The Impact of the Northern Spotted Owl Conservation Plan on Local Labor Markets*

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Abstract

Protecting species by preserving habitats that are critical to their survival often involves placing land-use constraints, raising concerns regarding job losses. I examine the effects on logging labor markets following the 1990 Endangered Species Act listing of the Northern Spotted Owl as Threatened in California, Oregon, and Washington. Using difference-in-differences, triple-differences, and synthetic control method, I find that employment in the Lumber & Wood sector, during the 1990-2000 period, declined by 25%, representing 40,000 jobs lost in the sector.
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1 Introduction

Environmental conservation often requires placing restrictions on the use of land. This creates a trade-off between conservation and economic activity (Duffy-Deno 1997; Brown and Shogren 1998; Shogren et al. 1999; James et al. 2001; Innes and Frisvold 2009; Bošković and Nøstbakken 2017; Ando and Langpap 2018). Such restrictions can either create an opportunity cost by delaying or preventing new economic development, or it can lead to direct economic losses when the environmental regulation results in a negative shock to an incumbent economic sector. A key concern with respect to environmental regulation is the effect it has on labor market outcomes, namely on the loss of jobs (Duffy-Deno 1997; Berck and Hoffmann 2002; Morgenstern et al. 2002; Cole, Elliott, et al. 2007; Livermore et al. 2012; Walker 2013; Melstrom et al. 2018).

One of the more controversial examples of this trade-off is the case of the Northern Spotted Owl (NSO) (Waters et al. 1994; Freudenburg et al. 1998). Following multiple legal actions, the Fish and Wildlife Service listed the NSO as Threatened under the Endangered Species Act (ESA), and then designated 6.9 million acres of old growth forest as Critical Habitats for the NSO. There was a wide agreement that this will have an impact on employment, yet the exact predicted numbers were highly debated (Montgomery et al. 1994; Meyer 1997). The case of the NSO listing is often mentioned as a cautionary tale regarding the labor market impacts of conservation.[1] Listing of species under the ESA often results in land-use regulation which could affect extractive in-

[1] See two recent examples in Loyola (2013) and Loomis (2019).

dustries, as in the case of the logging sector. Even without generalizing from the listing of one species, we can potentially learn about the upper bound of job-losses, especially regarding other land-use dependent industries. Such estimates will allow to better evaluate the impacts of the ESA, which remains a highly controversial policy with multiple legislative actions and litigations around the Act (Ando 1999; Winter and K. 1999; Plantinga et al. 2014; Pang and Greenwald 2015; Puckett et al. 2016; Melstrom et al. 2018).

In this paper, I use data before and after the listing of the NSO as Threatened to estimate the effect this had on jobs in the Lumber & Wood sector. I use several methods to compare the effect in the regulated regions to several comparison groups. I find that on average, employment in the Lumber & Wood sector went down between 20-25.9%, and that the number of establishments went down by 8.6%. Overall, I estimate this led to 40,000 jobs lost in the Lumber & Wood sector in the counties neighboring the protected areas in California, Oregon, and Washington. This estimate lies roughly in the middle between estimates previously predicted by environmental organizations and estimates suggested by the timber industry, at the time of the listing. However, this estimate averages the effects over the post-listing period. Focusing on the results nearly a decade after the listing, the effects almost double. These estimates are robust to different subsamples that account for potential leakage, use different sample years, as well as when performing the analysis at either county or state levels in order to account for data suppression issues.

Old growth forests in the states of California, Oregon, and Washington serve as the habitat for the NSO. This necessary habitat was reduced over

time due to extensive logging (Bonnett and Zimmerman 1991; Montgomery et al. 1994). Even with existing reports that documented declines in the owl's population size, it took a court ruling for the Fish and Wildlife Service (FWS) to list the NSO as Threatened under the ESA in 1990. In 1992, the FWS designated 6.9 million acres as Habitat Conservation Areas (HCAs) in which additional logging was prohibited. This led to a large disagreement between environmental organizations and the timber industry over the predicted impact that the NSO conservation plan will have on job losses. Between 1984 and 1990, employment in the Lumber & Wood sector (SIC 24) in California, Oregon, and Washington was, on average, 63,411, 66,376 and 39,061, respectively, reflecting a share of 0.62%, 7.4%, and 2.6% out of overall employment in those states during that time period. The impacts of the NSO listing and the subsequent Critical Habitat Designation (CHD) on employment remain heavily debated even today, with little quantitative analysis to guide such discussions. This work adds to a larger literature studying the socioeconomic impacts of conservation, particularly in the Pacific Northwest (Lewis et al. 2002; N. Wear and Murray 2004; Charnley et al. 2006b; Eichman et al. 2010), as well as to a broader literature studying the relationship between protected areas, conservation policies, and economic outcomes (Loomis and White 1996; Duffy-Deno 1997; Ando et al. 1998; Innes and Frisvold 2009; Andam et al. 2010; Miteva et al. 2012; Bošković and Nøstbakken 2017; Ando and Langpap 2018; Melstrom et al. 2018).[2]

Earlier studies that looked at the impacts of the ESA listing of the NSO

[2] For a recent review of the literature see Ando and Langpap (2018).

relied on structural models or computable general equilibrium models, input-output models, or on contingent valuation methods (Haqen et al. 1992; Montgomery et al. 1994; Waters et al. 1994; Berck et al. 2003). Empirical analysis of the labor market outcomes following the NSO's 1990 listing is scarce. Freudenburg et al. (1998) used observational data for Washington and Oregon and tested for a trend break in employment levels in logging and sawmills. The authors concluded that the decline in jobs was the result of pre-existing trends, and not an effect caused by the listing of the NSO. However, in a response to their analysis, Carroll et al. (1999) highlighted that by confining the treatment area, in Oregon, to the habitats of the NSO they were able to find a negative and statistically significant effect on jobs in the logging sector. Helvoigt et al. (2003) study the outcomes of workers in Oregon in the wood products sector who got displaced during the 1990s. They find that nearly half of those workers were no longer employed in Orgeon by 1998, and that those who remained in Oregon were earning less, on average. Both Freudenburg et al. (1998), Carroll et al. (1999), and Helvoigt et al. (2003) analyzed only the treated states of Oregon and Washington, but did not include other states as a control group. In addition, the use of a linear trend break model imposes strict structure on the data and might not be able to capture any cyclic economic trends such as the recessions in 1981 and the early 1990s.

A more recent estimation by Ferris (2017) includes California in addition to Oregon and Washington, and uses county level data in these states to study the impact on labor demand and job losses. My work adds to the current knowledge as I depart from that study in several key ways. First, I do not

use counties within the NSO states of California, Oregon, and Washington as control groups. I only use units outside of those states as comparison groups as there might be spillovers within each state, causing a SUTVA violation. Second, I focus my attention on estimating the average effect of the listing, while Ferris (2017) estimates the marginal treatment effect from an additional designated acre. Third, I use both county and state level data to overcome different potential issues of sample representation and non-disclosure of data.

Using data on employment and the areas that are considered as as the natural habitat of the NSO, I estimate the impacts of the NSO listing. I use data on employment both in the U.S. and in Canada, and I classify counties as treated according to their distance from the habitat range areas, when analyzing the data at the county level, or based on whether the state was affected by the NSO policy when analyzing the state level data. The main identifying assumption in the analysis is that the listing of the NSO and subsequent CHD were a shock to the local labor markets, and as such can be used as a natural experiment. I compare the treated counties and states to comparison groups that did not have forest land considered as habitat areas for the NSO.

Choosing an appropriate control group for the treated counties is complicated by the already pre-existing trends with respect to logging across the U.S. These trends were a function of global demand patterns, the 1981 and 1990 recessions in the U.S., and the other regulations around forest timber harvests. As such, I use estimation strategies that compare areas with NSO habitats to areas without, both inside and outside the U.S. To better account for ongoing economic trends, I also compare employment in the Lumber & Wood sector

(SIC 24) to overall employment (SIC 0). Because leakage both within and across states is a potential concern, I use county level data to restrict the treatment group to the counties in the vicinity of the habitat areas. I also estimate the results using subsamples which either omit neighboring Midwestern states, or omit regions by their Forest Service classification. Neighboring areas could have absorbed some of the additional labor supply, and similar areas in terms of wood products could have benefited from the reduced timber supply in the NSO states. The results from these subsample estimations recover similar point estimates to those in the main analysis. Only in the case of focusing on the states further out on the East Coast, I find smaller, yet sizable negative effects on employment.

My analysis finds large declines in employment and establishments, as well as reduced timber cuts, both in volume and value. I also find an increase in timber prices, as well as suggestive evidence of outward migration from the affected counties of men and women in ages between 20 and 54. I fail to find employment growth in other sectors, where one might have expected to observe such an employment response, following an increase in labor supply. These results highlight that protecting species, which often involves conserving their habitats, has non-negligible impacts in terms of job losses due to the conservation efforts. In the case of the NSO and the impact on employment in the Lumber & Wood sector, it appears that the decline in employment is persistent even years after the listing and the designation of Critical Habitats. While it is possible that the case of the NSO represents an upper bound as to the magnitude of such conservation efforts given some of the unique

circumstances involved, many other forests in the U.S. have areas in them that are designated as Critical Habitats.

2 The Listing of the Northern Spotted Owl

The habitat of the Northern Spotted Owl (NSO) (*Strix occidentalis caurina*) in the U.S. ranges across Washington, Oregon, and Northern California, where it is concentrated in old growth forests (Montgomery et al. 1994).[3] Large amounts of logging in old growth forests reduced the habitat of the NSO, and raised concerns regarding its survival. The extinction risk of the NSO was first recognized when the state of Oregon listed it as threatened in 1975 (Bonnett and Zimmerman 1991).[4] However, the Fish and Wildlife Service (FWS) conducted two separate status reviews in 1981 and 1987, and concluded that the conditions of the NSO do not justify listing under the Endangered Species Act (ESA) (Noon and McKelvey 1996).

Disagreeing with the determination of the FWS, several environmental groups filed a lawsuit against the FWS following the 1987 decision to not list the NSO under the ESA. In November 1988, the District Court ruled that the FWS decision was "arbitrary and capricious," and was "contrary to law" (Bonnett and Zimmerman 1991). In response, the FWS listed the NSO as Threatened under the ESA in June 26$^{\text{th}}$ 1990 (Fish & Wildlife Service 1990).[5]

[3] The definition for an old growth forest has changed over time, but it generally refers to forests that are older than 200 years.

[4] States can list species under state level conservation lists even if they do not appear in the federal level list of the ESA.

[5] The ESA has two categories: Threatened and Endangered. Threatened species are expected to become Endangered without conservation action. Endangered species are

As part of the litigation around the NSO, environmental organizations had injunctions issued against the sale of NSO habitats for logging. In 1989, a short-term injunction blocked 140 timer sales. It was later lifted until a 1991 ruling stalled plans of harvesting 2 billion board feet, about 75% of planned timber sales at the time, until the development of a recovery plan for the NSO.[6] A series of negotiations resulted in the 1989 "Northwest Compromise" that expanded the NSO habitat areas by up to 25% of their previous size, and restricted the logging and fragmentation in those areas (Thomas et al. 1990). Assuming similar harvest rates to those in the 1980s, and using tentative plans at the time regarding harvesting approvals, the FWS estimated that most of the NSO habitats on federal land would be cleared by 2050, and would be cleared on private lands by 2000 (Bonnett and Zimmerman 1991).

In January 1992, the FWS designated 6.9 million acres of forest land as Habitat Conservation Areas (HCAs) which prohibited logging in those forests (Fish & Wildlife Service 1992).[7] The majority of the suitable habitats, about 91%, were on federal lands. The Critical Habitats were designated all throughout the habitat of the NSO. See Figure 1 for a summary of the key policy

those that face a high extinction probability in all or some of their range, in the foreseeable future.

[6] See https://www.upi.com/Archives/1989/03/24/Timber-sales-stopped-pending-ruling-review/4293606718800/, https://www.nytimes.com/1989/03/16/us/judge-allows-timber-cutting-in-owl-habitat.html, and https://law.justia.com/cases/federal/appellate-courts/F2/952/297/368051/ for more information.

[7] Today, the NSO is still listed as Threatened under the ESA. In addition to the loss of habitats, invasion of the Barred Owl is hindering the recovery of the NSO. The invasion of the Barred Owl to the west is attributed to land use changes in the Northeast and Midwest. It was first documented in Washington in 1973, and in California in 1981. The Barred Owl is more aggressive and competitive relative to the NSO, making the protection of the NSO's habitat insufficient in terms of protecting its survivability (Dark et al. 1998; Peterson and Robins 2003; Dugger et al. 2011).

events, and Figure 2 for a map of the habitat range of the NSO, along with the areas designated as Critical Habitats.

The logging industry objected the designation, through court appeals and lobbying, on the grounds that the NSO can live in secondary growth forests as well. The main argument was that the economic implications of restricting timber harvests will outweigh the benefits of protecting the owl (Bonnett and Zimmerman 1991). Projections at the time suggested job losses between 18,000 and 130,000 industry and service jobs (1991; Montgomery et al. 1994). Environmental organizations disputed the large numbers suggested by industry by referencing levels of employment around 1990. Industry members argued that employment levels at the time were low due to the early 1990s recession and have not returned to their pre-recession levels, leading to underestimations of potential job losses (Bonnett and Zimmerman 1991).

3 Data

In the paper, I use data on labor market outcomes, NSO habitat areas, and timber harvests from national forests. Below I briefly describe the different data sets, how I combine them, and how I define the treatment and control groups. Table 1 reports descriptive statistics for the main variables used in the analysis.

3.1 Labor Market Data

I use data from the Quarterly Census of Employment and Wages compiled by the Bureau of Labor Statistics (BLS), between 1984 and 2000.[8] The data include the number of establishments, number of people employed, and average weekly wages, across different sectors which are classified according to the Standard Industrial Classification Codes (SIC).

