An Analysis of New Capital Expenditures by the Forest Products Industry in the Pacific Northwest[1]

by

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Abstract

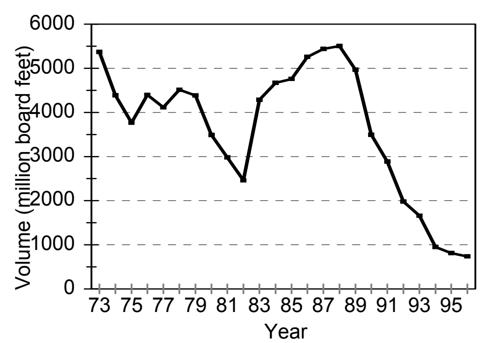
Annual new capital expenditures are analyzed for the lumber and wood products industry (SIC 24), the logging industry (SIC 241), and the paper and allied products industry (SIC 26) in the Pacific Northwest from 1963 to 1996, with particular attention given to changes after 1988, the date harvest restrictions came into effect. Various time series models are considered. An autoregressive model, AR(1), incorporating a nonlinear (linear) trend variable and a dummy variable for the pre- and post-1988 period best fits the data. Results show that investment has been declining over time but the harvest restrictions had no significant impacts.

INTRODUCTION

Old growth forests in the Pacific Northwest (PNW) are rich pools of natural resources. They provide desirable habitats for the northern spotted owl (*Strix occidentalis caurina*) as well as high-quality lumber and plywood. Since each pair of owls requires roughly 300 acres of old growth forest to breed successfully (Caldwell et al. 1994), substantial acreage of old growth forest is required for the recovery of the northern spotted owl population level. Therefore, the northern spotted owl's habitat protection under the Endangered Species Act (ESA) has led to harvest restrictions on National Forests in the PNW, which have traditionally been the largest timber providers in the United States. The harvest restrictions have resulted in tremendous reductions in the timber harvest in the PNW, which started in 1989, and have been sustained thereafter (Figure 1).

Since the northern spotted owl was listed as a threatened species in 1990, many economic analyses have been conducted. Rubin et al. (1991) analyzed benefits and costs of the northern spotted owl's protection using the contingent valuation method (CVM), and concluded that the cost of spotted owl protection was greater than the benefit in Washington and Oregon, but less in California and the United States. Sample and Le Master (1992) traced employment studies in the forest products industry in the PNW, and suggested that the downward trend in employment should be viewed as increasing labor productivity and decreasing timber harvests unrelated to the protection of spotted owl habitat. Waters et al. (1997) examined the harvest restrictions' impacts on the Northeast Oregon economy using regional computable general equilibrium (CGE) models, and indicated that the harvest restrictions had resulted in the loss of jobs and household income. They suggested that the employment in resource-based industries was shifting to tourism and retirement-based services.

Figure 1. Volume of timber harvested from National Forests in the PNW.



Source: PNW-GTR-423 (Haynes 1998).

Although there were many studies on estimates of economic costs to timber-dependent industries from the northern spotted owl habitat protection, conclusions did not always agree. Furthermore, most studies focused on short-term, adverse effects on existing economic institutions (Marcot and Thomas 1997).

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Therefore, the short-term response of the forest products industry to the harvest restrictions is to reduce the timber production sharply, cut down employment, and seek for substitutes related to old-growth forests' products. However, the long-term response is yet unclear. New capital expenditures, or new investments on fixed assets, may provide information about the industry's long run intentions. We investigate three industry sectors: lumber and wood products (SIC (Standard Industrial Classification) 24), logging (SIC 241), and paper and allied products (SIC 26) because these three industries represent important sectors of the regional economy, and are expected to be influenced by the harvest restrictions.

This study estimates long-term trends of new capital expenditures by the forest products industry in the PNW. The underlying objective is to analyze impacts of the harvest restrictions on the forest products industry.

METHODS AND DATA

One of the assumptions in classical regression models is that the disturbances are normally distributed, with zero mean and constant variance. This assumption implies that the disturbances are statistically independent as well as uncorrelated. However, when most time series data are used in regression analysis, the disturbances are not independent through time. If the disturbances are not independent, ordinary least squares (OLS) parameter estimates are not efficient and standard error estimates are biased.

Assuming the disturbance be an autoregressive process of a given order ρ, denoted AR (ρ), we have:

$$y_t = \mathbf{x}'_t \beta + \mu_t$$

$$\mu_t = \varepsilon_t - \alpha_1 \mu_{t-1} - \ldots - \alpha_\rho \mu_{t-\rho}$$

where Y_t represents new capital expenditures (NCE), X_t is a vector of regressor values, β is a vector of structural parameters to be estimated, and ε_t is normally and independently distributed with a mean of 0 and a variance of σ^2. In our models, the X_t vector consists of the following variables.

$$\mathbf{x}_t \subset \{Intercept\ , Time\ , Time^2, POST\ 88, Time * POST\ 88\}$$

where *Time* is a trend variable taking sequential values from 1 to 34, representing the years from 1963 to 1996, and *POST88* is a structural break variable taking the value of one for the period after 1988 and zero otherwise. We tested six function forms, equation 1- 6.

