Explaining Timberland Values in the United States

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ABSTRACT

The financial fortunes of timberland investors ultimately depend on conditions in markets for timberland properties. The behavior of timberland markets, however, is not well understood. In this article, we use data from the National Council of Real Estate Investment Fiduciaries (NCREIF) Timberland Property Index to develop historical series of timberland property values in the US South and US Pacific Northwest. We then use these historical series to examine the influence of operating revenues and interest rates on timberland values in each region. The former is influential, while the latter is not.

Keywords: timberland property values; NCREIF Timberland Property Index; timberland investment

Returns from investments in timberland properties are comprised of two elements. The first is an "income" return, or cash dividend, reflecting the current net operating revenues associated with timber harvesting and the sale of various nontimber outputs that forests produce. The second is an "appreciation" return reflecting the change in the value of the timberland property, including the bare land and timber inventory. The former is readily and widely understood to depend mainly on timber prices, and a comparatively large body of work, starting in the 1950s, has been devoted to understanding and forecasting supply, demand, and prices for timber (e.g., Newman and Wear 1990, Haynes 2003). Changes in timberland property values are comparatively less well understood.

This information gap is problematic. Historically about two-thirds of the total returns from timberland properties have been in the form of appreciation, and the appreciation returns have been, by far, the more volatile component (Figure 1). As a result, identifying the factors that create this volatility in timberland values is critical to effective timberland investment management.

This article uses a simple discounted cash flow model to examine the determinants of timberland value. The first section presents the value model. In the second section, we estimate time series of historical timberland property values in the US South and US Pacific Northwest with data that are part of the National Council of Real Estate Invest-

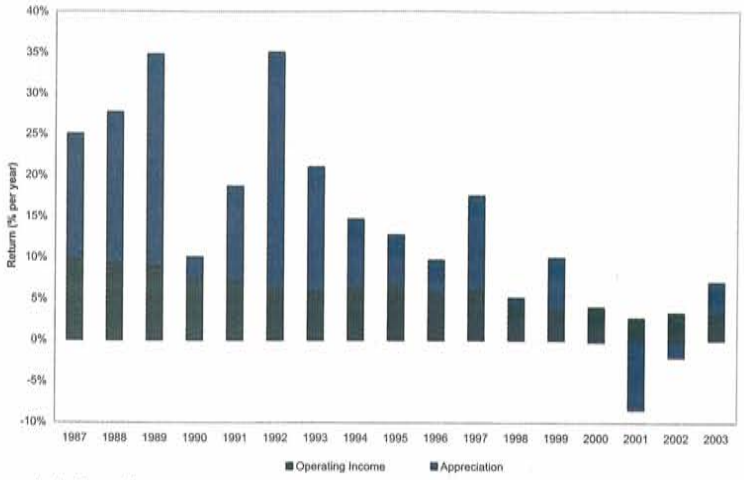

Figure 1. **NCREIF Timberland Property Index returns.**

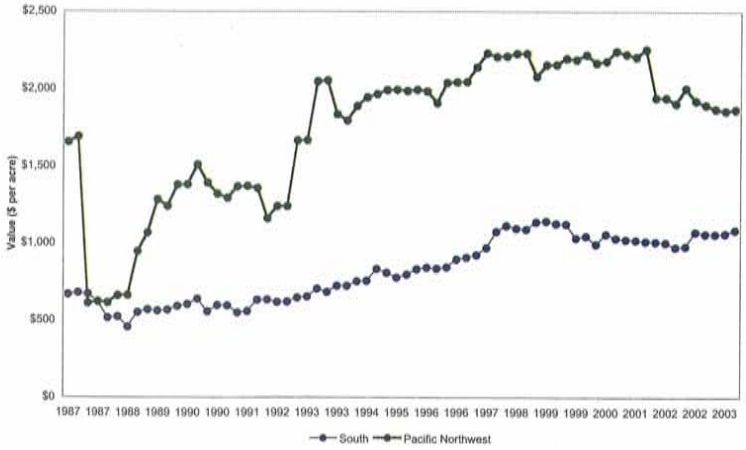

Figure 2. **Average reported per-acre value of timberland in the NCREIF Timberland Property Index.**

ment Fiduciaries (NCREIF) Timberland Property Index. The third section uses these historical series to examine the influence of operating revenues and interest rates on timberland values in each region.

