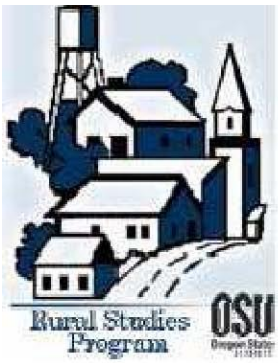

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Federal Forest Policy and Community Vitality in the Pacific Northwest: How Did the Northwest Forest Plan Affect Population, Wealth and Income in Rural Communities?[i]

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Federal forest policy in the Pacific Northwest has been a source of much debate since at least the 1980s when forest management policy began to work toward a different balance between habitat protection and harvesting timber on Federal lands. The Northwest Forest Plan (NWFP), put into place in 1994, established a new forest management framework that shifted 11 million acres of federal forest land from timber production to old-growth forest protection.

Studies that focus on the impact on local employment using input-output analysis tend to predict a negative impact on community employment (Beuter 1990, Anderson and Olson 1991, Waters, Holland and Weber 1994 and Charnley 2006). Eichman et al. (2010) conducted a more robust analysis on the impact of the NWFP and extend the literature by explicitly considering the possible policy impact on amenity-related migration. Applying a simultaneous equations estimation on employment change and net migration using county-level data from Oregon, Washington and Northern California, their study provides evidence that the NWFP did in fact reduce employment in the region, and that this negative effect was not offset by the small positive net migration associated with the NWFP.

Almost all of the previous analyses of the NWFP have been county-level analyses because most social-economic data are available at the county level. Most previous studies have used county level data that may not capture the spatially differentiated effects that occur at a smaller geographic scale. This is particularly important for analysis in the Western United States, where counties are quite large geographically. In the only study we encountered that used community-level data in analyzing the impact of the Northwest Forest Plan on amenity migration and community well-being. Charnley, McLain and Donoghue (2008) found that the links between the NWFP and amenity migration were more complex and varied than implied by county-level studies. And among the 1314 nonmetropolitan communities in the NWFP region,

they found mixed evidence about amenity migration. Population increases in forest communities (those within 5 miles of the federal forests and thus having better access to forest amenities) grew more slowly between 1990 and 2000 than those more distant from the forests, and forest communities were more likely to have lost population during the decade.

Since we expect that some of the important impacts to be more localized and that county level analysis may miss important local effects, we also examine the impact of NWFP in this paper at the community level, using data from small cities in Oregon. We hypothesize that the negative impact of NWFP on local economies is manifested through the mill closures and reduced logging employment. While we believe that the reduced logging employment impact of the NWFP is likely to occur near where trees have been harvested, we expect the mill closure impact to occur at the larger regional scale. Logs often travel long distances to the mills and mills all over the state are likely to be impacted by reduced harvests from NWFP-protected land. On the other hand, we believe that impacted loggers are likely to live in communities close to the Federal forestland. Similarly, the impact of the NWFP on amenity related migration is likely to be strongest among the communities close to the protected forestland under the NWFP. We use the geocoded dataset on statewide mill closures to capture the impact of job losses due to the NWFP on mill towns. To capture the more localized amenity migration effects of the NWFP, we use a dummy variable indicating the proximity to NWFP-protected forestland. To capture the localized logging loss effect of the NWFP, we use an interaction term of the proximity variable and a variable measuring employment shares in logging.

We also hypothesize that the negative impact of NWFP harvest reductions and the positive NWFP impact through amenity-related migration may manifest themselves differently over time. We expect that the negative impact on the local economy of mill closures and of

loggers losing jobs will be an immediate impact. For instance, as a mill closes, the real property value of the industrial property goes down. This may also have a negative effect on community income. Whether these negative impacts are long-lasting may depend on other local contextual variables, so that in the longer time period, the direction and the statistical significance is undetermined. The impact of the NWFP on amenity related migration, however, may exhibit a different pattern over time. If the implementation of the NWFP did attract amenity migration, we will first observe an increase in community population, which may push up the local demand and increase the real property value for commercial and industrial use. At the same time, as more and more people move into the community, the real property value for residential houses also goes up. This will mitigate the incentive for in-migration and may increase the incentive for out-migration for low-income people. When the equilibrium is reached, people have no incentive to migrate among communities, and the real property values of residential houses remain high.