We employed the coefficient of determination (R^2), and Schwarz's information criterion (SBC) as criteria to select the "best" models, and the Durbin-Watson statistic (DW) to test for the presence of first-order autocorrelation.

Annual new capital expenditures data were obtained from 1963 through 1996 from various issues of the *Annual Survey of Manufactures* and the *Census of Manufactures*. From 1979 to 1981 the *Annual Survey of Manufactures* was not published. New capital expenditures data for these missing years were interpolated assuming a constant annual rate of change in new capital expenditures between 1978 and 1982. The new capital expenditures data were deflated to 1992 constant dollars using the gross domestic product (GDP) deflator (USDC Bureau of Economic Analysis). Washington and Oregon data were combined to represent the PNW.

(1) $$NCE_t = \beta_0 + \beta_1 Time_t + \varepsilon_t$$

(2) $$NCE_t = \beta_0 + \beta_1 Time_t + \beta_2 POST\ 88_t + \beta_3 Time_t * POST\ 88_t + \varepsilon_t$$

(3) $$NCE_t = \beta_0 + \beta_1 Time_t + \beta_2 Time_t^2 + \varepsilon_t$$

(4) $$NCE_t = \beta_0 + \beta_1 Time_t + \beta_2 Time_t^2 + \beta_3 POST\ 88_t + \beta_4 Time_t * POST\ 88_t + \varepsilon_t$$

(5) $$NCE_t = \beta_0 + \beta_1 Time_t + \beta_2 POST\ 88_t + \beta_3 Time_t * POST\ 88_t + \mu_t$$

(6) $$NCE_t = \beta_0 + \beta_1 Time_t + \beta_2 Time_t^2 + \beta_3 POST\ 88_t + \beta_4 Time_t * POST\ 88_t + \mu_t$$

RESULTS

New capital expenditures in the lumber and wood products industry and logging industry over the study period are depicted in Figure 2. New capital expenditures in both industries have a similar pattern, characterized by peaks in 1975. The logging industry represents a large part of its parent sector, lumber and wood products, which contributes to the similarity. New capital expenditures patterns in both industries are nonlinear with relatively flat trends in the 1989 – 96 period. Figure 3 depicts new capital expenditures in the paper and allied products industry over the study period. There is no obvious trend but several peaks are present. Recent capital spending peaked at $914 million in 1991 and declined steadily to $292 million in 1994 before recovering somewhat in 1995 and 1996. This movement is consistent with the national pulp and paper industry (Jensen 1999, Cody 1997).

Figure 2. New capital expenditures by the lumber and wood products industry and logging industry in the PNW.

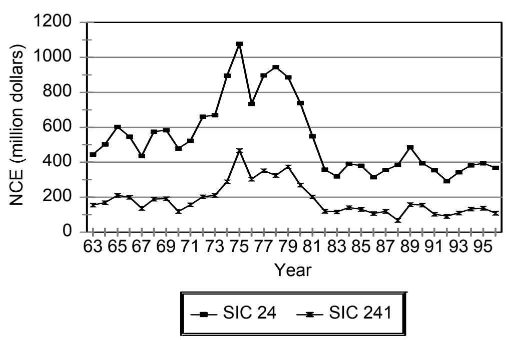
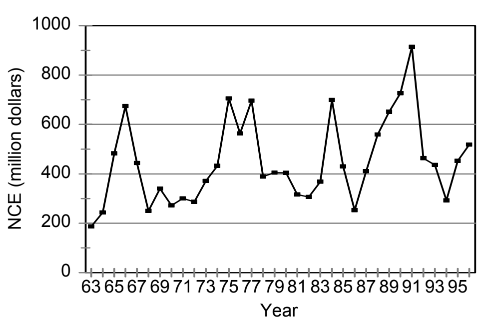


Figure 3. New capital expenditures by the paper and allied products industry in the PNW.



Based on the autocorrelation analysis, there were, as expected, strong autocorrelations in the new capital expenditures data. Therefore, classical regression was unsuitable and autoregressive models were used. Since our underlying purpose was to estimate long run new capital expenditures behavior in the regional forest products industry, and analyze the harvest restrictions' impacts on regional new capital expenditures, we incorporated linear and nonlinear trend variables, a structural break variable, and an interaction term between the linear trend and structural break variables into the autoregression models. Of six functional forms tested, the one that minimized the Schwart's information criterion value and had a larger R^2 was selected.