The data are reported both for county and state levels. However, when using county level data there are cases where the data are suppressed if there are a small number of people employed, or a small number of employing firms. This non-disclosure of data prevents identifying specific people or firms. As a result, some counties have missing data in a few or many of the time periods. To address this, I restrict the county level sample only to the counties that fully report employment data in the Lumber & Wood sector during 1984-2000. In addition, I use the state level data which includes data from all counties, and is always fully disclosed.

The benefits of using the county level data are that it allows to focus on the counties around the designated areas, as well as controlling for more granular fixed effects. However, restricting the sample to those counties for which data are always disclosed results in focusing on the counties with a sufficiently large number of people and firms in the reporting sector. This could weaken the

[8] Even though data is available before 1984 most counties are not reported in the sample consistently. In order to increase the number of counties that are fully balanced I restrict the sample to 1984 onward, since the number of observations sharply increases following 1984. I end the sample at the end of 2000 because that marks the year in which the BLS transitioned from the Standard Industry Classification system to the North American Industrial Classification System.

representativeness of the sample. Using the state level data represents all of the counties in each state. However, it either assumes that all counties within each state are strictly in either treatment or control status, or if there is leakage within an NSO state between counties, that the estimated effect on those state will be net of that leakage.

It is not clear that all counties within the three NSO states are treated with a negative labor demand shock as a result of the listing. For this reason, I use the distance from the protected areas to determine treatment status when using the county level data (as I explain in the protected areas data subsection).[9] I also include data from Statistics Canada on employment in the forestry and logging and support activities for forestry sector, which I use as an additional comparison group in the analysis. The data from Canada only extends from 1987 to 2000, whereas the other data sources all span 1984 to 2000.

In Figure 3a, I plot the average employment in the Lumber & Wood sector, as well as overall employment in all sectors, across California, Oregon, and Washington (the NSO states). I include markers for the timing of the lawsuit against the FWS, the court ruling, and the final CHD. In the figure, there is a sharp drop in employment following the court ruling. However, this drop coincides with the recession in the early 1990s. This is evident in a similar drop in overall employment during that time.[10] Overall employment appears to have

[9] Using distance from the protected areas also helps to address the issue that each county reports employment based on the location of the firms' offices, and not by the location where the employment took place. The buffers around the protected areas allow to capture employment that is attributed to neighboring counties even though it took place outside of the reporting county.

[10] In Figure 3a, I emphasize the timing of the recession in red.

recovered and continued to increase after the recession, yet employment in the Lumber & Wood sector remains stagnant. While it could be the case that labor demand already declined following the court's ruling, it is confounded by the recession. As such, it is important ho have a comparison group that allows to difference out the effect of the 1990s recession.

In Figure 3b, I plot the employment in the Lumber & Wood sector per-each state, scaled relative to 1990q2, prior to the listing. Comparing the NSO states to the rest of the Contiguous U.S. it appears that all states saw a decline in employment in this sector during the early 1990s, as part of the recession at the time. Following the 1990-listing, employment continued to decline in all three NSO states, while the majority of non-NSO states saw continued growth in their Lumber & Wood sector employment. In addition, there appears to be meaningful heterogeneity in the response of the three NSO states, especially in the case of California which began showing recovery in 1996, relative to Oregon and Washington.

3.2 Northern Spotted Owl Habitat Range & Critical Habitats

I use data from the Fish and Wildlife Service (FWS) on the location of areas that are classified as the habitat range for the NSO, and areas designated as Critical Habitats. This allows me to assign treatment status to a subset of counties within the states of California, Oregon, and Washington based on distance from the habitat areas. Treatment assignment can be based either by the habitat range or Critical Habitats location. Choosing one or the other

ends up making little difference as the ESA regulations apply throughout the range of the species, and the Critical Habitats are dispersed throughout the range (see Figure 2).

In the preferred sample definition, I consider counties that are within 25 km from the habitats of the NSO, resulting in a treatment group of 71 counties. Basing the sample definition on a 25 km distance to the Critical Habitats would have only removed 4 counties from the treatment sample. To verify that the choice of distance cutoff is not driving the results, I choose several distance cutoffs and perform the analysis using the different treatment groups that result from each cutoff.

Figure 2 highlights the California, Oregon, and Washington counties included in the 25 km range from the habitat areas (red) and the counties in the three states that are omitted from the analysis. Counties within the three NSO states that are further away from the protected areas could be considered as either control or treatment units. Because it is unclear whether they are completely unaffected by the listing of the NSO, I choose to drop them from the analysis. This way the treatment group is composed only of counties that are in the surrounding areas of the NSO habitats. The control counties are those that are outside the three states that have NSO habitats in them.

3.3 Timber Harvests

I use data from U.S. Forest Service (USFS) on Cut-Sold Reports for National forests for the period between 1984 and 2000. The data are reported at the

forest level, which I aggregate to the state level.[11] Data include the number of sales, sold volume and value, and actual cut volume and value.

3.4 Variable Construction

Many of the outcome variables of interest in the data are reported in levels, such as the labor outcomes and timber harvests. To compare between counties and states that have values at different scales, I transform the data using a close equivalent of a logarithmic transformation. Specifically, I use the Inverse-Hyperbolic-Sine function (Burbidge et al. 1988).[12] This allows to map values of zero in the sample to zero, should they arise, instead of dropping those observations because the log of zero is not defined.

4 Empirical Strategy

To test for the effect of the NSO listing on labor market outcomes, I use three different strategies: a difference-in-differences (DD) analysis, a triple-difference (DDD) analysis, and a synthetic control method (SCM). The identification strategy relies on the plausibly exogenous shock from the federal court ruling regarding the listing of the NSO. The court found the Fish and Wildlife Service (FWS) at fault for not listing the Northern Spotted Owl (NSO) under the ESA, and the subsequent listing and Critical Habitat Designation (CHD) provide a demand shock to the labor markets in California, Oregon, and Washington. The fact that the FWS assessed the NSO twice during the 1980s, and decided

[11] Each forest is administered by a different state.
[12] $\text{asinh}(x) = \log(x + \sqrt{x^2 + 1})$.

against listing the NSO, further enables to interpret the court ruling as a shock to the labor markets in the area.

Throughout the analysis, I use June-1990 as the beginning of the treatment period. The multitude of events surrounding the listing, see Figure 1, complicates choosing the exact treatment onset. The effect on labor markets could have started as early as the 1989 "Northwest Compromise" that placed additional logging injunctions, or even as soon as the court case in 1988, by affecting the expectations of logging firms. I choose the listing as Threatened as the onset of treatment for two main reasons. First, under the ESA the listing already had an immediate effect on the ability of firms to harvest timber. Second, following the listing there were court rulings that placed injunctions on timber sales. These injunctions were only partially resolved with the 1994 Northwest Forest Plan (for more details, see Section 2: The Listing of the Northern Spotted Owl).

4.1 Difference-In-Differences

A simple Event-Study analysis relies on there being no pre-existing trends in the data with respect to the variables of interest. If pre-trends exist then it is not possible to interpret the pre-treatment values as the likely counterfactuals in the absence of treatment. Due to the economic recessions in 1980s and early 1990s, it becomes even more important to have a comparison group that allows to control for economic cyclicality and other contemporaneous changes in timber markets.

The DD identifying assumption is that in the absence of the listing of the

NSO, counties in California, Oregon, and Washington would have exhibited similar trends, with respect to their job market outcomes, relative to the counties in the control group. Another important assumption is that there is no effect on non-treated units. This could be violated if other counties absorb any of the the labor leaving the treated counties, or benefit from reduction in timber supply from the Northwest. In the results, I use several sample restrictions to account for the potential scope of leakage in this setting. The empirical specification that estimates the average post-treatment effect for the labor market outcome of interest, L_{cyq}, is:

$$L_{cyq} = \beta_1 Listing_{cyq} + \lambda_c + \delta_y + \gamma_q + \varepsilon_{cyq} \tag{1}$$

Where $Listing_{cyq}$ is equal to one for counties in California, Oregon, and Washington after the ESA listing of the NSO, and is equal to zero for all previous periods, and for all other counties across all the periods. I control for average differences across counties and for pooled periodic effects using λ_c, δ_y, and γ_q which are county, year, and quarter fixed effects, respectively. County fixed effects control for any time-invariant characteristics at the county level. The year fixed effects allow to control for flexible time-trends that are pooled between the treatment and control counties. Quarter fixed effects remove any pooled seasonality relationship that is time-invariant. A more flexible specification which estimates the average treatment effect by year is given by:

$$L_{cyq} = \sum_{\substack{\tau \in \{1984,\ldots,2000\} \\ \tau \neq 1991}} \beta_\tau \mathbb{1}\{y = \tau\} \times Treated_c + \lambda_c + \delta_y + \gamma_q + \varepsilon_{cyq} \tag{2}$$

Where the interaction of $\mathbb{1}\{y = \tau\} \times Treated_c$ creates a set of dummies that is equal to one for each county c, which is part of the treatment group, in each year, and zero otherwise. Each β_τ is estimating the average difference between the treated counties, relative to the other counties in the control group, in each year. While I keep the data at the quarterly level, I estimate the effects at the yearly level for efficiency purposes.

4.2 Triple-Differences

The DD specifications compare the Lumber & Wood sector in the treatment counties to those in the control counties. However, there could be other confounding factors that are not accounted for when comparing only that sector. For example, the economic recession which started in 1990 could be have contributed other macroeconomic effects that are responsible for any observed declines in employment in the Lumber & Wood sector. Using the employment in all other sectors but the Lumber & Wood sector as an additional control group could help to further difference out any macroeconomic differences between treatment and control counties. The DDD specification is:

$$\begin{aligned} L_{scyq} =& \beta_1 Listing_{cyq} \times SIC24_s + \\ & \lambda_{cyq} + \delta_y \times SIC24_s + \gamma_c \times SIC24_s + \varepsilon_{scyq} \end{aligned} \tag{3}$$

Where $Listing_{cyq}$ is a dummy variable equal to one for all periods after the NSO listing for the treated counties, and zero otherwise, and $SIC24_s$ is a dummy variable for the Lumber & Wood sector, which is compared to all

other industries (i.e. SIC0 but after subtracting SIC24).[13] The parameter of interest is β_1 which accounts for the effects within each treated county, between the Lumber & Wood sector to other sectors, relative to the difference within the control counties between the two sectors, following the listing. County-year-quarter fixed effects allow to flexibly control for any other additive effects that change at the county level over time. Pooled changes over time in the Lumber & Wood sector (e.g. technological changes) are captured by the year-sector fixed effects, $\delta_y \times SIC24_s$. Any baseline difference in employment in the Lumber & Wood sector between counties are accounted for by the county-sector fixed effects, $\gamma_c \times SIC24_s$.[14] Similar to Equation (2), a more flexible approach results in:

$$L_{scyq} = \sum_{\substack{\tau \in \{1984,\ldots,2000\} \\ \tau \neq 1991}} \beta_\tau \mathbb{1}\{y = \tau\} \times Treated_c \times SIC24_s + \tag{4}$$
$$\lambda_{cyq} + \delta_y \times SIC24_s + \gamma_c \times SIC24_s + \varepsilon_{scyq}$$

This specification estimates how the Lumber & Wood sector developed in the treated counties, before and after the 1990 listing decision, relative to all other sectors, while comparing the development to other counties that were not part of the treated group.

Both national and international macroeconomic trends could have affected the Lumber & Wood sector around the same time of the 1990-listing. The

[13] Notice that the first term is the DDD triple interaction, as $Listing_{cyq}$ is the interaction of post-treatment with the treated group.

[14] Remaining double and single interactions are nested within these three sets of fixed effects

above DDD strategy allows to account for national, but not international impacts. In order to test if logging-related employment in the NSO states was declining more due to international market forces than national regulation, I compare their employment levels to those in the Canadian labor market. However, if the listing of the NSO caused large disruptions to global timber markets, then Canada might not be a valid control group. Using data on comparable labor markets allows to estimate the following DDD specification:

$$L_{ryq} = \sum_{\substack{\tau \in \{1984,\ldots,2000\} \\ \tau \neq 1991}} \beta_\tau \mathbb{1}\{y = \tau\} \times Treated_r \times USA_r + \lambda_{yq} + \delta_y \times USA_r + \gamma_r + \varepsilon_{ryq} \tag{5}$$

Where each β_τ captures the average difference, in each year, between each region r (state or province), between the affected NSO states, to the unaffected states and provinces. The year-quarter, λ_{yq}, year-U.S., $\delta_y \times USA_r$, and region, γ_r fixed effects nest the remaining double and single interactions. The specification in Equation (5) can also be collapsed to estimate an average post-CHD treatment effect, similar to Equation (3).

4.3 Synthetic Control Method

Running the DD and DDD regressions described in the above subsection produces a comparison of unweighted averages between treatment and control groups. Ex-ante, it is not obvious that a simple average will result in a control group that best fits the labor market patterns of the NSO states prior to the

1990 listing. Using a weighted average might produce a control group that is a better representation of the counterfactual in the absence of treatment.

Synthetic Control Method (SCM) is a data-driven approach that chooses weights that produce a weighted comparison group. The weights are chosen such that they maximize the fit between the weighted average, referred to as the synthetic control, and the treatment group (Abadie and Gardeazabal 2003; Abadie et al. 2010; 2015; Athey and Imbens 2017). Following Cavallo et al. (2013), I apply this method to the case where there is more than one treated group. For conciseness, I describe the implementation of the method in the appendix. I run the SCM using the state level data, as using the county level data might result in over-fitting due to the large number of donor units.

5 Impacts on Labor Market Outcomes

In this section I describe the main estimation results for employment, and number of establishments. Across several specifications and estimation strategies, employment is estimated to have declined by 25% and establishments declined by 8.6%, in California (CA), Oregon (OR), and Washington (WA). In a subsequent section, I use restrictions on the composition of the sample and the sample years to account for potential leakage and other confounders such as the 1994 Northwest Forest Plan. I recover similar estimates for employment, but the result for the decline in establishments becomes smaller and imprecise.