Literature Review

Traditionally, assessments of the potential impacts of resource conservation policies focus on the economic damages resulting from loss of jobs in the regulated sector. Hence, large job losses and other economic damages have been estimated to result from policies such as the NWFP, designed to protect forest habitat for the northwest spotted owl and provide other amenities. Beuter (1990), Anderson and Olson (1991), Waters, Holland and Weber (1994) and Charnley (2006) used input-output models to estimate that employment reduction would range from 13,000 to 147,000 jobs. Charnley (2006) conducted case studies and found a negative impact of NWFP on county employment.

The impact of such an amenity-related migration on income is not clear. On one hand, many studies suggest that the income level in amenity rich communities tend to be lower because

people are willing to accept lower wages in places with higher natural amenities as proposed by Rosen (1979) and Roback (1982). A set of papers (like Blomquist et al. 1988, Gyourko and Tracy 1991 and Schmidt and Courant 2006) investigated individual location decisions and find that amenities in and outside the metropolitan area generates compensating wage and land differential because workers are willing to accept lower wages and pay higher rent. There is also the long-standing concern that the amenity-related development is less desirable because it increases the service employment with low paying jobs (McKean et al. 2005) and result in less equitable income distribution (Gibson 1993, Marcouiller and Green 2000).

On the other hand, other studies find that the presence of higher natural amenities can contribute to an increase in income. According to a review article by Waltert and Schlapfer (2010), among the 11 articles included in their analysis that reported amenity impact on income (7 on income per capita and 4 on wage and transfers), 4 reported significant positive impact. Shumway and Otterstrom (2001) find that in the 1990s, counties characterized by environmental amenities, recreation-based economies and retirement communities experienced higher population growth and gained in income as in-migrant income is on average about $10,000 higher than the out-migrant income. (Shumway and Otterstrom 2001, p.498) Reeder and Brown (2005) focus on the impact of amenity related growth on rural communities and find that recreation and tourism development attracts population growth, increases county income and pushes up housing cost. Lorah and Southwick (2003) find that population and income growth rates in nonmetropolitan counties with protected lands are much higher than those without protected land. Rasker (2006) find similar results in Western U.S. Lewis, Hunt and Plantinga (2003) find that the public conservation lands had no significant impact on wage growth in the Northern Forest region. Deller et al. (2001) and English et al. (2000) found that amenity based

development had a positive impact on income.

Empirical Model

In order to capture the effects of the change in Federal forest policy, we use community-level data from Oregon's rural communities – incorporated cities with fewer than 50,000 people in 2000. Our empirical model has three dependent variables: 1) average annual changes in community population, 2) average annual changes in community real property value and 3) the annual changes in community median household income. The same model is estimated for two time periods: 1990-2000 and 2000-2010.

Population change. The census data on place level population gives the number of residents in the place. Therefore, community population change derived from the census data incorporate two components: natural growth and migration following utility differentials. Because available data do not allow us to separate the two components at the place level, we incorporate explanatory variables that are believed to affect natural growth along with those that are believed to affect net migration. Natural growth is a function of the population base and demographic variables like the percentage of Hispanic population, the age structure of the population, and the percentage of population with at least bachelor degree. Mathews and Ventura (1997) have found that people of Hispanic origin and with lower educational attainment tend to have higher birth rates. The migration component, following the migration literature as articulated in Ferguson et al. (2007), is modeled as a function of median household income, the unemployment rate, percentages of population with bachelor degrees and professional degrees, heating degree days[iii], and distance to Portland (the largest urban center in Oregon). Because educational attainment could influence both the natural growth and migration, we can only

estimate the total effect rather than identify the individual effect. According to location choice models (like Epple and Sieg 1999), people will rank the communities by income and community characteristics in their choice of location. In locational equilibrium, given their preference characteristics, richer households will outbid poor households in more desirable communities, i.e. more highly ranked communities. The implication for overall population size at equilibrium is undetermined. However, in the transition to equilibrium, more desirable communities are expected to draw in migrants. Because household migration is a slow process that involves substantial moving costs, the full impact of the NWFP – implemented in 1994 – may not be evident during the 1990 decade. To capture the possible impact of relative community desirability, we include the ranking of communities in income and community real property value in the analysis. Highly ranked communities in terms of income are expected to attract migrants but, given a high income ranking, high real property value rankings may deter migrants.