We also compared different orders of AR(ρ), and found AR(1) was appropriate. Table 1 presents the AR(1) models and regression results for SIC 24, SIC 241 and SIC 26. For SIC 24, an AR(1) model, incorporating a nonlinear trend and a dummy variable for pre- and post-1988 period, best fits the data. The trend variable *Time* and its quadratic form $Time^2$ are significant, implying long run new capital expenditures patterns for SIC 24 follow a nonlinear trend. Neither *POST88* nor *Time*POST88* are significant, implying that the harvest restrictions did not alter new capital expenditures in the region. This may suggest that the industry doesn't plan to abandon the region immediately. However, $Time^2$ is negative and significant, indicating that in the long run new capital expenditures were already on a downward trend.

Table 1. AR(1) models and regression results for SIC 24, SIC 241, and SIC 26.

Variables	SIC 24	SIC 241	SIC 26
Intercept	357.2*	94.8	341.4*
Time	60.2*	28.3*	5.5
$Time^2$	-2.4*	-1.1*	-
POST88	-1999.5	-839.4	1397.8
*Time*POST88*	80.6	35.3	-44.3
α_1	-0.6*	-0.6*	-0.3
R^2	0.75	0.67	0.32
SBC	432.60	386.30	449.90
DW	1.72	1.96	1.80

Note: * means significant at the 5% level; Dependent variable = new capital expenditures (million dollars);

For SIC 241, an AR(1) model, incorporating a nonlinear trend and a dummy variable for the pre- and post- 1988 period, best fits the data. Just as in the SIC 24 sector, *POST88* and *Time*POST88* are not significant, indicating no change in new capital expenditures after harvest restrictions were imposed.

For SIC 26, the R^2 for all models tested are low. However, an AR(1) model, incorporating a linear trend only and a dummy variable for the pre- and post- 1988 period, is better than other models. *Time*, *POST88*, and *Time*POST88* are not significant, indicating that no shifts in new capital expenditures occurred over time.

CONCLUSIONS

The long-run new capital expenditures for SIC 24 and SIC 241 follow a nonlinear trend, whereas SIC 26 follows a linear trend over the study period. This indicates that capital formation is different between industries. SIC 24 and SIC 241 have a shorter capital depreciative cycle compared to SIC 26. The nonlinear trends also imply that new capital expenditures in SIC 24 and SIC 241 are declining. These declines, however, may be caused by the innate investment cycle property (Markusen 1985), rather than the harvest restrictions.

There has been no significant change in new capital expenditures in the PNW forest products industry after the harvest restrictions. The paper and allied products industry is relatively small compared to the other forest products sectors in the region and does not rely on the old-growth forests for its fiber source. Also, the industry is highly capital intensive, making it costly to shut down operations (Gray and Shadbegian 1998). Therefore, it is not surprising that that there has been no decline in its new capital investments. For the logging and lumber and solid wood industries, these results indicate the industries are not abandoning the region which, in turn, suggests that investment strategies have switched to equipment and plants that can efficiently use old-growth substitutes.

LITERATURE CITED

Caldwell, L.K., C.F. Wilkinson, and M.A. Shannon. 1994. Making ecosystem policy: three decades of change. Journal of Forestry 92 (4):6-10.

Cody, H.M. 1997. Capital spending plans, 1996-98 and beyond. Pulp & Paper 71(1):69-77.

Gray, W.B., and R.J. Shadbegian. 1998. Environmental regulation, investment timing, and technology choice. The Journal of Industrial Economics XLVI(2):235-256.

Haynes, R.W. 1998. Stumpage prices, volume sold, and volumes harvested from the National Forests of the Pacific Northwest region, 1984 to 1996. USDA For. Serv. Gen. Tech. Rep. PNW-GTR-423. Portland, Oregon. 100p.

Jensen, K.P. 1999. Spending shrinks further as North American companies show restraint. Pulp & Paper 73(1):60-66.

Marcot, B.G., and J.W. Thomas. 1997. Of spotted owls, old growth, and new policies: a history since the interagency scientific committee report. USDA For. Serv. Gen. Tech. Rep. PNW-GTR-408. Portland, Oregon. 34p.

Markusen, A.R. 1985. *Profit Cycles, Oligopoly, and Regional Development*. Cambridge, MA: MIT Press.

Rubin, J., G. Helfand, and J. Loomis. 1991. A benefit-cost analysis of the northern spotted owl. Journal of Forestry 89(12):25-30.

Sample, V.A., and D.L. Le Master. 1992. Economic effects of northern spotted owl protection. Journal of Forestry 90(8):31-35.

U.S. Department of Commerce, Bureau of Economic Analysis. 1998. GDP and other major NIPA series, 1929-97. Survey of Current Business 8:147-166.

U.S. Department of Commerce, Bureau of the Census. Various issues. Annual Survey of Manufactures and Census of Manufactures. U.S. Gov. Print. Off., Washington, DC.

Waters, E.C., D.W. Holland, and R.W. Haynes. 1997. The economic impact of public resource supply constraints in northern Oregon. USDA For. Serv. Gen. Tech. Rep. PNW-GTR-398. Portland, Oregon. 23p.