A Simple Model of Timberland Value

Our timberland value model applies to a prototypical steady-state, or "area-regulated," forest. An area-regulated forest has, by definition, a stable inventory of timber. It produces an equal flow of timber harvests, off an equal number of acres, from year to year in perpetuity.

The value of an area-regulated forest can be modeled as follows:

$$V_t = I_t / r_t, \qquad (1)$$

where V_t is the value of the forest at the end of year t, I_t is the net operating revenue produced by the forest during the calendar year t, and r_t is the real discount rate used by timberland market participants to value timberland properties at the end of year t.

The model implies that net operating revenues are expected to keep pace with general inflation. In other words, participants in timberland markets are assumed to use the past year's net operating revenue as an expectation of future levels, in real terms.

Historical Estimates of Timberland Values in the United States

The study of timberland markets has been hampered by the lack of a consistent time series of historical data on timberland values. One potential source of historical value information is NCREIF. NCREIF is a nonprofit association of individuals and organizations with an interest in institutional private real estate investment—advisory firms, appraisers, property managers, institutional investors, consultants, and academics.

NCREIF maintains quarterly data on the investment performance of timberland properties in the United States owned and managed by member organizations. These performance data are published as the NCREIF Timberland Property Index. The NCREIF timberland database, which begins in 1987, now contains 264 properties, covering 5.5 million ac, with a market value of $7.0 billion (as of 31 Mar. 2004). Figure 2 shows the average per-acre reported market values of properties in the NCREIF database for the US South and US Pacific Northwest.

At least four issues complicate the direct use of these data as time series of timberland property values:

- the values are based largely on appraisals rather than actual market transactions,
- all properties are not revalued each quarter,

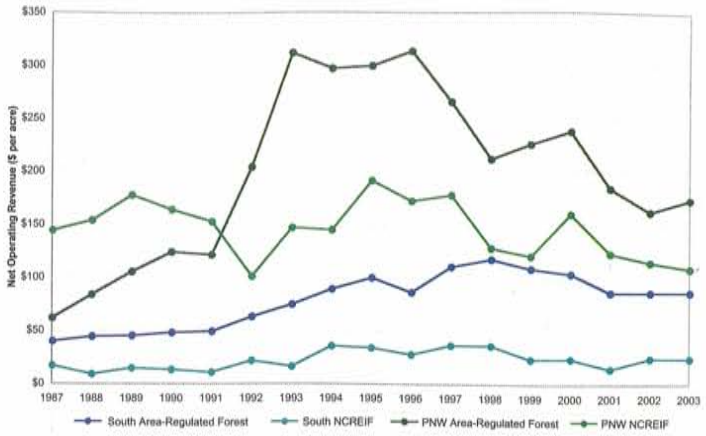

Figure 3. **Estimates of annual net operating revenues from area-regulated forests compared with revenues reported for properties in the NCREIF Timberland Property Index.**