Wealth change. Community real property is mainly composed of industrial/commercial and residential real property[iv]. Residential real property value is expected to be affected by housing and community characteristics such as urban and natural amenities that are capitalized into property values. To explain changes in real property values, we include in the analysis the average number of rooms, heating degree days, the distance to Portland and average commuting time.

Income change. Community-level median household income is expected to be correlated with the number of minorities (African, Native American, Hispanic, Asian and Pacific Islanders), educational attainment, percent of employment in professional jobs, and the unemployment rate. To investigate the impact of amenities on income, we include heating degree days and distance to Portland.

We had expected that other proximity variables like the distances to the nearest city of 20,000 or more people, to interstate highways (to capture the accessibility into and out of the community), and to valued services such as medical care and law enforcement facilities[v] might be important in explaining population and wealth changes. However, none of these variables were statistically significant in preliminary analyses and are excluded from the final model.

NWFP Impact Indicators. The NWFP may affect population and wealth changes as well as changes in median household income through the two impact pathways.

As noted above, we expect that the effect of the Northwest Forest Plan through the *enhanced amenity pathway* will be most pronounced in communities close to the protected land. We attempt to capture the enhanced amenity effects of the NWFP by creating a dummy variable that indicates *whether a community is within a 10 mile-buffer of the "reserved land" designated in the NWFP* for species protection. From now on, we will refer to the communities within 10-mile distance as "*NWFP-adjacent communities*".

We hypothesize that the *reduced harvest pathway* effect of the Northwest Forest Plan on a given community can be captured in two ways. The first is through a variable measuring the *number of mill closures* during the 1990s, the decade in which the NWFP was implemented. The effect of reducing federal timber harvests is not confined to communities adjacent to the harvested timberland because harvested logs often travel long distances to mills. The effect is spread to mill towns across a broader region[vi].

We also expect that loggers living in communities close to the protected land are more at risk from the NWFP than those in more distant communities and create a second variable to capture this reduced harvest pathway. We hypothesize that NWFP-induced reductions in forest harvest will have a greater negative impact on NWFP-adjacent communities in which greater

shares of residents work in logging. Our data allow us to identify the share of each community's workers employed in farming, fishing, and forestry occupations. Since about 2000, over one quarter of those in farming, fishing, and forestry occupations in Oregon have been working in logging jobs.[vii] We explore the hypothesis that the effect of the NWFP in adjacent communities may depend on how important logging is in each community by creating a variable that identifies communities that both are adjacent to NWFP-protected land and have 10% or more of workers in farming, fishing, and forestry occupations. Since we expect that the farm, fishing and forestry workers living in NWFP-adjacent communities were more likely to be employed in logging than those living in more non-NWFP-adjacent communities, we call the NWFP-adjacent communities with 10% or more of workers in farming, fishing and forestry *"NWFP-adjacent logging-dependent communities*". The third NWFP indicator variable, then, equals 1 for NWFP-adjacent communities with 10% or more of their workers in farming, fishing and forestry occupations, and equals 0 for other communities.

The definition and data sources for the variables are summarized in Table 1a. The summary statistics are listed in table 1b.

