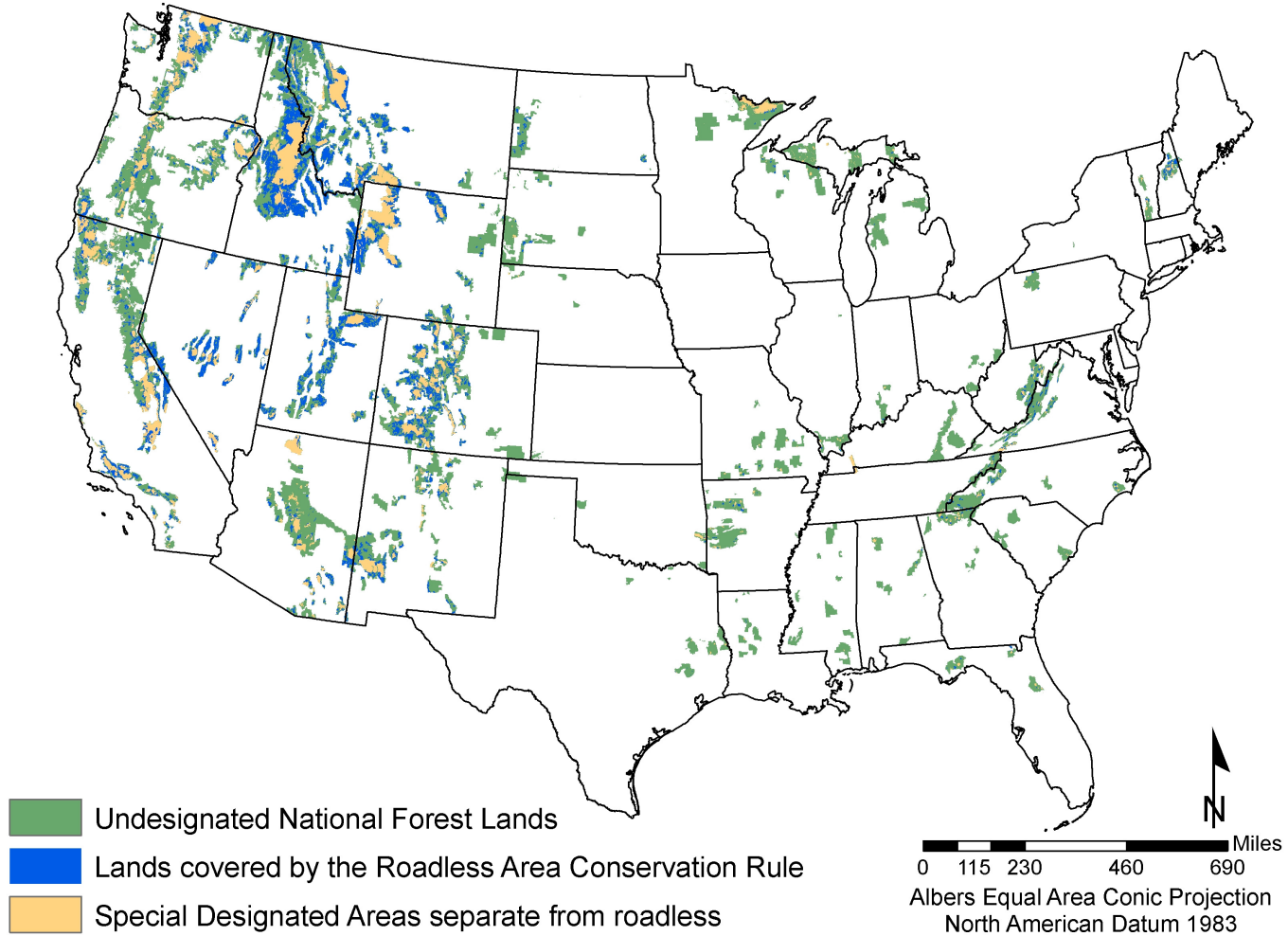
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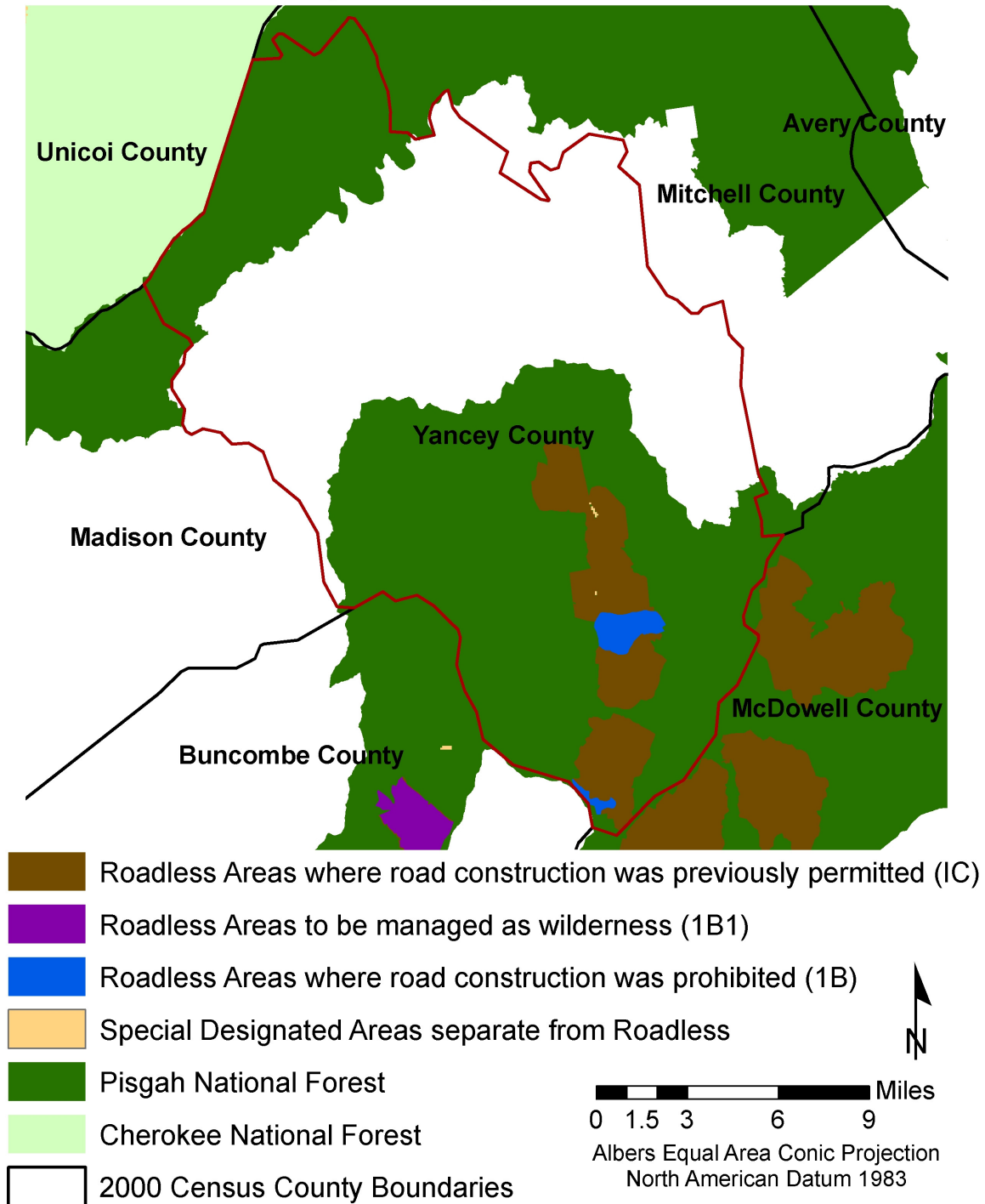
**Figure 1: Trends in Nationwide Logging Employment can be Affected by Changes in Reporting Standards**



**Figure 2: National Spatial Data**



**Figure 3: Spatial Data at the County Level  
Yancey County, North Carolina**



Average County  
Employment

**Figure 4**

**Average County Level Employment in the Logging Industry**