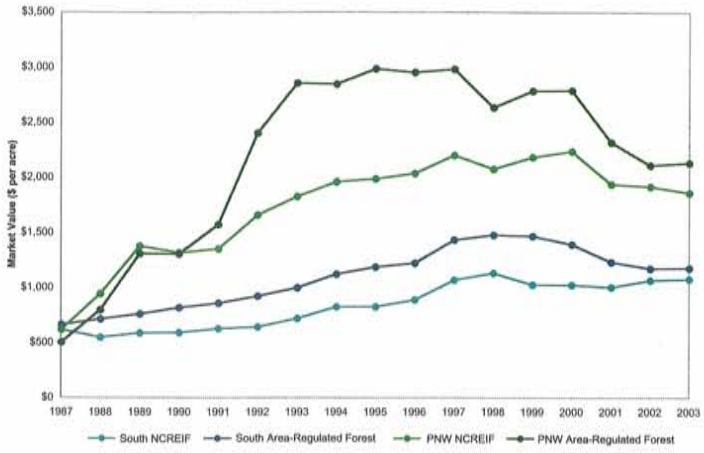

Figure 4. **Estimates of year-end market values for area-regulated forests compared with values reported for properties in the NCREIF Timberland Property Index.**

- the sample of properties in the Index changes from quarter to quarter (the result of a shifting property sample in the Pacific Northwest is evidenced by the large drop in per-acre values during 1987), and
- the timber inventory on each property changes over time due to growth and harvest.

The first issue is problematic because of the well-known fact that appraisals are lagging indicators of value due to their reliance on past comparable transactions and tend to be less volatile than actual value changes (Geltner 1993). Similar issues arise in commercial real estate investment research, and methods have been devised in that context to deal with the appraisal smoothing problem (e.g., Giliberto 2003). We leave that work to another day, however.

We are able in this analysis to address the other issues with the data. We use only annual analyses based on calendar-year changes in values to help mitigate the stale appraisal problem. This works well because the large majority of properties in the Index are revalued at the end of the fourth quarter.

We handle the problems associated with the changing sample of properties and the changing timber inventory by using rates of total return for the NCREIF Timberland Property Index to estimate an adjusted series of per-acre market values for an area-regulated forest.

Our procedure for estimating historical values for area-regulated forests has two parts. First, we estimate historical per-acre net operating revenues for the forest. Then, we compute the timberland values that, in combination with the net operating revenues, produce the same rates of total return as reported by the NCREIF Timberland Property Index. Said another way, we take as given the NCREIF returns and apply them to our prototypical forest. We determine what the operating income return would be for a fully regulated property, and we attribute the remainder of the NCREIF return to changes in the property's market value.

Determining Historical Net Operating Revenues for an Area-Regulated Forest. We estimated per-acre levels of annual operating activity—timber harvests by species and product, production of nontimber products, and management activities—for a representative timberland property under management by the Hancock Timber Resource Group in the South and Pacific Northwest, under an assumption that the timber inventory on the property was in our prototypical area-regulated condition.

We assumed that costs of management activities, and prices for nontimber products, were constant in real terms and applied 2003 levels to earlier years. We applied historical re-