We employ generalized method of moments (GMM) to estimate our simultaneous equations model. The system of equations is specified as:

$$\Delta N_{j,t} = \alpha_0 + \alpha_{1,2}\Delta W_{j,t} + \alpha_{1,3}\Delta I_{j,t} + \alpha_2 X^N_{j,t-1} + \alpha_3 P_j + \varepsilon_j$$
$$\Delta W_{j,t} = \beta_0 + \beta_{1,1}\Delta N_{j,t} + \beta_{1,3}\Delta I_{j,t} + \beta_2 X^W_{j,t-1} + \beta_3 P_j + \eta_j$$
$$\Delta I_{j,t} = \gamma_0 + \gamma_{1,1}\Delta N_{j,t} + \gamma_{1,2}\Delta W_{j,t} + \gamma_2 X^I_{j,t-1} + \gamma_3 P_j + \zeta_j$$

where t (=1 or 2) is the time index and j is the community index. We try to identify how changes in community population *N*, real property value *W*, and median household income *I* over the time period are correlated with community characteristics at the beginning of the period and how they are affected by *P* , the three NWFP impact pathway indicator variables (mill closures, NWFP-

adjacency, and the interaction of NWFP-adjacency and logging-dependence). $X^{N}_{j,t-1}$, and $X^{W}_{j,t-1}$ and $X^{W}_{j,t-1}$ are the exogenous contextual variables of the base year that might affect changes in community population, wealth and median household income. ε_j, η_j and ζ_j are the disturbance terms. The differences in the economic and demographic conditions across rural communities can be potential sources of heteroskedasticity; these are controlled implicitly using the optimal weighting matrix under GMM.[viii]

How did the NWFP affect rural community population, income and wealth?

The estimation results from the simultaneous equations model are shown in Table 2. Coefficient estimates in this table provide information about the partial impact of each independent variable on the changes in community population, wealth or income, holding all other variables constant. Thus a finding, for example, that mill shutdowns reduce property values, ceteris paribus, does not allow conclusions about the total effect of mill shutdowns on property values, since mill shutdowns may have also affected population or income, which in turn could affect property values. Estimates of total impact of the three NWFP variables on population, wealth and income growth require further analysis, the results of which are shown in Table 3.

Partial effects of NWFP indicator variables

The decade of the 1990s in Oregon saw income growth and significant in-migration. Results in Table 2a suggest adjacency to the NFWP-protected forests had no significant direct impact on community-level population change during the 1990s.

From Table 2b, we see that communities closer than 10 miles to the NWFP reserved land saw real property values increase by around $3.4 million more per year on average than communities farther away from NWFP-protected land. Towns with mill shutdowns in 1990s, however, experienced $1.7 million less growth in real property value on average.

There was no difference in median household income growth in the 1990s between towns with mill shutdowns and those without (Table 2c). Among the communities adjacent to the NWFP, however, those that were logging-dependent experienced a slower increase in the median household income. On average, the increase in income was $770 less per year.

The early 2000s were a time of reduced economic growth and slower in-migration, both nationally and in Oregon, and timber harvests in Oregon remained at the levels of the 1990s. Mill-closure effects of the NWFP seem to have been short-lived. Towns with mill closures in the 1990s did not see different changes in population in the 2000s from those without closures (Table 2a). Amenity effects however seem to have continued after 2000. NWFP-adjacent communities continued to experience higher growth in community real property values (Table 2b). Moreover, the difference in annual property value growth between the NWFP-adjacent and non-adjacent communities increased from $3.4 million to $15.9 million per community. And the differences in median household income growth between the logging and non-logging communities that had been observed in NWFP-adjacent communities in the 1990s disappeared by the following decade (Table 2c).

Total effects of NWPF indicator variables

To explicitly account for the interactions among population growth, real property value change and change in household income in our impact estimates, we estimate the total effects of each of the three Northwest Forest Plan impact pathway indicators. The results are summarized