5.1 Employment Impacts Using County Level Data

For the Lumber & Wood sector, I report the average treatment effects on employment and number of establishments, using the county level data, in Table 2. On average, employment in logging is lower by 25.9% (column 1), and the number of establishments declined by 8.6% (column 3), in the years after the 1990 listing in counties that are within 25 km of the NSO habitat area.[15] This is estimated relative to the other counties that are in the contiguous U.S. but are not in CA, OR, and WA, and do not fall below the disclosing threshold.[16] In Figure A3, I demonstrate that the results are not sensitive to the choice of the distance threshold used to define the treatment group. These results remain similarly large and precise when controlling for the population shares at the county-year level (columns 2 and 4).

The estimated 25.9% decline in employment is similar to the result in Ferris (2017) of a 22.9% decline. However, Ferris (2017) defines treated counties as those with NSO Critical Habitats in them, and uses the other counties in the three NSO states as the control group, which could result in the estimate capturing leakage across counties. Ferris (2017) also uses data from 1975-2000, which introduces issues with both balancing and data suppression, that are accounted for in the analysis in this paper.

I present the effects by year for employment and establishments in Figures 4a and 4b. Starting in 1990, employment levels begin to decline, and by 1994

[15] Converting the log points to percent changes uses the $[(e^{\hat{\beta}-0.5\times\hat{se}^2\times\hat{\beta}}-1)\times 100\%]$ transformation.

[16] Out of the 71 counties that are 25 km from the habitat area, 51 counties never have their employment data suppressed for the Lumber & Wood sector.

it is about 20% lower relative to the 1989 level. There does not appear to be any sign of preemptive action, where logging firms increased extraction, and as a result employment, in the periods prior to the lawsuit, injunctions, listing, and Critical Habitat designation. Such a spike is also missing in the timber extraction estimates, reported in Figure A4. A lack of preemptive action can be explained by two rulings the FWS made in 1980s to not list the NSO which could have lowered the probability that logging firms assigned the event of the NSO getting listed. Establishments follow a similar dynamic pattern with the key difference of seeing a small increase from the mid-1980s to the late 1980s, which could be capturing the recovery from the early 1980s recession.

I report the average changes in employment and establishments using the DDD strategy in Table 3, columns 1 and 2.[17] Comparing the Lumber & Wood sector to all other sectors helps ruling out that the counties considered as treated were not already experiencing an overall economic contraction, which the DD analysis is picking up as the effect of the NSO listing. The DDD results, using county level data, are comparable to the DD estimates in Table 2 in their magnitude and precision. The dynamics and magnitude of the response reported in the DD year-by-year results, are also present in the equivalent DDD results in Figures 4c and 4d. The main difference between the DD and DDD results is that in the DDD results, the decline in establishments is more than double than in the DD results. This suggests that there were larger exits of firms in the Lumber & Wood sector in the NSO counties relative to firm exits in other sectors.

[17] I only report the triple-interaction effect as the double and single interaction effects are nested by the fixed effects.

When using the county level data, I drop from the sample any county for which data are not disclosed at least once. While this helps achieve a balanced panel, it also places the focus on the counties that had sufficiently high employment levels such that there are no constraints on public data disclosure. To avoid any misrepresentation in the sample, I also run the analysis at the state level, at which data are always disclosed. I report the results at the state level in Table A1, Table 3, and Figure A1.

5.2 Comparison to the Lumber Sector in Canada

Comparing the Lumber & Wood sector to the other sectors helps to control for regional changes in economic activity. However, beyond the regional changes, there could have also been changes to demand and supply of timber products that overlapped with the 1990-listing and are not fully accounted for in the DD and DDD specifications used. To control for such changes in global timber markets, I use data from Canada on employment in the forestry and logging sector. In Table 3, column 5, I report the DDD results that compare the Lumber & Wood sector in the U.S., between the NSO states to the non-NSO states, to the forestry and logging sector in Canada, before and after the 1990-listing. I recover estimates of similar magnitude and precision to the previous results at the county and state levels. While relative to the Canadian forestry and logging sector, the decline in employment only becomes large and precise following 1993, on average, employment declined by 22.8% in the NSO states following the listing.

5.3 Synthetic Control Method Results

The timber and labor markets in the Northwest might be considerably different than those throughout the rest of the U.S. As such, comparing unweighted averages of the treatment and control groups using a fixed effects regression could be insufficient to capture all the pre-existing differences between the groups. For this reason, I also include results using synthetic control method (SCM) for employment and establishments in Figure 6.[18] Both employment and the establishments decline by 50% and 30%, respectively, by the year 2000. Based on the p-values, which are standardized relative to the goodness-of-fit in the pre-treatment periods, the results are more precise in the case of employment levels than in the case of the number of establishments.

6 Restricting to Subsamples to Examine Potential Threats to Identification

In this section, I cover results that repeat the main DD analysis but for different subsamples of the data. Each subsample enables studying the degree to which a potential threat to identification appears to be influencing the results.

[18] The results here use state level data in order to avoid overfitting issues that arise when the donor group size is very large. The weights are calculated to fit on the outcome variable during the pretreatment period, as to avoid arbitrary decisions as to which covariates to include in the calculation of the weights.

6.1 Accounting for the 1994 Northwest Forest Plan

The year-by-year results suggest that post-1994 the labor market outcomes were still declining but at a slower rate. To focus on the medium-term period between 1990 and 1994, I reestimate the DD specifications for both county and state level data for a subsample of 1984 to 1994. For employment, the results in Table 4, columns 1 to 4 are somewhat smaller than those in the full sample of 1984 to 2000, but are of similar magnitudes. More importantly, the impacts on employment are not statistically significant from the results in Table 2. However, the results on establishments are smaller and imprecise (Table 4, columns 4 and 8). This subsample provides estimates that are hardly influenced by the 1994 adoption of the Northwest Forest Plan, which resolved standing timber sale injunctions but also placed restrictions on timber harvesting in the Northwest. These results also offer an estimate that does not take into account changes that could have taken place long after the 1990-listing.

6.2 Accounting for Potential Leakage

One potential threat to the estimation strategy is potential spillovers to other states. Changes in labor markets and the supply of timber in the NSO states could have increased labor supply and timber demand in the other non-NSO states. This leakage is more likely to occur in neighboring states where relocation costs for workers and transportation costs of timber are lower. Full leakage, where each job lost in the NSO states leads to a new job in the non-NSO states, would mean that my estimates are double counting each job loss

in the NSO states.

To test if this is a severe problem, I construct a subsample consisting of the NSO states along with states in the eastern part of the U.S. This East Coast subsample allows to test if I recover similar estimates even when excluding the regions that are more susceptible to absorb the increase in labor supply and increase in timber demand. This goes beyond a somewhat common approach of treating commuting zones as approximate borders of labor markets. By restricting the control counties to lie along the eastern part of the U.S. I take a much more conservative approach than that of relying on commuting zones.

Results in Table 4 report the estimates for the East Coast subsample for both county (columns 5 and 6) and state levels (columns 7 and 8). County level results are slighltly lower relative to the full sample. Employment in the full sample dropped by 25.9% (Table 2, column 1) and in the East Coast subsample it dropped by 22.9% (Table 4, column 5). Establishments in the full sample dropped by 8.6% (Table 2, column 3) and in the subsample it imprecisely dropped by 3.9% (Table 4, column 6). The estimated impacts are further reduced when using the state level data with the East Coast subsample as a control, where there is now an imprecisely estimated decline of 9.5% in employment.

The difference in the magnitudes between the full sample and East Coast subsample suggest that states in the Midwest, particularly in the Northwest, experienced growth in their Lumber & Wood sector, relative to the states further east and south, following the 1990-listing for the NSO. This suggests that adjustments across county borders might have resulted in a smaller net effect

on labor markets in the Lumber & Wood sector. However, two important caveats hold. As mentioned earlier, using the state level data means that even counties that were far from the habitat and designated areas are considered treated. If leakage across states is indeed a major concern then those counties within the NSO states, that are far from the protected areas, are also those that are more likely to absorb the spillovers. In addition, the forests in the Northwest, and to a degree the Midwest, offer a different supply of timber products. As such, while the East Coast subsample might allow to reduce the impacts of leakage on the estimates, it might also be a less adequate comparison group. Nevertheless, these estimate offer a more conservative approach to estimate the impact of the NSO listing impacts on employment in the NSO states.

6.3 Analysis by U.S. Forest Service Regions

In addition to the results that compare the NSO states to the East Coast sample of states, I also run the analysis using the regional division of the USFS (see Figure A6). The state of CA is its own region, and OR and WA define another unique USFS region. The rest of the contiguous U.S is divided to six more regions. I run the estimation for mean employment by either dropping one non-NSO region at a time, or comparing the NSO states only to that region.

Results using the county level estimation are summarized in Table 5. In Panel (A), I report the estimation of the DD specification of NSO states relative to the full sample but without one USFS region. Panel (B) repeats this,

but includes the NSO states and only one USFS region at a time. Results in Panel (A) are very similar to one another, indicating that the results are not strictly driven by just one group of states. In Panel (B), there is more heterogeneity across the results. It is important to note, that when comparing the NSO states to the northeast and southeast separately, columns 5 and 6 in Panel (B), the results are of similar magnitude and precision to each other, and to the results in Table 2. The northeast and southeast regions likely have high relocation costs for workers as well as high transportation costs of timber. As such, I consider leakage to be less of a concern relative to these two regions. I repeat this regional analysis at the state level in Table A3.

7 Impacts on Timber Markets & Prices

In this section, I estimate the effect of the 1990-listing on the sale of timber in national forests, as well as the price of lumber commodity. I find timber sales in the NSO-affected forests declined by 44.6%, and that the future price of lumber doubled by the time the 1994 Northwest Forest Plan was implemented relative to other commodities.

7.1 Reductions in Timber Harvests

As additional evidence for the decline in labor demand in the Lumber & Wood sector, I test for the impacts on timber logging at the state level. In Table 6, I report the DD estimates for both timber cuts in volume and value. The volume of timber cut dropped by 44.6%, (column 1) while the value of the

timber dropped by 53.1% (column 2).[19] These estimates are statistically significant at the 1% level. Focusing on the comparison states in the east results in even larger point estimates (columns 3 and 4). While the precision of the estimates in columns 3 and 4 remains high, the number of clusters drops from 40 to 16. This could lead to underestimating the standard errors (Bertrand et al. 2004). This is less of a concern here, as the focus on the East Coast sample is meant to account for leakage, and to test whether the subsample estimation recovers similar magnitudes of the effects. The results for the 1984-1994 subsample produce slightly smaller, but still precise, estimates (columns 5 to 8). This suggests that between 1990 and 1994, logging operations were still able to harvest timber from the non-protected areas, but those resources became scarcer following 1994. I report year-by-year estimates in Figure A4, which helps to resolve concerns regarding the adoption of the Northwest Forest Plan in 1994, as the sharp decline in cut volume appears after the 1992 designation of Critical Habitats.

7.2 Impacts on Lumber Prices

Previous work by Rucker et al. (2005) studied the impact of the NSO court ruling on future lumber prices but did not observe an immediate jump around that time. They estimated a slow, and small in magnitude, increase in lumber prices that can also be attributed to the rebound from the early 1990s recession. I revisit these results using future commodity prices for lumber as well as other

[19] One potential concern is that timber prices reacted to the decline in timber supply from the Northwest. However, if timber prices increased in response to the reduced supply, that would drive the value of cut volume up, not down.

commodities. I adjust the nominal prices using a GDP implicit price deflator, and plot the data in Figure 7a. Ideally, I would be able to compare prices of specific timber prodcuts in local markets. Unfortunately, such level of data are not publicly available.

In Figure 7b, I report the results from an SCM analysis, comparing Lumber futures to 19 other commodities that have fully balanced data spanning 1984-2000. Both the raw data and the SCM analysis suggest there was a considerable increase in the price of lumber in the years after the NSO listing and the designation of Critical Habitats. However, as the SCM analysis shows, there was volatility in lumber prices relative to other commodities prior to the 1990 listing. The sharp increase, where the future price of lumber doubles, appears to begin following the designation of Critical Habitats, then tapers off after the 1994 Northwest Forest Plan, and finally increases in volatility after that. Given the lack of granularity in the data, and the imperfect fit in the pre-treatment periods, I interpret these results as suggestive of a large increase in lumber prices, but am cautious to associate it with the NSO listing.

8 Heterogeneous Effects, Outcomes in other Sectors & Impacts on Migration

In this section I start with estimating the impacts on the Lumber & Wood sector by state. I proceed to estimate whether other sectors, where it would be plausible to expect them to absorb additional labor, saw an increase in employment. I fail to find meaningful and precise increases in other such

sectors. Finally, I test for outward migration and find suggestive evidence that the population share of men, ages 20-54, declined by 2% in the counties neighboring the NSO habitat areas.

8.1 Heterogeneous Effects on Employment by State

Throughout the analysis, I pool the three NSO states as one treated unit. However, as can be seen in Figure 3b, each state had a somewhat different average response. I repeat the analysis for employment separately for each of the three NSO states. In Table 7, I report the average impact on employment, for the full sample, the East Coast sample, and the shorter sample of 1984 to 1994. The key difference in the results shows that California experienced a smaller impact relative to Oregon and Washington. While in the full sample, Oregon and Washington saw employment decline by 25.8-29.5% (columns 2 and 3), California only saw a decline of 20.4% (column 1). The result for California is also less precise than those of the other two states. This difference appears to be the result of the post-1994 period, as in column 7 to 9, the results for all three states for the 1984-1994 period appear to be in stronger agreement with one another.

The year-by-year estimates, by state, in Figure 8 show that while both Oregon and Washington saw the decline in employment persist until 2000, California began recovering in 1996. The ability of California to rebound might be a result of having only a fraction of the designated Critical Habitats. This might have allowed firms to more easily substitute towards logging in non-protected areas. However, the recovery appears to be much smaller when

using the state level data (see Figure A2), than when using the county level data.