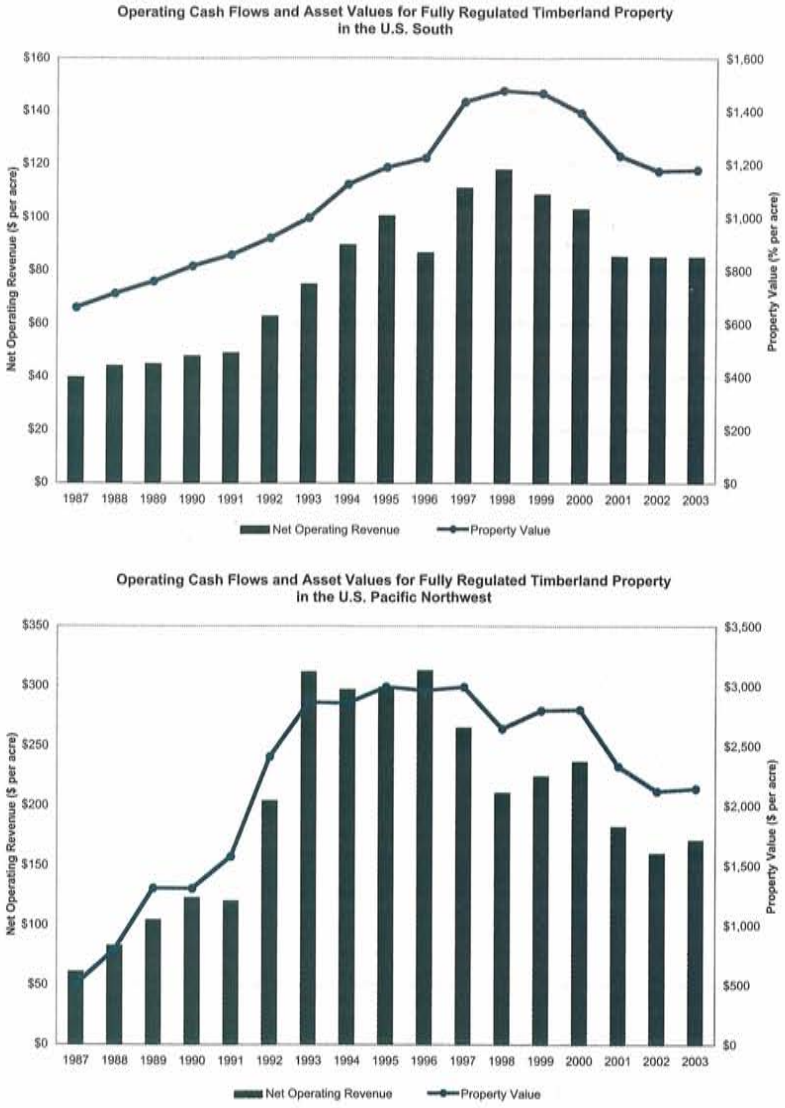

Figure 5. **Estimates of area-regulated forest operating revenues and market values.**

gional-average timber prices, calculated from Timber Mart-South and Log Lines reports, to the annual timber harvest levels to obtain historical estimates of timber sales proceeds. Figure 3 shows the net operating revenues for our prototypical forests in comparison with the actual NCREIF-reported data.

In the South, the income levels for the area-regulated property are far higher than those reported in the NCREIF database. This suggests that institutional investors tend to hold properties with forests younger than the area-regulated forest assumption, and the harvest levels are therefore lower. Anecdotal evidence is consistent with this conclusion, where southern timberland sellers often offer relatively immature properties for sale (keeping those with higher levels of cash flow for themselves), and some managers craft investment strategies out of this marketplace necessity.

The results of our analysis in the Pacific Northwest are a bit more complex. NCREIF-reported incomes have been flat but volatile compared to the South. The NCREIF-reported revenue through 1991 is higher than for our prototypical forest, suggesting that Pacific Northwest properties in the NCREIF Index during its early years contained large inventories of mature timber that landowners apparently harvested. The year-to-year volatility in the NCREIF results may be due to changes in log prices, changes in the property sample, harvest timing decisions, or a combination of factors.

Calculating Historical Area-Regulated Forest Values. With net revenue estimates in hand, one can calculate timberland values that would produce the NCREIF-reported total rates of return. The calculation uses the following formula:

$$R_t = (V_t - V_{t-1} + I_t)/V_{t-1} \qquad (2)$$

where R_t is the total rate of return reported by NCREIF for the calendar year t.

We need a starting point to set the level of our series of timberland values and selected year-end 2003. We used Equation 1 to calculate year-end 2003 value estimates. Real discount rates for timberland properties at year-end 2003 were calculated as the average real internal rate of return (IRR) that properties under Hancock Timber Resource Group management are expected to produce in each region given year-end 2003 appraised values and assuming that future timber prices and management costs hold steady in real terms at 2003 levels. These rates were 7.2% in the South and 8.1% in the Pacific

Northwest. We then divided our estimates of 2003 net operating income levels by these rates to obtain estimates of year-end 2003 values for an area-regulated forest in each region.

It is then a simple matter to use Equation 2 to iteratively calculate the earlier year-end timberland values back to 1987. The results of this calculation of market value are shown in Figure 4.