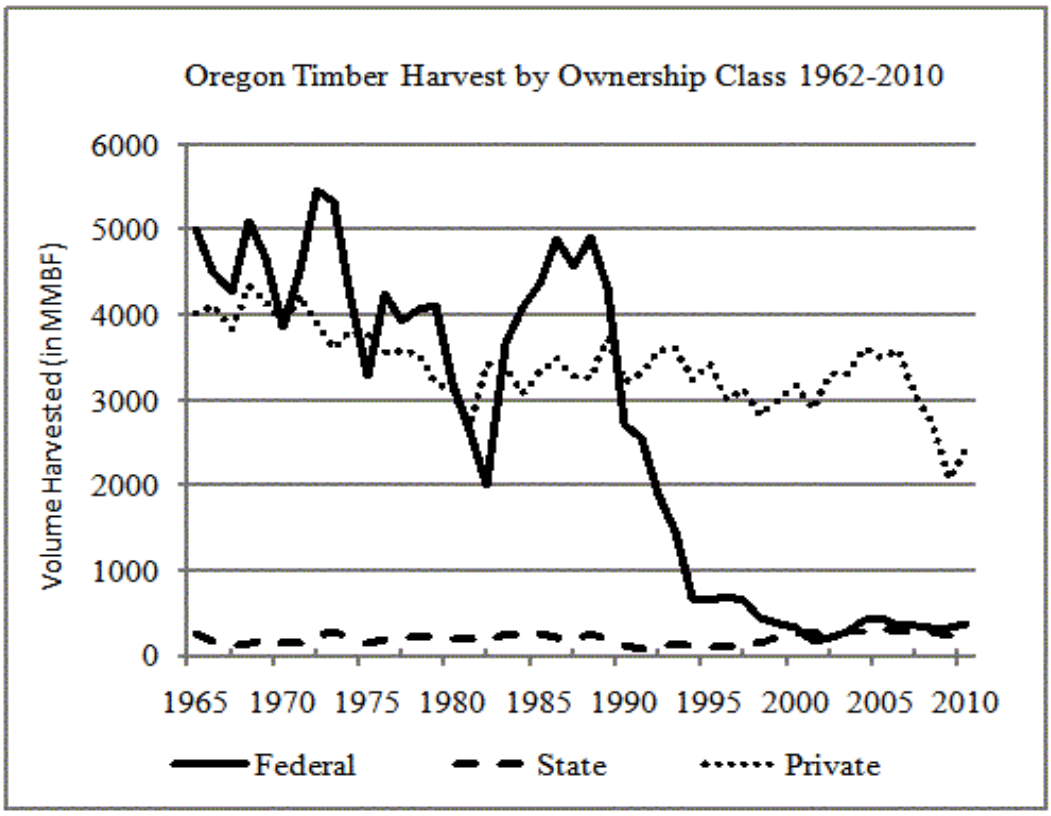
in Table 3. Estimated total effects are shown for variables in which there were significant partial effect coefficients in Table 2. The Delta Method is used to generate the test for the statistical significance of the total effect. The NWFP-induced mill closures negatively affected population growth and growth in community assets in the 1990s. Communities close to NWFP-protected forests grew faster in population and community real property value than communities further away in the 1990s. The NWFP-adjacent communities with more than 10% of the workers employed in farming, fishing and forestry, however, experienced slower growth in median household income during the decade in which the NWFP was implemented. In early 2000s, the main NWFP effect appears to have been through the enhanced amenity pathway: real property values grew faster in the NWFP-adjacent communities than in those farther away from NWFP-protected forests. This is consistent with the perception of approaching spatial equilibrium. That is, in the amenity-rich communities, increased demand for property (for example, by businesses to serve tourists and by those seeking second homes), will push up real property values. This increases the cost of living and dampens the incentive for further in-migration and may even drive the poor people out in future years.

Conclusion

There is evidence that the Northwest Forest Plan has affected community population, wealth and income in Oregon through both the reduced harvest and the enhanced amenity impact pathways. Using city-level data has allowed us to partially separate the reduced harvest pathway impact of the NWFP from the enhanced-amenity pathway impact. The reduced timber harvest appears to have reduced the population growth and growth in real property in the 1990s. And the logging-dependent communities adjacent to NWFP-protected forests suffered slower income

growth in the 1990s. The enhanced amenities realized in NWFP-adjacent communities, however, boosted both population and property values during the 1990s.