8.2 Changes in Employment in other Sectors

In the analysis thus far, I have focused on quantifying the decline of jobs in the Lumber & Wood sector. However, while those jobs might have been lost and never recovered, another important question is whether there were other sectors that increased in size and absorbed those who lost their jobs in the logging industry. I repeat the main DD analysis, at the county level, for six other sectors that could have potentially absorbed labor from the Lumber & Wood sector: agricultural production of crops and livestock, mining of metals and coal, construction, and forest conservation.

The results in Figure 9 fail to suggest a sector that might have played an important role in absorbing those who left the Lumber & Wood sector. I test for the effects on agricultural, mining, and construction sectors as they are either similar extractive industries or require similar physical stamina. I include the Land, Mineral, Wildlife & Forest Conservation sector as it might have increased in size due to the job retraining program that was part of the Northwest Forest Plan. The plan established a Jobs-in-the-Woods program, managed by the Bureau of Land Management, which aimed to train those who lost their jobs in logging to take up work in watershed conservation.[20]

[20] With respect to the Northwest Forest Plan, Charnley et al. (2006a) write that: "...Jobs-in-the-Woods has been the greatest disappointment of all of the initiative's components because public expectations for the quality and number of jobs created to offset job losses in the timber industry were never realized."

8.3 Changes in Age Structure Composition

Previous work on the impacts of the NSO listing highlight that some workers left the affected areas in pursuit of new employment (Helvoigt et al. 2003; Eichman et al. 2010). While studying this requires data at the worker level, I attempt to place bounds on the magnitude of this effect using county level data. I use population data from the Census Bureau and data harmonized by IPUMS to study the share of the age group between 20 and 54 (U.S. Census Bureau 2018; Manson et al. 2018). Population numbers are measured more precisely during decadal census years than they are between censuses. While year-to-year population data are available at the county level, they are estimated using an interpolation algorithm. Comparing the census data to the estimated data shows that the differences are mostly within 1%, relative to the census data. In Figure, A7, I plot the share of the 20 to 54 age group in the county's population using the two data sources, and plot the distribution of the differences between the two.

Estimating a DD specification for the change in the share of the 20 to 54 age group, I find a small, yet precise, effect. Figure 10a shows a drop in 2000 relative to the 1990 baseline, using the census data. Breaking the effect by men and women, I find the male population share in that age group declined by 0.9 percentage-points (a 2% drop relative to the mean share), while the female population share declined by 0.4 pp (a 0.9% decline relative to the mean share). The effect appears to persist even in the 2010 data. Focusing on the male population share, I estimate the effect separately for CA, OR, and WA and report these effects in Figure 10b. OR and WA had increasing male

population shares prior to 1990, relative to counties in other states. California had a stable pre-trend. Counties in the three NSO states saw their male population share, between 20 and 54, decline in 2000 and 2010. Using the estimated population data, I find smaller, by half, effects in 2000 relative to 1989 (Figure 11). The year-by-year estimates also show that the decline in the share of this age group was on a downward trend from 1984, and that a large drop happened in 1990, coinciding with the 1990s recession. These results are suggestive, but far from conclusive, about any demographic changes that can be attributed to the NSO 1990-listing. However, these results are consistent with the claims regarding outward migration of working age population from the area that were affected by the listing (Eichman et al. 2010).

9 Conclusions

In this paper, I estimate the impact that the Endangered Species Act (ESA) listing of the Northern Spotted Owl (NSO) as Threatened in 1990 had on labor market outcomes in the Lumber & Wood sector. Results from DD, DDD, and SCM estimations find declines in employment well within 20-25%. Employment in the Lumber & Wood sector in the counties that are 25 km from the NSO habitat areas averaged at 158,830 in the pre-treatment period of 1984 to 1989. This reflects about 1.4% of total employment in those counties. With a quarter of these jobs estimated to have been lost in the post-listing period, this amounts to about 40,000 jobs lost in the Lumber & Wood sector.

This analysis demonstrates that environmental conservation that aims to

protect species' habitats can result in non-negligible impacts on employment. While it is not straightforward to generalize from the case of the NSO to other ESA listings and other industries, several other forest areas are subject to ESA regulations that restrict the harvesting of timber. In Figure 12, I plot the overlap between forest areas and Critical Habitats. I plot Critical Habitats and not the habitat ranges as the latter would simply cover the entire land area of the U.S.[21]

Further research is still needed to learn more about the impacts on the workers themselves, and not just the jobs that were lost. It is also important to examine whether the case of NSO is representative of other ESA listings, or if it represents an upper bound of the effect of land-use restrictions on employment. As the logging industry relies on extracting resources from forests, and the listing of the NSO prohibited extraction of almost 40% of the resource base, the effects estimated in this paper might be in the right-tail of the treatment effect distribution across ESA listings. Better quantifying the impacts of the ESA on labor markets is key in having an informed discussion regarding any changes to the policy.

[21] Many species have ranges that are defined as an entire state, or span several states.

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Figures

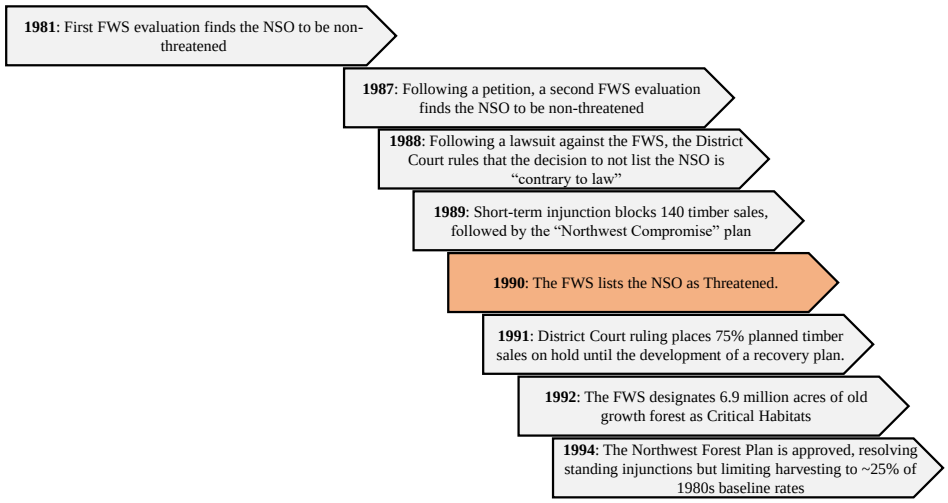


Figure 1: Timeline of Key NSO Policy Events

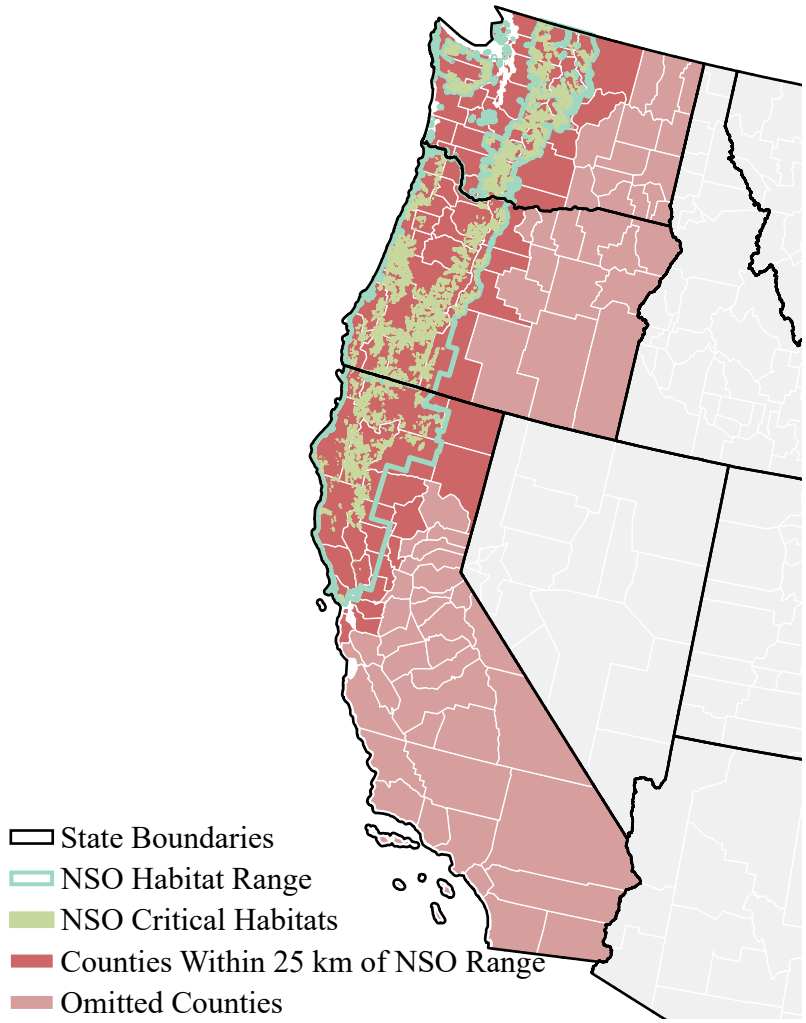
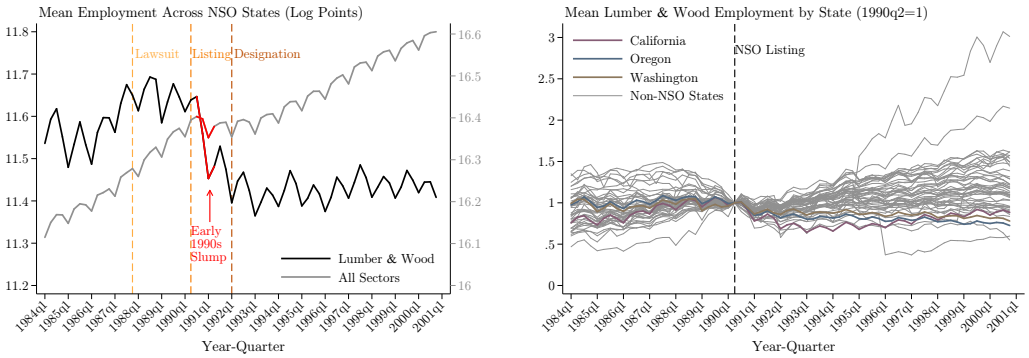


Figure 2: Habitat Ranges & Designated Critical Habitats

Notes: Map of habitat range for the NSO, designated Critical Habitats (2012 revision), counties that are at 25km from a habitat area, and counties in CA, OR, and WA which are later omitted in the main analysis in order to account for potential spillovers.

Source: Habitat ranges and Critical Habitats data from FWS.



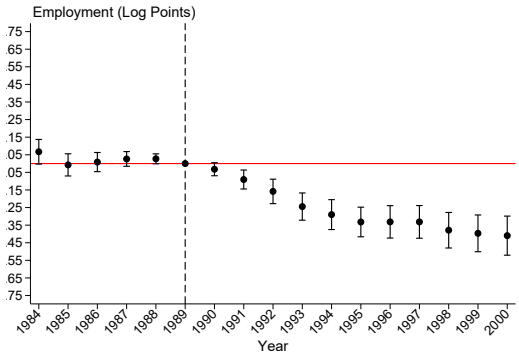
(a) NSO States (b) NSO States VS. Contiguous U.S.

Figure 3: Raw Employment Data Across States

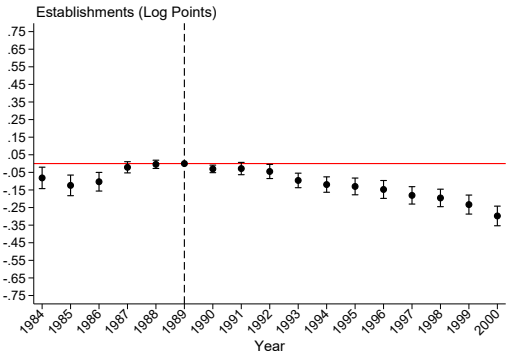
Notes: (a) Mean employment in the Lumber & Wood sector (SIC 24) or total employment (SIC 0), at the state-year-quarter level, in log points. Vertical dashed lines show the quarter of the lawsuit against the FWS, the court's decision that the NSO should be listed, and the designation of Critical Habitats. (b) Mean employment at the state-year-quarter level. Each state is scaled relative to 1990q2, prior to the listing taking effect.

Source: Listing data from the Fish and Wildlife Service. Labor data from the Bureau of Labor Statistics.

Difference-In-Differences Results

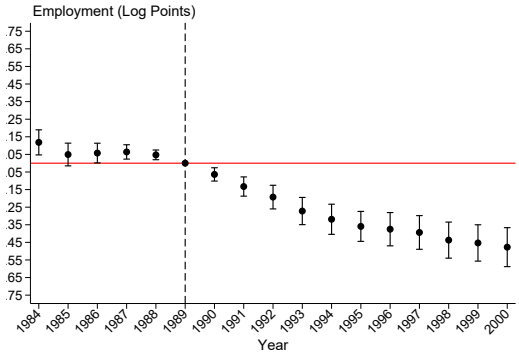


(a) Employment

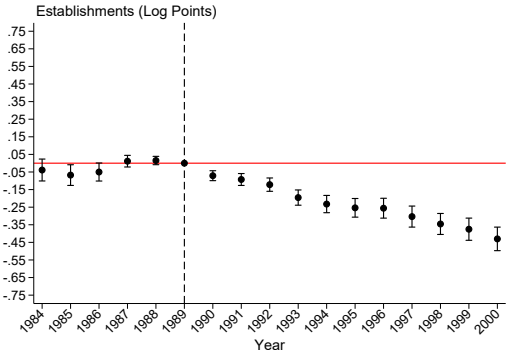


(b) Establishments

Triple-Difference Results



(c) Employment



(d) Establishments

Figure 4: County Level DD & DDD Results

Notes: Estimation results for the specifications in Equations (2) and (4). Treated counties are defined as the counties within 25 km of NSO habitat areas in CA, OR, and WA. Capped spikes denote 95% CIs. Standard errors are clustered at the county level.

