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 paper, we use data from the NCREIF Timberland Property Index to develop historical series of timberland property values in the U.S. South and U.S. 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 later, surprisingly, is not.

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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 a myriad of non-timber products from forests. The second is an ‘appreciation’ return reflecting the change in the value of the underlying timberland asset. 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., Haynes 2003; Newman and Wear 1990). Changes in timberland values are less well understood.

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

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 such information is the National Council of Real Estate Investment Fiduciaries (NCREIF). NCREIF maintains quarterly data on timberland properties in the United States owned by institutional investors (see Hancock Timber Resource Group, 2000, for a description of the NCREIF organization and its Timberland Property Index). The NCREIF timberland database, which begins in 1987, now contains 264 properties, covering 5.5 million acres, and valued in total at $7.0 billion (as of 31 March 2004). In their raw form, the NCREIF:

Figure 1. NCREIF Timberland Property Index returns

values are not directly suitable for the analysis contemplated in this paper. As a consequence, the first section, below, deals with some of these problems with the data. The second section uses
the adjusted time series to investigate the determinants of timberland values. As one might expect, timberland values are strongly influenced by net operating revenues, which in turn depend on timber prices. Conditions in overall capital markets, however, appear to have little effect on the value of timberland properties.

1. **Historical Estimates of Timberland Values in the United States**

   The NCREIF Timberland Property Index records data on the investment performance—including market values—of timberland properties managed for institutional investors by member organizations. Figure 2 shows the raw value data, stated on a per-acre basis, for the full time series in the South and Pacific Northwest. (Values are also available for the Northeast. The sample of Northeast properties is less homogenous, however, and we therefore focus on the South and Pacific Northwest.)

![Figure 2. Average reported per-acre value of timberland in the NCREIF Timberland Property Index](image)

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,
- The sample of properties changes from quarter to quarter, and
- The timber inventory on each property changes over time due to growth and harvest.

It is well known that appraisals are lagging indicators of value (owing to their reliance on past comparable transactions), and tend to be less volatile than actual value changes. 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., Geltner 1993; Giliberto 2003). We, however, leave that work to another day.
We are able in this analysis to address the other difficulties in the data. Because the large majority of properties in the Index are revalued at the end of the fourth quarter, we stick to annual analyses based on calendar-year changes in values. This is a simple way to mitigate the stale-appraisal problem.

We handle the problems associated with the changing sample of properties and the changing timber inventory by using rates of return for the NCREIF Timberland Property Index to estimate an adjusted series of per-acre market values for a prototypical ‘fully regulated’, or in foresters’ terms, ‘normal’, forest (although there is nothing normal about such a hypothetical forest!). A normal forest has, by definition, a stable inventory of timber, and produces a steady flow of harvested timber from year to year.

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

A. Determining Historical Net Operating Revenues for a Normal Forest

We estimated per-acre levels of annual operating activity—timber harvests by species and product, production of non-timber 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 this sample of properties was in a normal condition.

We assumed that operating costs and prices for non-timber forest products were constant in real terms, and applied 2003 levels to earlier years. We applied historical regional-average timber prices calculated from Timber Mart-South (for the South) and Log Lines (for the Pacific Northwest) to the annual timber-harvest levels to obtain historical estimates of timber-sales proceeds. Figure 3 shows the normal-forest operating revenues in comparison with the actual NCREIF-reported data.
Figure 3. Estimates of annual net operating revenues from normal forests compared with revenues reported for properties in the NCREIF Timberland Property Index

In the South, the normal-forest income levels are far higher than those reported in the NCREIF database. This suggests that institutional investors tend to hold properties with forests younger than the normal-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). Some timberland investment managers craft investment strategies out of this market-place necessity.

The results of our analysis in the Pacific Northwest are a bit more complex and interesting. NCREIF-reported incomes have been flat but volatile, where the normal-forest revenues track timber prices upward during the late 1980s and early 1990s, and downward thereafter. The NCREIF-reported revenue through 1991 was higher than that of a normal forest. This suggests that Pacific Northwest properties in the NCREIF Index during its early years contained disproportionately large inventories of harvestable timber. Landowners evidently harvested this timber heavily during this time of relatively high prices caused by a sharp reduction in the availability of public timber. The year-to-year volatility in the NCREIF results may be due to a changing property sample, harvest-timing decisions, or a combination of the two factors.

B. Calculating Historical Normal Forest Values

With the normalized revenue estimates in hand, one can infer the timberland values for a normal forest that are necessary to produce the NCREIF returns. We need a starting point to peg our series of timberland values, however, and selected year-end 2003. To obtain year-end 2003 values, we formulated a simple model of the value of a normal forest:
\[
\text{Value}_t = \frac{\text{Net Annual Operating Revenue}_t}{\text{Real Discount Rate}_t},
\]

where \(\text{Value}_t\) is the value of a normal forest at the end of year \(t\), \(\text{Net Annual Operating Revenue}_t\) is the operating income produced by the forest during the calendar year \(t\), and \(\text{Real Discount Rate}_t\) is the real discount rate used by timberland market participants to value timberland properties at the end of year \(t\). This model effectively assumes that net operating revenues are expected to keep pace with general inflation.