In 2000s, communities with mill-closures during the 1990s were no longer growing more slowly in population or real property than other communities, and income growth in logging-dependent NWFP-adjacent communities was no different than income growth in other communities. Communities close to NWFP protected areas, however, did experience faster growth in real property values, although they no longer experienced higher population growth than more distant communities. These findings suggest that after the implementation of the NWFP, people and firms adapted to this change in federal policy through relocation decisions. The evidence in this paper indicates that these relocation decisions are in line with the prediction of the spatial equilibrium in which local amenities push up the demand for real property and consequently real property values as a result of the capitalization of amenities. This offsets the incentive for amenity-related migration and appears to have moved Oregon rural communities toward a new spatial equilibrium.



Source: Oregon Department of Forestry

Figure 1. Timber harvest by ownership, 1962-2010

Table 1a. Variable Definitions and Data Sources

Variable	Definition	Source
Population Change	Change in population (persons/year)	Census, ACS
Wealth Change	Change in wealth [real property value] ($100,000/year)	Calculated
Income Change	Change in median household income ($1000/year)	Census, ACS
Population	Population in base year (persons)	Census, ACS
Wealth	Wealth in base year ($100,000)	ODR
Income	Median household income in base year ($1000)	Census, ACS
Income rank	Ranking of community by income	Calculated
Wealth rank	Ranking of community by wealth	Calculated
Pop_65plus	Population aged 65 + (persons)	Census, ACS
Pop_Hispanic	Hispanic population (persons)	Census, ACS
Pop_Nonwhite	Non-white population (persons)	Census, ACS
Education	Percent of population with bachelor degree or higher (%)	Census, ACS
Median rooms	Median number of rooms in housing units (number of rooms)	Census, ACS
Unemployment Rate	Unemployment rate (%)	Census, ACS
Managerial or Professional Jobs	Percent of employment in managerial or professional occupations (%)	Census, ACS
Heating Degree Days	Heating degree days	WRCC
Distance to Portland	Distance to Portland (miles)	Calculated
Commuting Time	Commuting time (minutes)	Census, ACS
Distance to National Park	Distance to a national park (miles)	GEO
Mill_Closure_90s	Number of mill closures in the 1990s (number)	NWFPREO
NWFP-adjacent community	Dummy variable, equals 1 if distance to NWFP reserved land is less than 10 miles	ODF
Farming, Fishing and Forestry Jobs	Percent of employment in farming, fishing and forestry occupations (%)	Census, ACS
Logging-dependent communityy	Dummy variable, equals 1 if more than 10% of community employment in farming, fishing and forestry occupations	Census, ACS

Note: ACS: American Community Survey;
CFFR: Consolidated Federal Fund Report;
GEO: Oregon Geospatial Enterprise Office;
NWFPREO: Northwest Forest Plan Regional Ecosystem Office;
ODR: Oregon Department of Revenue;
ODF: Oregon Department of Forest;
WRCC: Western Regional Climate Center.

Table 1b. Summary Statistics

YEAR	1990				2000			
Name	MIN	MAX	MEAN	STD	MIN	MAX	MEAN	STD
Population Change	-52.6	1191.7	102.1	202.8	-2222.9	1240.0	74.3	239.9
Wealth Change	-0.8	2720.3	186.2	378.6	-4395.3	2482.6	195.5	532.8
Income Change	-2.2	4.0	0.8	0.7	-4.9	2.6	-0.1	0.7
Population	34.0	44757.0	3600.7	5875.2	63.0	49184.0	4604.7	7430.9
Wealth	10.4	20765.3	1308.0	2618.9	20.9	47968.2	3147.2	6299.7
Income	16.8	80.5	32.4	8.3	19.3	105.0	40.4	11.2
Income rank	4.0	273.0	129.4	75.3	4.0	276.0	132.5	77.5
Wealth rank	1.0	267.0	124.9	77.0	1.0	265.0	122.6	75.5
Pop_65plus	6.0	4296.0	543.9	817.3	9.0	5206.0	629.4	964.2
Pop_Hispanic	0.0	4226.0	182.3	402.4	0.0	10171.0	438.7	978.0
Pop_Nonwhite	0.0	5702.0	309.0	624.7	0.0	10548.0	610.9	1236.4
Education	0.0	73.0	17.2	11.0	2.5	62.0	16.0	10.2
Median rooms	4.1	8.2	5.2	0.5	4.2	9.1	5.3	0.5
Unemployment Rate	0.0	30.9	8.2	4.3	0.0	15.3	3.9	2.3
Manag_Prof_Jobs	0.0	49.9	20.0	7.5	9.1	57.3	25.7	8.6
Heating Degree Days	4078.0	9022.0	5314.6	909.0	4078.0	9022.0	5311.0	908.5
Distance to Portland	0.0	292.2	109.8	82.4	0.0	292.2	109.3	82.5
Commuting Time	4.2	35.6	17.8	5.0	6.7	44.2	21.7	6.0
Distance to National Park	0.9	179.4	49.7	29.8	0.9	179.4	49.6	29.9
Mill_closure_90s	0.0	7.0	0.5	1.0	0.0	7.0	0.5	1.0
NWFP-adjacent community	0.0	1.0	0.6	0.5	0.0	1.0	0.6	0.5
Farming, Fishing and Forestry Jobs	0.0	33.3	7.1	5.8	0.0	22.7	3.4	3.5
No. Observations	224				225			