For the South, the estimates of area-regulated forest value are higher than the raw NCREIF data. This is consistent with our earlier conclusion that the sample of southern properties in the NCREIF database tends to be "young," without the aggregate timber inventory and value one would expect from an area-regulated forest.

Our southern value estimates follow the NCREIF data quite closely through the 1990s. Since 1999, however, our estimates of the per-acre value of an area-regulated southern forest have declined by 20%, whereas the raw per-acre value of the sample of NCREIF properties has increased by 5%.

Our estimates of area-regulated forest values for the Pacific Northwest are also generally higher than those in the NCREIF database, but not always. The lower values in the early years support our earlier conclusion that managers were depleting inventory on relatively "mature" properties in the late 1980s. The "Spotted Owl Effect" on timberland values in the Pacific Northwest, which is dampened in the NCREIF-reported values, is better reflected in our series of area-regulated property values.

Determinants of Timberland Values

To test our model of timberland value presented in Equation 1, we regressed the rate of change in our adjusted year-end timberland values against the rate of change in our estimates of annual-average income levels and the rate of change in real yields for 10-year US government bonds, assumed to be a proxy for percentage changes in the real timberland discount rate. This is expressed as:

$$\ln(V_t/V_{t-1}) = a + b_1\ln(I_t/I_{t-1}) + b_2\ln(B_t/B_{t-1}) + \text{error}, \quad (3)$$

where Bt is the nominal yield on a 10-year US bond at the end of year t less expectations of long-term inflation obtained from the University of Michigan Survey of Consumers (University of Michigan).

Using data from our prototypical forests, the results of the regressions are presented below:

US South:

$$\ln(V_t/V_{t-1}) = 0.016 + 0.45^{**}\ln(I_t/I_{t-1}) + 1.3\ln(B_t/B_{t-1}) \qquad R^2 = 0.73$$
$$(5.79) \qquad (1.59) \qquad \text{adjusted } R^2 = 0.69$$

US Pacific Northwest:

$$\ln(V_t/V_{t-1}) = 0.040 + 0.74^{**}\ln(I_t/I_{t-1}) - 2.0\ln(B_t/B_{t-1}) \qquad R^2 = 0.64$$
$$(4.80) \qquad (-0.71) \qquad \text{adjusted } R^2 = 0.59$$

where the numbers in parentheses are t-statistics and ** indicates the coefficient is statistically different from zero at the 0.01 level of confidence.

For both regions, the combination of rates of change in operating income and real bond yields explains about two-thirds of the variability in rates of timberland value change. There is a strong relationship between rates of change in timberland property prices and rates of change in operating income levels in both regions. This relationship is demonstrated in Figure 5, which shows that timberland values have tended to move with operating revenues. The elasticity of the rate of timberland value change with respect to rates of change in operating income was 0.45 in the South and 0.74 in the Pacific Northwest.

The results suggest that real discount rates used by participants in timberland markets are largely independent of changes in interest rates in the broader bond markets. This is consistent with the common observation that historical timberland returns have been independent of bond returns (e.g., Hancock Timber Resource Group 2003).

Conclusions

Because timberland is not traded frequently in public markets, like stocks and bonds, understanding the determinants of timberland values is critical to understanding the returns from timberland investments. Little previous research has focused on this problem as a result of an absence of a reasonable time series of data describing timberland values.

The emergence of the NCREIF Timberland Property Index has greatly helped to resolve this problem. However, the NCREIF database reflects the sample of properties that timberland investment advisors happen to contribute in a given quarter. These properties may be young or old, and may contain only immature plantations or over-mature timber. As a result, before meaningful analysis can be conducted, it is necessary to standardize the age distribution of the forests. We have outlined one means to do so and have used the resultant data to investigate the factors that explain movements in timberland values.

Timber prices—through their influence on operating revenues—appear to have a strong effect on timberland values; interest rates do not. A key remaining issue is to understand how appraisal-based valuations influence return volatility.

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