We estimated real discount rates for timberland properties at year-end 2003 as the average real IRR that properties under HTRG management are expected to produce in each region assuming that future timber prices and management costs hold steady in real terms at 2003 levels. These rates were 7.2 percent in the South and 8.1 percent in the Pacific Northwest.

We then divided our estimates of 2003 income levels by these rates to obtain estimates of year-end 2003 values for a normal forest in each region. It is then a simple matter to calculate the year-end timberland values back to 1987 that, in combination with our historical operating revenue estimates, generate the historical NCREIF rates of return.

![Regional Average Market Values](image)

Source: NCREIF and HTRG Research

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

The results of this calculation are shown in Figure 4. For the South, the estimates of normal forest value have been above the raw NCREIF data. This supports 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 a normal 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 a normal southern forest have declined by 20 percent, where the per-acre value of the sample of NCREIF properties has increased by 5 percent. We speculate that this is due largely to the addition to the NCREIF
database of a substantial number of properties managed by new member organizations that are carried at relatively high per-acre values.

Our estimates of normal-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 supports 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 normal-forest series of property values.

2. **Determinants of Timberland Values**

While the normal-forest property-value estimates are of interest in their own right, they are more compelling as the basis for an analysis of the determinants of timberland values.

The simple model of timberland value that we outlined earlier suggests that changes in the per-acre price of timberland properties should be a function of changes in per-acre operating income levels and changes in the real timberland discount rate. To test the model, we regressed the rate of change in our adjusted year-end timberland values on the rate of change in our estimates of annual-average income levels and the rate of change in real yields for 10-year government bonds, a proxy for the timberland discount rate:

\[
\ln(\text{Value}_t / \text{Value}_{t-1}) = \alpha + \beta_1 \ln(\text{Revenue}_t / \text{Revenue}_{t-1}) + \beta_2 \ln(\text{Real Bond Yield}_t / \text{Real Bond Yield}_{t-1}) + \text{error}_t,
\]

where Real Bond Yield, is the nominal yield on a 10-year US bond at the end of year t less surveyed expectations of long-term inflation (Wilshire Associates 2003).

The results of the regressions are (t-statistics in parenthesis):

**South**

Timberland Value = 0.016 + 0.45*Revenue + 1.3*Real Yield  
(5.79)  (1.59)  
R² = 0.73

**Pacific Northwest**

Timberland Value = 0.040 + 0.74*Revenue – 2.0*Real Yield  
(4.80)  (-0.71)  
R² = 0.64

For both regions, the combination of changes in operating income and real bond yields explains about two-thirds of the variability in timberland value changes. There is a strong relationship between rates of change in timberland property prices and rates of change in net income levels in both regions. This relationship is demonstrated in Figure 5a and 5b, which shows that timberland values have tended to move with operating revenues.
Figure 5a and 5b. Estimates of normal-forest operating revenues and market values

The elasticity of timberland values with respect to operating revenues in the Pacific Northwest is 64% higher than in the South (0.74 vs 0.45). While the reasons are not altogether clear, two factors appear to be at work. First, timber supply is much less elastic in the Pacific Northwest, so changes in lumber prices are more rapidly translated into changes in timber prices. The stickiness of supply response in the South is due to the structure of timberland ownership, comprised in that region of a myriad of nonindustrial private landowners. We hypothesize that these landowners probably respond less rapidly to changes in timberland markets just as they
respond less rapidly to changes in timber markets. Second, bare land values in the South are a higher proportion of timberland value than in the Pacific Northwest, and bare-land values (at least as reported by appraisers) are less responsive to timber-price movements than are the values of the standing timber inventory.

The results also suggest that discount rates used by participants in timberland markets are largely independent of interest rates in the broader bond markets. This is illustrated in Figure 6, which plots our historical estimates of the real yield on a 10-year US bond against estimates of historical discount rates for a timberland property portfolio (with an assumed weighting of two-thirds in the South and one-third in the Pacific Northwest.) The two series do not move together, as evidenced by the variability of the premium for timberland discount rates over bond yields.

3. Conclusions

Understanding the determinants of timberland values is critical to understanding the returns from timberland investments. Little previous research has focused on this problem largely, we believe, 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 but does not go the full way. Of particular importance is the fact that the NCREIF database simply reflects the sample of properties that timberland investment advisors happen to contribute in a given quarter. These properties my be young or old, and may contain only immature plantations or old-growth timber. As a result, before any 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; interest rates do not. A key remaining issue
is to take account of the appraisal-based reductions of return volatility, and some promising paths exist to do so.

**Literature Cited**