Source: Listing data from the Fish and Wildlife Service. Labor data from the Bureau of Labor Statistics.

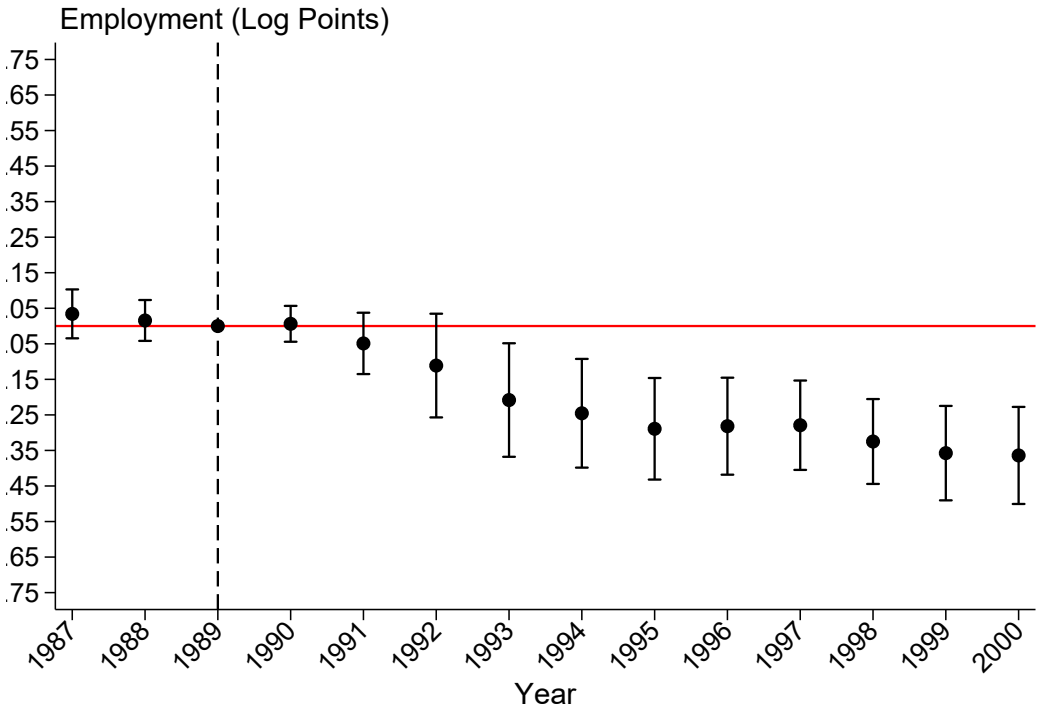
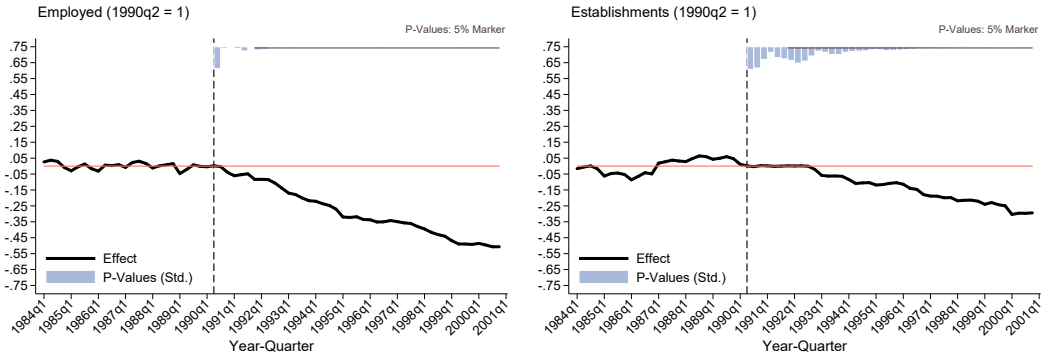


Figure 5: U.S VS. Canada DDD Employment Results

Notes: Estimation results for the specification in Equation (5). Treated states are CA, OR, and WA. Capped spikes denote 95% CIs. Standard errors are clustered at the region (state or province) level.

Source: Listing data from the Fish and Wildlife Service. Labor data from the Bureau of Labor Statistics and Statistics Canada.

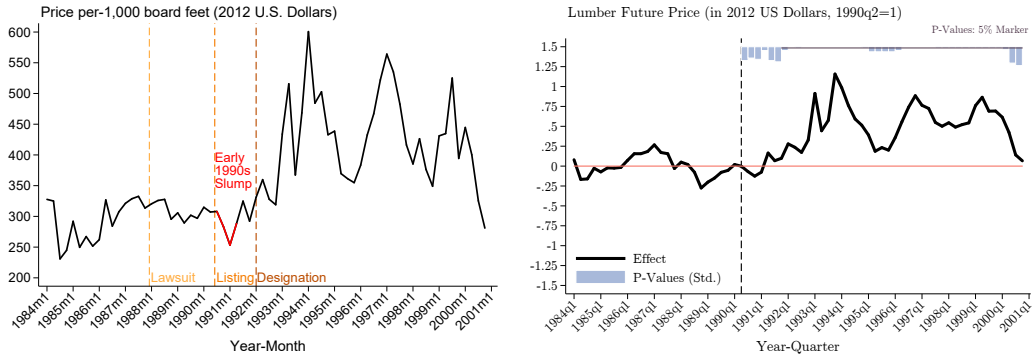


(a) Employment (b) Establishments

Figure 6: State Level SCM Results

Notes: Synthetic Control Results using data for CA, OR, and WA as treated groups.

Source: See Table 3.



(a) Raw Data (b) SCM

Figure 7: State Level SCM Results

Notes: 7a Lumber futures data, deflated using a GDP deflator (2012 as the base year). 7b Synthetic control results using data for other commodities.
Source: Futures data from CME Group. GDP Deflator data from U.S. Bureau of Economic Analysis, Gross Domestic Product: Implicit Price Deflator [GDPDEF], retrieved from FRED, Federal Reserve Bank of St. Louis.

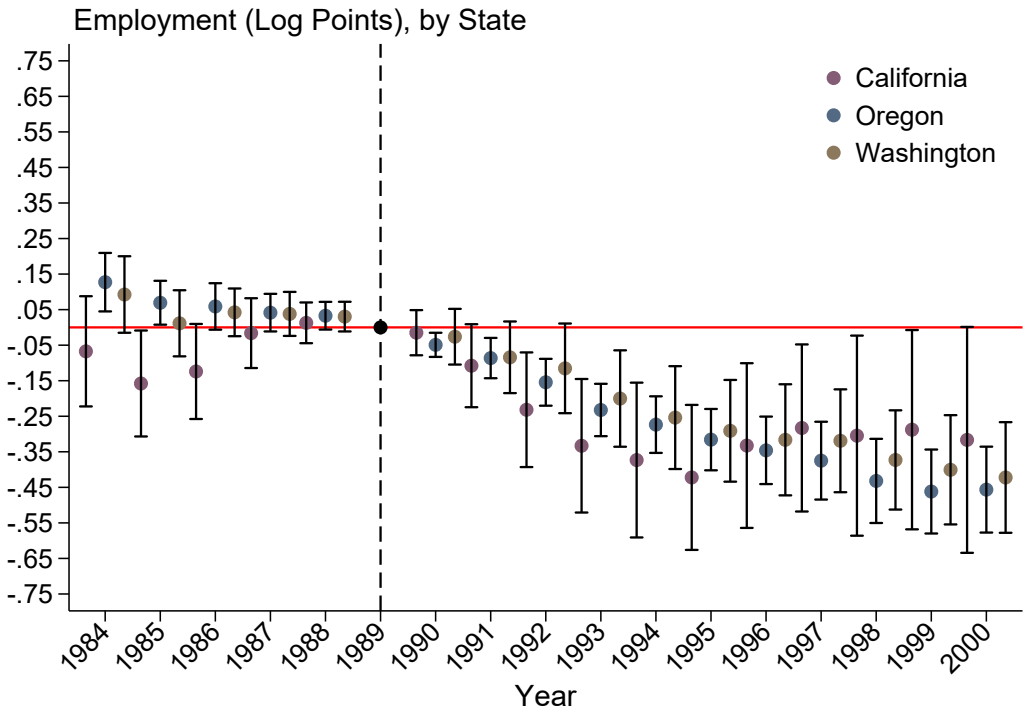
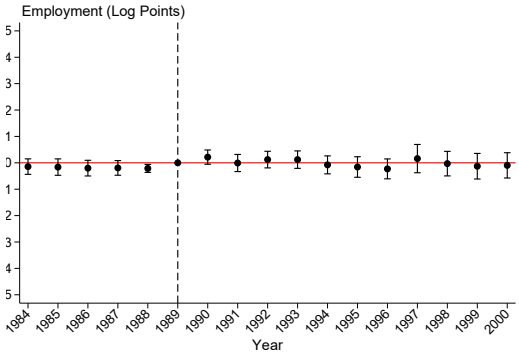


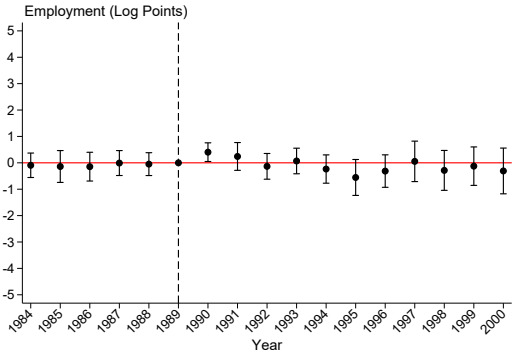
Figure 8: Results on Employmeny, by State

Notes: Estimation results for the specification in Equation (2), run separately for CA, OR, and WA. Capped spikes denote 95% CIs. Standard errors are clustered at the county level.

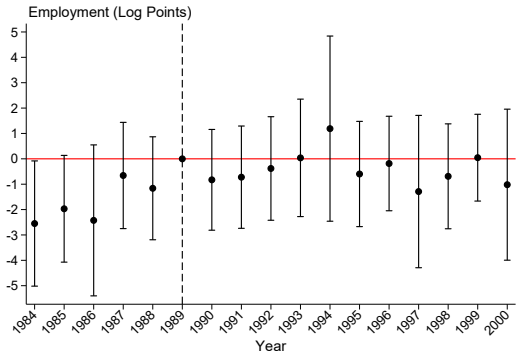
Source: See Figure 4.



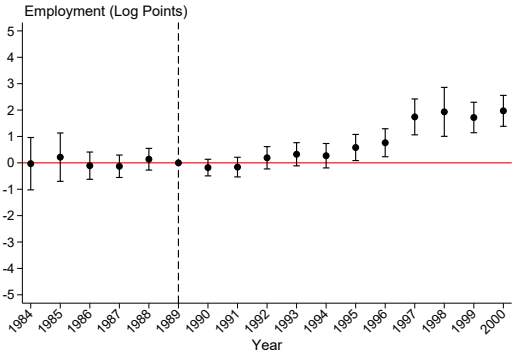
(a) Agricultural Production-Crops (SIC 01)



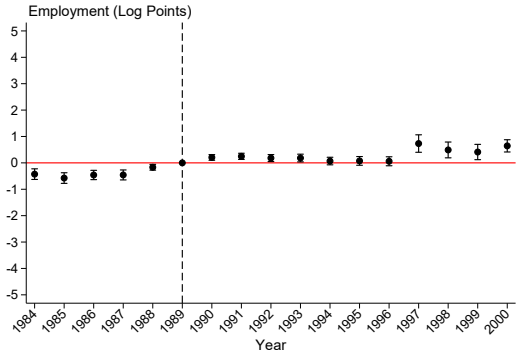
(b) Agricultural Prod-Livestock & Animal Specialties (SIC 02)



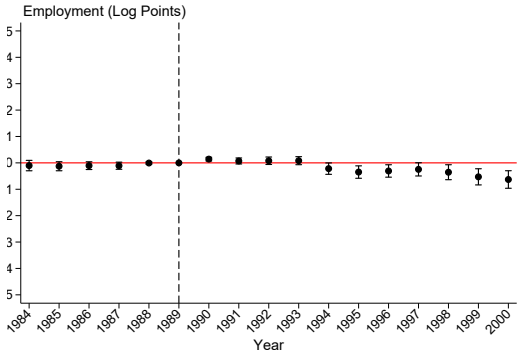
(c) Metal Mining (SIC 10)



(d) Bituminous Coal & Lignite Mining (SIC 12)



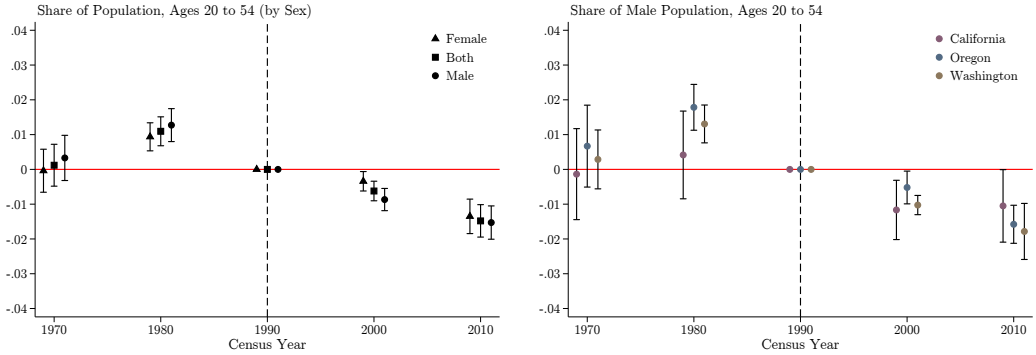
(e) Building Construction General Contractors & Operative Builders (SIC 15)



(f) Land, Mineral, Wildlife & Forest Conservation (SIC 9512)

Figure 9: Employment in other Sectors

Notes: See Figure 4.
Source: See Figure 4.