Table 2a. Regression Results on Community Population Change

		1990-2000			2000-2010		
		Regression Coefficient	Standard Error		Regression Coefficient	Standard Error	
Population change	Intercept	-157.74	218.05		-43.50	107.75	
	Wealth change	0.99	0.18	***	-0.02	0.06	
	Income change	91.38	64.86		40.95	44.39	
	Population	-0.032	0.011	***	0.015	0.007	**
	Income rank	0.28	0.23		0.30	0.13	**
	Wealth rank	0.182	0.155		0.139	0.146	
	Pop_65plus	0.043	0.080		-0.031	0.074	
	Pop_Hispanic	0.08	0.03	**	0.03	0.02	*
	Education	-0.74	1.92		-0.44	1.11	
	Unemployment Rate	3.955	2.694		-2.413	2.295	
	Heating Degree Days	0.001	0.018		0.005	0.013	
	Distance to Portland	0.27	0.21		-0.01	0.20	
	Distance to National Park	4.68	27.17		-32.63	21.50	
	Mill_Closure_90s	14.60	8.94		7.91	12.17	
	NWFP-adjacent community	-30.35	23.57		33.59	44.20	
	NWFP-adjacent*logging dependent community	60.42	54.88		-136.81	133.77	
	R-square	0.67			0.29		
	Adjusted R-square	0.65			0.23		
	Instrument Irrelevance Stat	40.791			9.591		
	Overidentification (p-value)	7.28	(1.00)		0.70	(1.00)	

Note: ***: significant at 0.01, ** significant at 0.05, * significant at 0.1

Table 2b. Regression Results on Changes in Real Property Value

		1990-2000			2000-2010		
		Regression Coefficient	Standard Error		Regression Coefficient	Standard Error	
Change in Real Property Value	Intercept	-214.94	83.57	**	-4.90	296.86	
	Population change	0.60	0.08	***	1.10	0.35	***
	Income change	-2.53	15.47		56.38	96.65	
	Wealth	0.11	0.01	***	0.02	0.01	
	Median rooms	22.11	11.69	*	-27.83	35.55	
	Commuting time	0.18	1.50		-4.80	2.88	*
	Heating Degree Days	0.02	0.01	***	0.06	0.02	**
	Distance to Portland	-0.06	0.06		-0.31	0.41	
	Distance to National Park	12.30	10.61		-35.41	33.76	
	Mill Closure_90s	-16.97	6.18	***	-12.70	24.60	
	NWFP-adjacent community	34.42	12.08	***	159.42	50.01	***
	NWFP-adjacent*logging dependent community	-10.29	15.69		158.38	383.62	
	R-square	0.92			0.18		
	Adjusted R-square	0.92			0.14		
	Instrument Irrelevance Stat	62.251			41.581		
	Overidentification (p-value)	2.26	(0.99)		0.08	(1.00)	