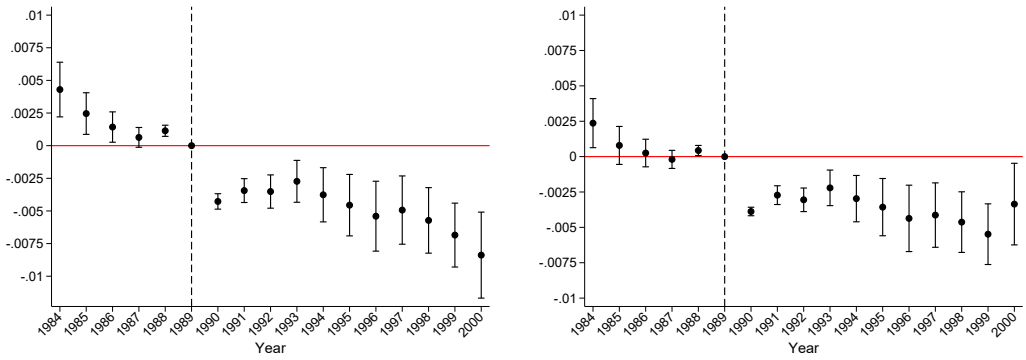
(a) By Sex, All NSO States

(b) Males Only, By NSO State

Figure 10: Population Share, Ages 20 to 54, Decadal Census Data

Notes: Estimation results for the specification in Equation (2). Each estimate is a separate regression. Capped spikes denote 95% CIs. Standard errors are clustered at the county level.

Source: See Figure 4. Population data from the U.S. Census Bureau and IPUMS.



(a) Male Population Share, All NSO States

(b) Female Population Share, All NSO States

Figure 11: Population Share, Ages 20 to 54, Estimated Yearly Data

Notes: Estimation results for the specification in Equation (2). Each estimate is a separate regression. Capped spikes denote 95% CIs. Standard errors are clustered at the county level.

Source: See Figure 4. Population data from the U.S. Census Bureau and IPUMS.

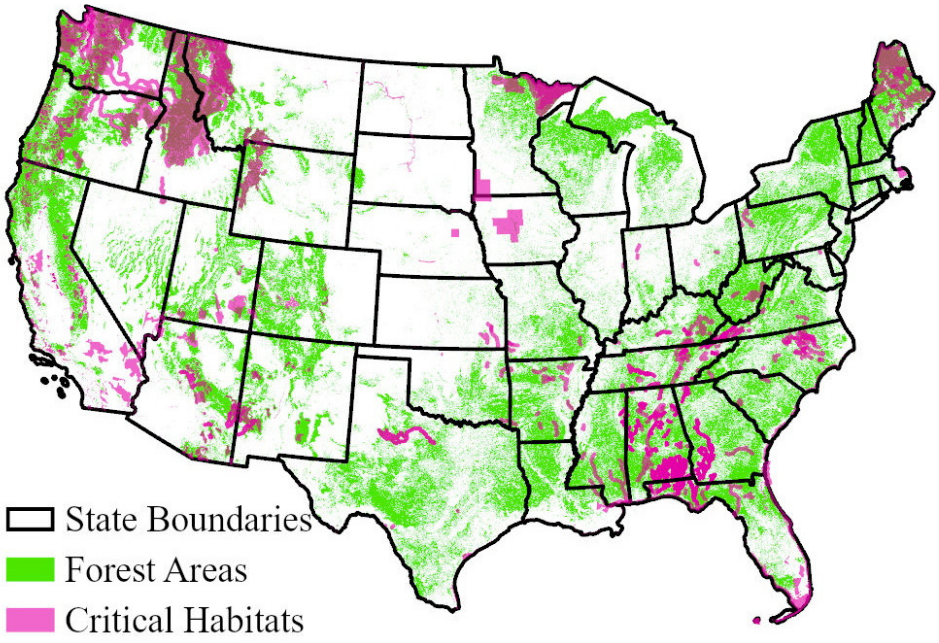


Figure 12: Overlap of Forest Areas & Critical Habitats

Notes: Distribution of forest areas, for all ownership types, and areas that are designated as Critical Habitats.

Source: Critical Habitat data from the FWS. Forest areas data from the USFS.

Tables

Table 1
Descriptive Statistics

Variable	Mean	Std. Dev.	Min.	Max.	N
Panel A. Employment Variables, County Level, Unbalanced Sample					
Employment (Hundreds)	2.8	6	0	141.6	175,593
Establishments (Levels)	14.1	23.4	0	625	175,593
Employment (Log Points)	4.4	2.7	0	10.3	175,593
Establishments (Log Points)	2.4	1.5	0	7.1	175,593
Panel B. Employment Variables, County Level, Balanced Sample					
Employment (Hundreds)	4.6	7.1	0	121.7	80,988
Establishments (Levels)	23.3	24.9	3	400	80,988
Employment (Log Points)	6.2	1.1	1.8	10.1	80,988
Establishments (Log Points)	3.5	0.7	1.8	6.7	80,988
Panel C. State & Province Levels					
(i) Employment Variables (U.S.)					
Employment (Hundreds)	158.8	146	2.7	742.2	3,196
Establishments (Levels)	806	649.8	38	3364	3,196
Employment (Log Points)	9.8	1.1	6.3	11.9	3,196
Establishments (Log Points)	7	1	4.3	8.8	3,196
(ii) Employment Variables (Canada)					
Employment (Hundreds)	78.8	95.5	2	403	555
Employment (Log Points)	8.9	1.4	6	11.3	555
(iii) U.S. Timber Data					
Timber Cut Volume (Thousands)	180.2	458.2	0	4394.2	2,720
Timber Cut Value (, Millions)	19.6	64.8	0	692	2,720
Timber Cut Volume (Log Points)	11.1	2.5	2.5	16	2,720
Timber Cut Value (Log Points)	15.1	2.9	4.8	21	2,720

Notes: Summary statistics for the Lumber & Wood Sector (U.S., SIC code 24), and the forestry and logging and support activities for forestry (Canada), at the county (U.S.), state (U.S.), and province (Canada) levels.
Source: Labor data from the Bureau of Labor Statistics and Statistics Canada. Timber data from the U.S. Forest Service.

Table 2
County DD Employment Estimates
Logged Employment and Establishment Levels

	Emp.		Est.	
	(1)	(2)	(3)	(4)
Listing×NSO	-0.30	-0.29	-0.09	-0.11
	(0.04)	(0.05)	(0.02)	(0.03)
R^2	0.918	0.919	0.937	0.938
N	80,988	80,948	80,988	80,948
Clusters	1,191	1,191	1,191	1,191
County FE	X	X	X	X
Year FE	X	X	X	X
Quarter FE	X	X	X	X
Pop. Share		X		X

Notes: Estimation results for the specification in Equation (1). Treatment is defined as the interaction after the 1990 ESA listing for the Northern Spotted Owl (NSO), in the counties that are within 25 km from the NSO habitat areas. Standard errors are clustered at the county level.
Source: Listing data from the Fish and Wildlife Service. Labor data from the Bureau of Labor Statistics. Population data from the U.S. Census Bureau.

Table 3
County & State DDD Employment Estimates
Logged Employment and Establishment Levels

	County Level Results		State Level Results		
	SIC24 to SIC0		SIC24 to SIC0		USA to CAN
	Emp.	Est.	Emp.	Est.	Emp.
	(1)	(2)	(3)	(4)	(5)
Listing×NSO^{C}×SIC24	-0.38	-0.23			
	(0.05)	(0.03)			
Listing×NSO^{S}×SIC24			-0.30	-0.22	
			(0.07)	(0.08)	
Listing×NSO^{S}×U.S.					-0.26
					(0.05)
R^2	0.997	0.998	0.999	1.000	0.980
N	161,840	161,840	6,392	6,392	3,187
Clusters	1,190	1,190	47	47	57
FIPS×YQ FE	X	X	X	X	
FIPS×SIC24 FE	X	X	X	X	
YQ×SIC24 FE	X	X	X	X	
Region FE					X
YQ FE					X
Year×U.S. FE					X

Notes: Estimation results for the specification in Equation (3). For columns 1 to 4, treatment is defined as the interaction after the 1990 ESA listing for the Northern Spotted Owl (NSO), with either the counties that are within 25 km from the habitat areas (NSO^{C}), or in the NSO state, CA, OR, and WA (NSO^{S}), interacted with the Lumber & Wood Sector (SIC24). For column 5, treatment is defined as the interaction after the 1990 ESA listing for the NSO states, interacted with being a U.S. State (relative to a Canadian province), and being one of the NSO states. Standard errors are clustered at the county level (columns 1 and 2), state level (columns 3 and 4), or region (state or province) level (column 5).
Source: Listing data from the Fish and Wildlife Service. Labor data from the Bureau of Labor Statistics (for the U.S) and from Statistics Canada (for the Canadian labor data).

Table 4
County & State DD Employment Subsamples Estimates
Logged Employment and Establishment Levels

	Years: 1984-1994				East Coast Sample			
	County		State		County		State	
	Emp.	Est.	Emp.	Est.	Emp.	Est.	Emp.	Est.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Listing×NSO^{C}	-0.20	-0.01			-0.26	-0.04		
	(0.04)	(0.02)			(0.05)	(0.03)		
Listing×NSO^{S}			-0.16	0.01			-0.10	0.00
			(0.04)	(0.07)			(0.06)	(0.08)
R^2	0.935	0.950	0.989	0.995	0.918	0.940	0.985	0.990
N	52,404	52,404	2,068	2,068	44,948	44,948	1,428	1,428
Clusters	1,191	1,191	47	47	661	661	21	21
County FE	X	X	X	X	X	X	X	X
Year FE	X	X	X	X	X	X	X	X
Quarter FE	X	X	X	X	X	X	X	X

Notes: See Tables 2 and 3.
Source: See Tables 2 and 3.

Table 5
County DD Employment Estimates, Omitted Regions
Logged Employment Levels

Panel A. Omitting One USFS Region

	(1)	(2)	(3)	(4)	(5)	(6)
Listing×NSO	-0.30	-0.31	-0.30	-0.30	-0.29	-0.31
	(0.04)	(0.04)	(0.04)	(0.04)	(0.05)	(0.05)
R^2	0.917	0.918	0.919	0.918	0.921	0.929
N	79,356	80,240	79,220	80,308	51,816	37,944
Clusters	1,167	1,180	1,165	1,181	762	558

Panel B. Relative to One USFS Region

	(1)	(2)	(3)	(4)	(5)	(6)
Listing×NSO	-0.33	0.07	-0.25	0.03	-0.33	-0.30
	(0.07)	(0.12)	(0.09)	(0.12)	(0.05)	(0.05)
R^2	0.963	0.962	0.960	0.963	0.932	0.922
N	5,576	4,692	5,712	4,624	33,116	46,988
Clusters	82	69	84	68	487	691
County FE	X	X	X	X	X	X
Year FE	X	X	X	X	X	X
Quarter FE	X	X	X	X	X	X

Notes: See Table 2. Columns 1 to 6 refer to the Intermountain, Northern, Rocky Mountain, Southwestern, Eastern, and Southern groups in Figure A6 respectively.
Source: Listing data from the Fish and Wildlife Service. Labor data from the Bureau of Labor Statistics. Region division from the U.S. Forest Service.

Table 6
State DD Timber Estimates
Logged Volume and Value of Timber Cuts

	Years: 1984-2000				Years: 1984-1994			
	Full Sample		East Coast		Full Sample		East Coast	
	Volume	Value	Volume	Value	Volume	Value	Volume	Value
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Listing×NSO	-0.60	-0.77	-0.70	-0.85	-0.40	-0.15	-0.38	-0.00
	(0.18)	(0.19)	(0.18)	(0.21)	(0.13)	(0.17)	(0.20)	(0.23)
R^2	0.931	0.910	0.952	0.933	0.952	0.935	0.960	0.952
N	680	680	272	272	440	440	176	176
Clusters	40	40	16	16	40	40	16	16
State FE	X	X	X	X	X	X	X	X
Year FE	X	X	X	X	X	X	X	X
Quarter FE	X	X	X	X	X	X	X	X

Notes: Estimation results for the specification in Equation (1), modified for state level data. Treatment is defined as the interaction after the 1990 ESA listing for the Northern Spotted Owl (NSO), with the NSO states (CA, OR, and WA). Standard errors are clustered at the state level.
Source: Listing data from the Fish and Wildlife Service. Timber data from the U.S Forest Service.

Table 7
County DD Employment by State Estimates
Logged Employment Levels

	Years: 1984-2000						Years: 1984-1994		
	Full Sample			East Coast			Full Sample		
	CA	OR	WA	CA	OR	WA	CA	OR	WA
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Listing×NSO	-0.23	-0.35	-0.30	-0.19	-0.31	-0.26	-0.18	-0.22	-0.18
	(0.11)	(0.05)	(0.07)	(0.12)	(0.05)	(0.07)	(0.08)	(0.04)	(0.07)
R^2	0.908	0.913	0.911	0.902	0.911	0.907	0.927	0.931	0.929
N	77,996	78,540	78,540	41,956	42,500	42,500	50,468	50,820	50,820
Clusters	1,147	1,155	1,155	617	625	625	1,147	1,155	1,155
County FE	X	X	X	X	X	X	X	X	X
Year FE	X	X	X	X	X	X	X	X	X
Quarter FE	X	X	X	X	X	X	X	X	X

Notes: Estimation results for the specification in Equation (1). Treatment is defined as the interaction after the 1990 ESA listing for the Northern Spotted Owl (NSO), with each of the NSO states (CA, OR, and WA). Each column is a separate regression. Standard errors are clustered at the county level.
Source: Listing data from the Fish and Wildlife Service. Labor data from the Bureau of Labor Statistics.

Online Appendix

A1 Additional Results

A1.1 Employment Impacts Using State Level Data

Similar to the year-by-year estimates using the county level data, employment and establishments declined following the 1990-listing.

Repeating the by-state analysis at the state level, Table A2, but using the state level data results in similar estimates to those in Table 7, with two exceptions. First, while California and Oregon have similar estimates for the decline in employment when using either the county or state level data, Washington goes from a 25.9% decline (Table 7, column 3), to a 19.8% decline (Table A2, column 3). This suggests that the inclusion of data from all counties in Washington might be adding counties that were not affected by the CHD, or even saw an increase in employment if there was leakage within Washington.

Second, the results for the East Coast sample are lower for all three states when using the state level data (Table A2, columns 4 to 6). However, when using the county level data, they are much lower only in the case of California (Table 7, columns 4 to 6). This highlights the issue that non-disclosure at the county level might be masking spillovers both within and between states. The analysis by state also reveals that the severity of potential leakage is different by state, as the point estimate for the East Coast sample for Oregon is twice as large than that of Washington (Table A2, columns 5 and 6).

A1.2 Sensitivity of Distance to Critical Habitats

In the county level analysis, I only use counties within 25 km to the habitat areas as the treatment group. I end up dropping the California, Oregon, and Washington counties that are further away. Here I report the main DD estimate for employment using different distance thresholds. The results in Figure A3 show that there is very little change in the estimate or in the number of clusters (the number to the right of each point estimate). As such, the results are insensitive to the choice of the distance threshold.

A1.3 Timber Data

Results in Figure A4 show the declines in timber cut volume and value. Cut volume declined sharply after 1992, and cut value continued to decline throughout the 1992-2000 period.

A1.4 Mean Weekly Wages

For completeness, I also report results on the mean weekly wages paid in the Lumber & Wood sector. Only the county level DDD results show a large decline in mean weekly wages. However, there is a large pre-trend in those results, the post-treatment results are imprecisely estimates, and other specification at both county and state levels find a precise zero effect.

A1.5 Analysis by U.S. Forest Service Regions

Table A3 repeats the analysis of either omitting or including only one USFS region at a time, as in Table 5. The key magnitudes are similar to those in Table 5, and to those in the main text. One thing worth noting, is that the number of clusters in Panel (B) is now much smaller. However, the main goal of this robustness check is to test whether the inclusion or exclusion of certain regions allows to recover similar point estimates as those in the main analysis. As such, while the standard errors are likely underestimated, the emphasis here is on the point estimates and not their precision.

A1.6 Comparing Population Data Between Census and Estimated Sources

In the main text I use population data from both census years, and interpolated data for between and during census years. Here I plot how the two data sets agree with each other for the years 1980, 1990, and 2000. The differences appear to be small and evenly distributed around zero. While some counties can see differences of up to 10%, the vast majority of observations (95.5%) fall within a 1% difference.

A2 Data Appendix

I provide additional details regarding the construction of the data set used in the analysis.

A2.1 Employment Data

I use the Quarterly Census of Employment and Wages compiled by the Bureau of Labor Statistics (BLS). I place two key restrictions on the county level data. First, I use data between 1984 to 2000 to improve balance, as more counties begin to report in 1984. In addition, I only use data from counties that always disclose data during that time period. This avoids including counties that enter and exit the sample due to data suppression issues.

I focus on the Contiguous U.S. and drop the state of Alaska and Hawaii. Rhode Island exhibits abnormally high rates of non-disclosed data. As such, I drop Rhode Island from the sample. I drop these states both in the county and state level samples.

A2.2 Construction of the East Coast Sample

When accounting for potential leakage I limit the sample to consist of the three NSO states of California, Oregon, and Washington as well as: Alabama, Connecticut, Delaware, Florida, Georgia , Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, North Carolina, Pennsylvania, South Carolina, Tennessee, Vermont, Virginia, and West Virginia.

A3 Synthetic Control Method: Description

Following similar notation as in Abadie et al. (2010), I define L_{st}^{I} as the labor market outcome in state $s = 1, .., S$ that has designated critical habitats for the NSO at time $t = 1, ..., t_0, ...T$, with t_0 as the period in which treatment

commences. Similarly, L_{st}^N is the labor market outcome at state s that has not designated critical habitats at time t. The treatment effect for state s at time t is defined as:

$$\alpha_{st} = L_{st}^I - L_{st}^N \tag{6}$$

At each period we can only observe either L_{st}^I or L_{st}^N, such that the observed outcome is:

$$L_{st} = L_{st}^N + \alpha_{st} D_{st} \tag{7}$$

With D_{st} being equal to 1 for a state s that has designated critical habitats in time t, and 0 otherwise. Meaning that for states with designated critical habitats we observe L_{st}^I, following designation, and in order to estimate the treatment effect a_{st} we need to estimate the counterfactual L_{st}^N:

$$\hat{\alpha}_{st} = L_{st}^I - \hat{L}_{st}^N \tag{8}$$

In the SCM the counterfactual is estimated as a weighted sum of the members in the control group, which are referred to as the "donors." Assuming a known weight vector for J donors, the estimated treatment effect is then given by:

$$\hat{\alpha}_{st} = L_{st}^I - \hat{L}_{st}^N = L_{st}^I - \sum_{j=1}^{J} w_{sj} L_{jt}^j \tag{9}$$

Where w_{sj} is the weight for donor j relative to treated state s, and the weights satisfy:

$$w_{sj} \geq 0 \, \forall \, j = 1, ..., J \tag{10}$$

$$\sum_{j=1}^{J} w_{sj} = 1 \tag{11}$$

$$\sum_{j=1}^{J} w_{sj} L_{jt} = L_{st} \, \forall \, t = 1, ..., t_0 \tag{12}$$

In practice, the last constraint rarely holds given the observed data, and the estimated weights, $\hat{w}_{sj}$, are chosen such that they approximate the last constraint. Formally, the vector $\hat{w}_{sj}$ is chosen to minimize a distance metric between the linear combination of a treated state, X_1, and the linear combinations of the donor states, X_0, with a $k \times k$ matrix, V, of constants that is used to construct the linear combinations. The SCM algorithm solves for the weight vector, W, that minimizes:

$$\sqrt{(X_1 - X_0 W)' V (X_1 - X_0 W)} \tag{13}$$

The choice of constants in V can also be allowed to be data driven. I use 70% of the pre-treatment data to choose V that minimizes the Root Mean Square Prediction Error (RMSPE) for the main outcome variable, and use the remaining 30% to cross-validate the matching.

I run the SCM procedure for each treated state, relative to all the donor states, separately. In this particular case where there are 3 treated states being considered, it means that I obtain $\hat{\alpha}_{1t}$, $\hat{\alpha}_{2t}$, and $\hat{\alpha}_{3t}$ for all time periods $t = 1, ..., T$. Following the extension in Cavallo et al. (2013), I consider the average treatment effect as a simple average of the separately obtained treatment effects:

$$\hat{\alpha}_t = \frac{1}{S} \sum_{s=1}^{S} \hat{\alpha}_{st} \; \forall \, t = 1, .., T \tag{14}$$

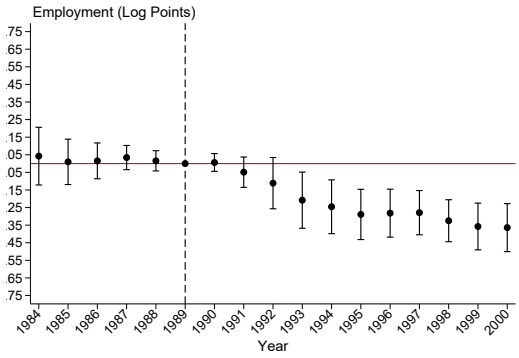
Inference in the SCM is conducted using a series of permutation tests. Essentially, the procedure above is repeated multiple times where each time the truly treated states are completely dropped from the sample, and one of the donor states is considered as the treated state. This procedure produces a distribution of estimated placebo treatment effects: $\hat{\alpha}_{jt}^{PL}$ for all $t = t_0, ..., T$. This distribution allows to construct p-values that do not impose a distribution on the error term. In line with other permutation inference procedures, the p-value is given by:

$$p - value_{st} = \frac{\sum_{j=1}^{J} \mathbb{1}\{\hat{\alpha}_{jt}^{PL} \geq \hat{\alpha}_{st}\}}{J} \tag{15}$$

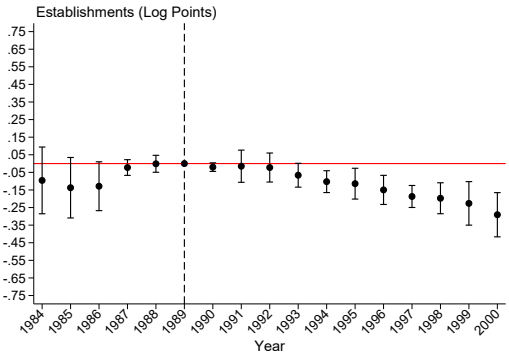
Extending this to the case of multiple treated states requires accounting for the fact that the averaging of the treatment effect in Equation (14) reduces some of the noise. This can be corrected for by calculating all the possible average placebo effects, and comparing $\hat{\alpha}_t$ against that distribution. A full procedure is detailed in Cavallo et al. (2013) and is not repeated here for conciseness.

Figures

Difference-In-Differences Results

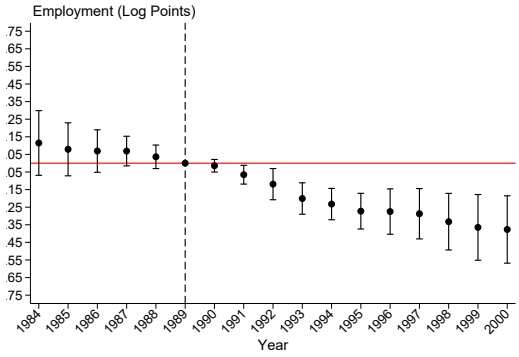


(a) Employment

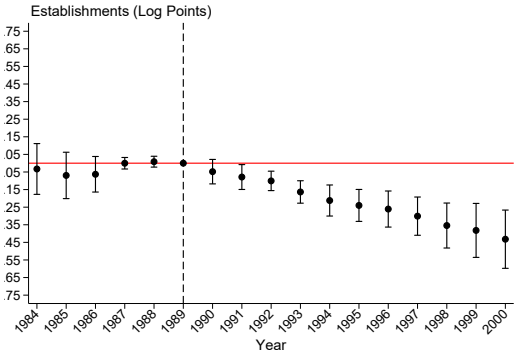


(b) Establishments

Triple-Difference Results



(c) Employment



(d) Establishments

Figure A1: State Level DD & DDD Results

Notes: Estimation results for the specifications in Equations (2) and (4). Treated states are CA, OR, and WA. Capped spikes denote 95% CIs. Standard errors are clustered at the state level.

Source: Listing data from the Fish and Wildlife Service. Labor data from the Bureau of Labor Statistics.

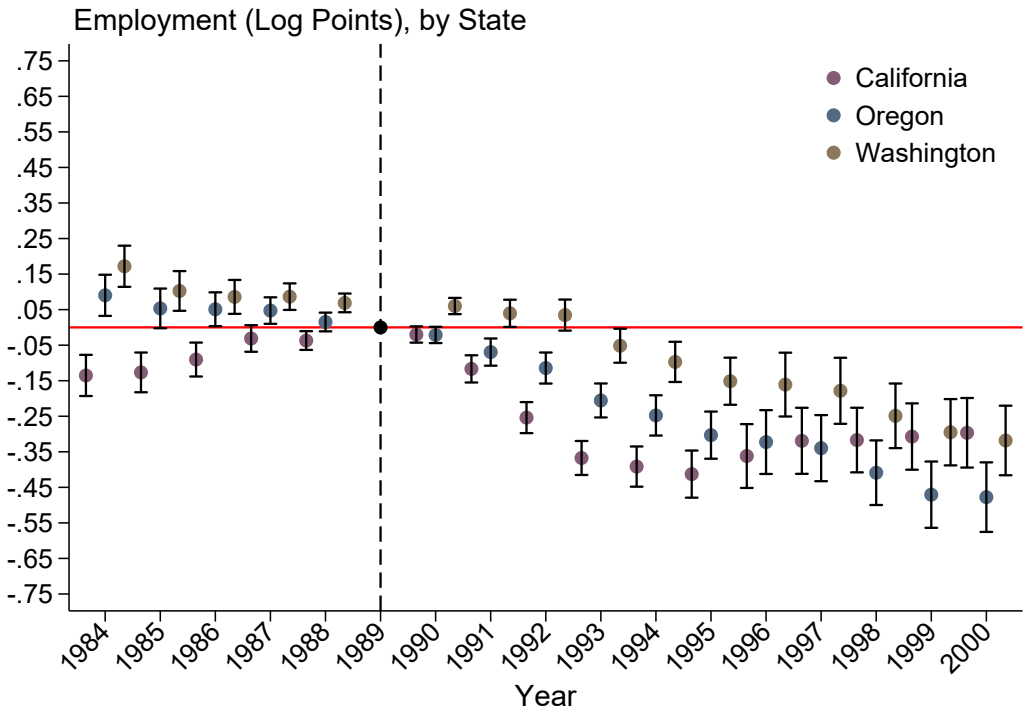


Figure A2: State Level

Notes: Estimation results for the specification in Equation (2), run separately for CA, OR, and WA. Capped spikes denote 95% CIs. Standard errors are clustered at the state level.

Source: See Figure 4.