Note: ***: significant at 0.01, ** significant at 0.05, * significant at 0.1

Table 2c. Regression Results on Change in Median Household Income

		1990-2000			2000-2010		
		Regression Coefficient	Standard Error		Regression Coefficient	Standard Error	
Change in Median Household Income	Intercept	4.56	0.97	***	0.40	0.50	
	Population change	0.00	0.00		0.00	0.00	
	Wealth change	0.00	0.00		0.00	0.00	
	Income	-0.04	0.01	***	-0.01	0.01	**
	Pop_Non-white	0.00	0.00		0.00	0.00	
	Education	0.02	0.03		0.00	0.01	
	Manag_Prof_Jobs	-0.05	0.04		0.01	0.01	
	Unemployment Rate	-0.04	0.01	***	0.00	0.02	
	Heating Degree Days	0.00	0.00	*	0.00	0.00	
	Distance to Portland	-0.0022	0.0007	***	0.0010	0.0006	
	Distance to National Park	-0.4067	0.1659	**	0.0788	0.1036	
	Mill_Closure_90s	-0.01	0.04		-0.02	0.03	
	NWFP-adjacent community	0.04	0.18		0.02	0.12	
	NWFP-adjacent*logging dependent community	-0.77	0.30	**	-0.32	1.06	
	R-square	0.08			0.12		
	Adjusted R-square	0.02			0.07		
	Instrument Irrelevance Stat	39.876			38.817		
	Overidentification (p-value)	5.24	(0.81)		5.38	(0.80)	

Note: ***: significant at 0.01, ** significant at 0.05, * significant at 0.1

Table 3. Estimated Total Effect (test statistics in parenthesis)

	Mill Closure	NFP	NFP & FFF10
1990s			
Population change	-41.96 (3.12)*	85.07 (2.72)*	0
Wealth change	-42.19 (4.55)**	85.53 (4.29)**	0
Income change	0	0	-0.77 (6.57)**
2000s			
Population change	0	0	0
Wealth change	0	159.42(10.16)***	0
Income change	0	0	0

Note: ***: significant at 0.01, ** significant at 0.05, * significant at 0.1

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[iii] We exclude the July temperature because the weather in the summer in Oregon is quite temperate. We included other weather variables like precipitation, but none are significant, except for January temperature, which is correlated with heating degree days.

[iv] There is no statewide property value database that separates residential real property from industrial/commercial real property at the city level. The values of centrally assessed property (such as large power plants and railroad

property) are reported separately, however. These property values are not dependent on local economic forces and thus not expected to be affected by policy affecting local timber harvests. We excluded centrally assessed properties from our local real property value dataset.

[v] These two variables are also subject to endogeneity,which is difficult to control given the limited city level data.

[vi] The wood products industry has been in transition for many decades, with mill closures occurring before and after the implementation of the NWFP. The spike in mill closures during the 1990s could have been due to other causes besides the NWFP. Even if one believes that mill closures were not directly caused by the NWFP and thus should not be considered a NWFP-induced phenomenon, a mill closure variable would need to be included in the analysis as a predictor of population, income and wealth change. Reconceptualizing the mill closure variable as a control variable rather than a pathway indicator would not affect the results or interpretation of variables representing other pathways.

[vii] In 2012, the Bureau of Labor Statistics reported 13,050 workers in Farming, Fishing and Forestry occupations in Oregon. Over one quarter (29%) of these (3750) were employed as loggers (fallers, logging equipment operators, log graders and scalers and other logging occupations) (Source: http://www.bls.gov/oes/current/oes_or.htm#45-0000) In 2000, BLS reported 11,990 workers in this occupational group, 27% of whom (3190) were loggers. (Source: http://www.bls.gov/oes/2000/oes_or.htm#b45-0000).

[viii] The instruments pass the relevance test as the statistics for each period are above 10 (Stock and Watson, 2007). The single-equation over-identifying test statistics for each equation and each period are reported in Table 2. The Hansen's J test statistic for each period is also calculated. The J-test statistic is 16.90 with p-value 0.26 for 1990s and 7.43 with p-value 0.92 for early 2000s.