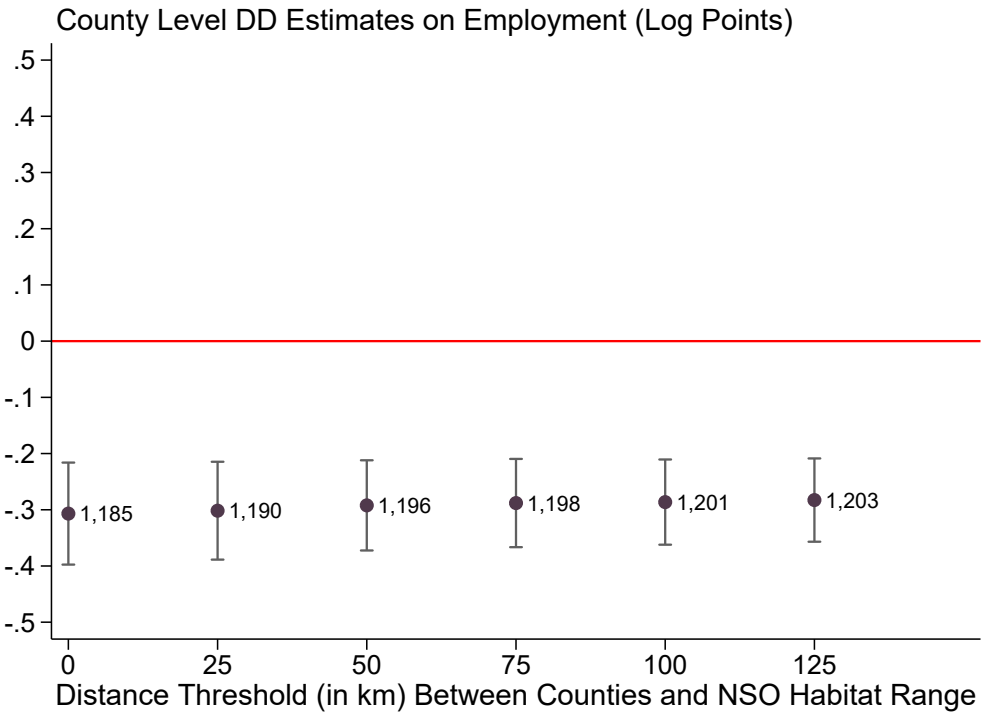
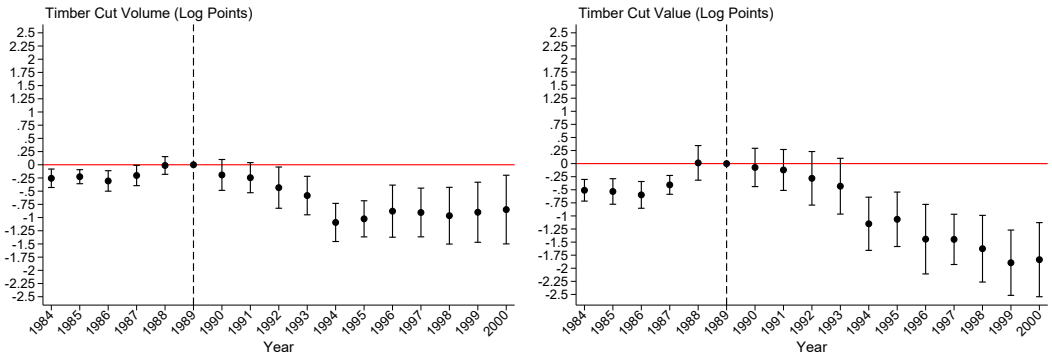


Figure A3: County Level Distance Threshold Sensitivity Test

Notes: Estimation results for the specification in Equation (2). Treated counties are counties that are within the distance threshold to the Critical Habitat. Each point estimate is a separate regression. Black lines denote 95% CIs. Standard errors are clustered at the county level. The number of clusters is to the right of each point estimate.

Source: Listing data from the Fish and Wildlife Service. Labor data from the Bureau of Labor Statistics.



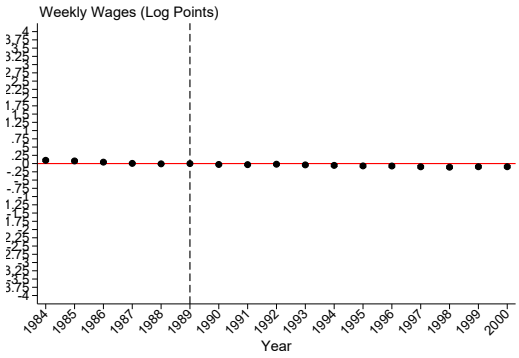
(a) Volume (b) Value

Figure A4: State Level DD Timber Cut Results

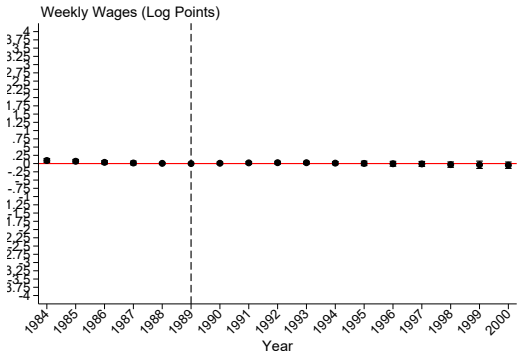
Notes: Estimation results for the specification in Equation (2). Treated states are CA, OR, and WA. Capped spikes denote 95% CIs. Standard errors are clustered at the state level.

Source: Listing data from the Fish and Wildlife Service. Timber data from the U.S. Forest Service.

Difference-In-Differences Results

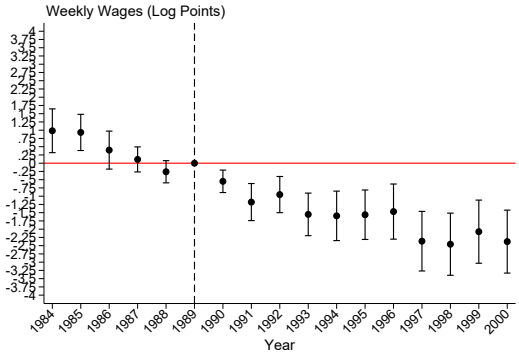


(a) County Level

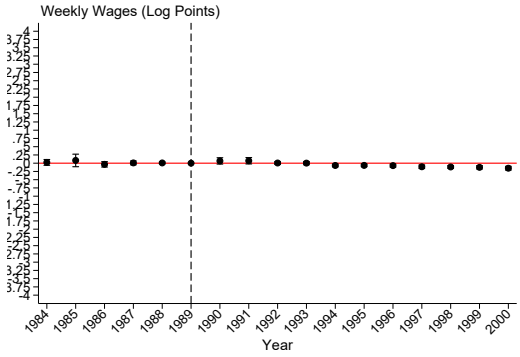


(b) State Level

Triple-Difference Results



(c) County Level



(d) State Level

Figure A5: County & State Level DD & DDD Mean Weekly Wages Results

Notes: Estimation results for the specifications in Equations (2) and (4). Treated counties are defined as for the counties within 25 km of NSO habitat areas in CA, OR, and WA. Treated states are CA, OR, and WA. Capped spikes denote 95% CIs. Standard errors are clustered at the region (county or state) level.

Source: Listing data from the Fish and Wildlife Service. Labor data from the Bureau of Labor Statistics.

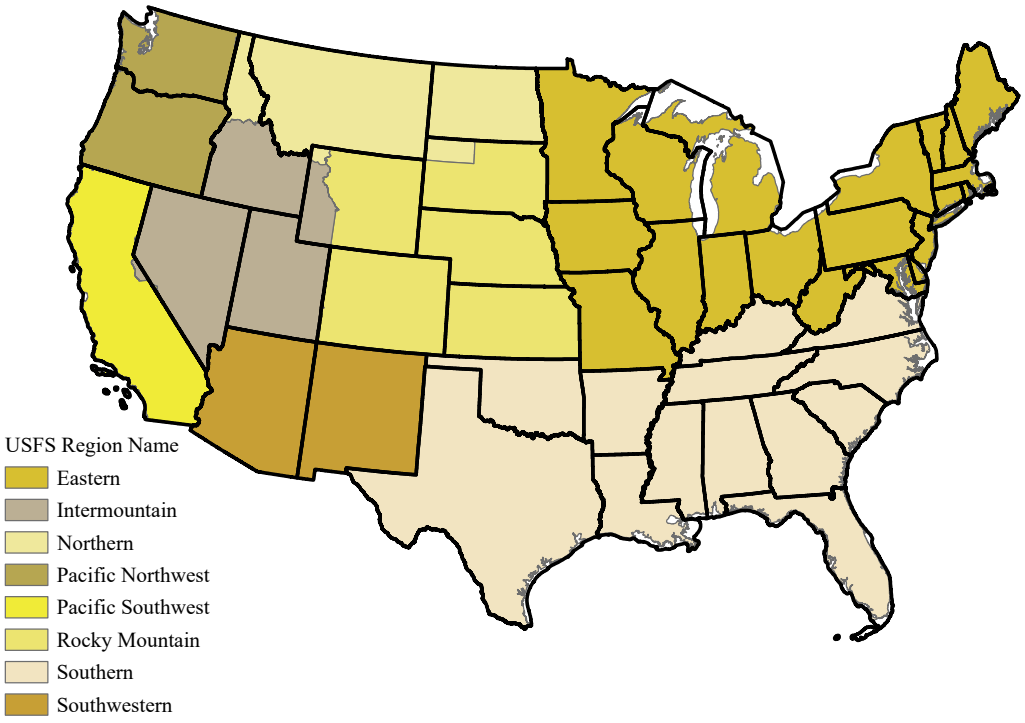
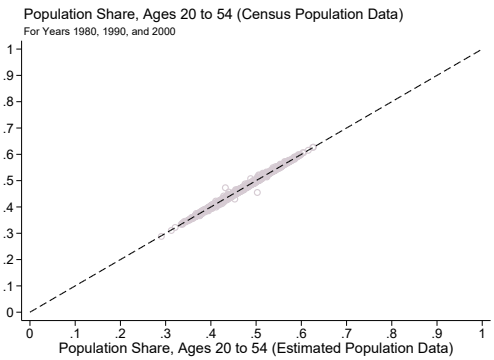


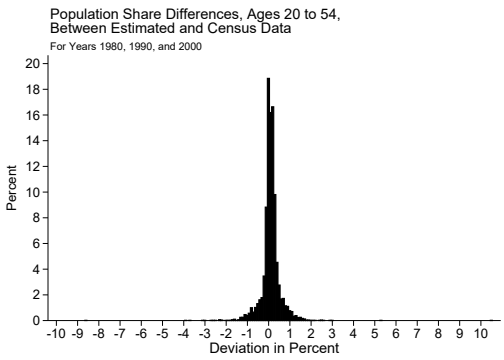
Figure A6: USFS Regions & State Borders, Contiguous U.S.

Notes: Each color represents a different USFS region. Black lines denote state boundaries.

Source: Data on regions from USFS. Data on state boundaries from the Census Bureau.



(a) Census VS. Estimated Population Data



(b) Deviations of Census from Estimated Population Data

Figure A7: Population Shares, Ages 20 to 54, Comparison

Notes: Comparing the population data from the decadal censuses to the data from the yearly population estimates.

Source: Population data from the U.S. Census Bureau and IPUMS.

Tables

Table A1
State DD Employment Estimates
for Lumber & Wood (SIC24) and All Industries (SIC0)

	Log(Employment)		Log(Establishments)	
	SIC24	SIC0	SIC24	SIC0
	(1)	(2)	(3)	(4)
Listing×NSO	-0.26	0.04	-0.07	0.14
	(0.05)	(0.05)	(0.07)	(0.03)
R^2	0.979	0.997	0.992	0.996
N	3,196	3,196	3,196	3,196
Clusters	47	47	47	47
State FE	X	X	X	X
Year FE	X	X	X	X
Quarter FE	X	X	X	X

Notes: Estimation results for the specification in Equation (1), modified for state level data. Treatment is defined as the interaction after the 1990 ESA listing for the Northern Spotted Owl (NSO), with the NSO states (CA, OR, and WA). Standard errors are clustered at the state level.
Source: Listing data from the Fish and Wildlife Service. Labor data from the Bureau of Labor Statistics.

Table A2
State DD Employment by State Estimates
Logged Employment Levels

	Years: 1984-2000						Years: 1984-1996		
	Full Sample			East Coast			Full Sample		
	CA	OR	WA	CA	OR	WA	CA	OR	WA
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Listing×NSO	-0.24	-0.32	-0.22	-0.08	-0.16	-0.06	-0.19	-0.19	-0.10
	(0.04)	(0.04)	(0.04)	(0.05)	(0.05)	(0.05)	(0.03)	(0.03)	(0.03)
R^2	0.978	0.978	0.977	0.984	0.984	0.983	0.988	0.988	0.988
N	3,060	3,060	3,060	1,292	1,292	1,292	1,980	1,980	1,980
Clusters	45	45	45	19	19	19	45	45	45
State FE	X	X	X	X	X	X	X	X	X
Year FE	X	X	X	X	X	X	X	X	X
Quarter FE	X	X	X	X	X	X	X	X	X

Notes: Estimation results for the specification in Equation (1). Treatment is defined as the interaction after the 1990 ESA listing for the Northern Spotted Owl (NSO), with each of the NSO states (CA, OR, and WA). Each column is a separate regression. Standard errors are clustered at the state level.
Source: Listing data from the Fish and Wildlife Service. Labor data from the Bureau of Labor Statistics.

Table A3
State DD Employment Estimates, Omitted Regions
Logged Employment Levels

Panel A. Omitting One USFS Region

	(1)	(2)	(3)	(4)	(5)	(6)
Listing×NSO	-0.25	-0.25	-0.24	-0.27	-0.30	-0.27
	(0.05)	(0.04)	(0.05)	(0.05)	(0.05)	(0.06)
R^2	0.979	0.983	0.977	0.980	0.985	0.975
N	2,992	3,060	2,856	3,060	1,904	2,312
Clusters	44	45	42	45	28	34

Panel B. Relative to One USFS Region

	(1)	(2)	(3)	(4)	(5)	(6)
Listing×NSO	-0.36	-0.53	-0.40	-0.07	-0.20	-0.24
	(0.10)	(0.40)	(0.07)	(0.13)	(0.07)	(0.04)
R^2	0.993	0.979	0.995	0.993	0.977	0.984
N	408	340	544	340	1,496	1,088
Clusters	6	5	8	5	22	16
County FE	X	X	X	X	X	X
Year FE	X	X	X	X	X	X
Quarter FE	X	X	X	X	X	X

Notes: See Table 5.
Source: See Table 5.