Historical Returns *for* Timberland

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Hancock Timber Resource Group®

Historical Returns for Timberland

This research note uses both the John Hancock Timber Index and the National Council of Real Estate Investment Fiduciaries (NCREIF) Timberland Property Index to estimate the historical level and volatility of timberland returns.

The note includes:

- **a discussion of the methodology and assumptions that underlie the John Hancock Timber Index, and**
- **estimates of the historical performance of timberland in the U.S. South, Pacific Northwest and Northeast, as well as New Zealand and coastal British Columbia.**

*A companion research note (N-03-4) entitled **The NCREIF Timberland Property Index** explains the methodology used by NCREIF to measure historical returns for actual institutional timberland assets in the United States. Another companion note (N-03-3), **Timberland as a Portfolio Diversifier,** compares timberland returns to returns for other assets such as stocks, bonds and commercial real estate, and examines the capacity of timberland to diversify a portfolio of these traditional investments.*

Measuring Historical Timberland Returns

The best available source of historical timberland returns in the United States is the NCREIF Timberland Property Index, which is patterned after the well-known NCREIF Property Index for commercial real estate. To construct the Index, NCREIF members submit information on the performance of every qualifying U.S. timberland property they manage. NCREIF staff bank these data, and then aggregate the property-level information to produce rates of return for the asset class. The NCREIF Timberland Property Index is thus based on the actual reported performance of institutional timberland assets.

Because institutions did not invest in timberland prior to the mid-1980s, the NCREIF Timberland Property Index covers a relatively short period of time: the return series for the U.S. Pacific Northwest and U.S. South begin in 1987; the series for the U.S. Northeast begins in 1994. To lengthen the historical performance record for U.S. timberland as well as measure the performance of offshore timberland, some other method must be used to obtain timberland returns.

When returns for actual timberland assets are lacking, analysts have generally combined historical timber prices (which are available for extended periods) with various assumptions about timber growth, historical values of forestland and timber growing stock, and management expenses to reconstruct returns for a model forest.

Most researchers begin with an assumption that their model forest is "fully regulated." A forest is said to be fully regulated if it contains an equal distribution of timber inventory among all age classes. This condition allows an equal volume of timber to be harvested from the model forest each year and ensures that both the timber inventory and the rate of timber growth remain constant over time. Although few individual forests contain an even mix of timber ages, portfolios of several timberland properties can approach full regulation. This assumption provides a useful, stable benchmark for valuation comparisons.

Analysts differ in their other assumptions. Some argue that land and growing stock values track timber prices, and that management expenses are a constant proportion of forest value. Well-known analyses of this kind include studies by Redmond and Cubbage (1988) and Washburn and Binkley (1993). Under these conditions, all of the variation in the reconstructed series of timberland returns is caused by variation in timber prices. Other analysts make more complex assumptions about the components of returns for forests. The most prominent examples include Binkley and Washburn (1990), Conroy and Miles (1989) and Mills (1988). Even in these cases, however, fluctuating timber prices account for most of the variation in the timberland return estimates. Consequently, different reconstructed indices of forest value tend to generate similar estimates of historical timberland returns.

John Hancock Timber Index

The John Hancock Timber Index is one example of a reconstructed timberland return series. We utilize it to extend our historical record of U.S. timberland performance back in time to 1960, and to estimate historical returns for timberland in New Zealand and coastal British Columbia.

In brief, the John Hancock Timber Index assumes that forestland and timber growing stock values follow timber prices, and that management expenses are a constant proportion of forest value. Thus, the Index is a relatively simple formulation.

The Index calculates quarterly rates of return for timberland via the following standard formula:

$$\text{Rate of Return}_t = [(\text{Net Income}_t + \text{Capital Value}_t) / \text{Capital Value}_{t-1}] - 1$$

- Net Income_t is an index of the net revenue produced by the forest during quarter t, and
- Capital Value_t is an index of the value of the forest land and timber growing stock during quarter t.

Annual rates of return are readily calculated from the quarterly rates.

The capital value of forestland and timber growing stock is assumed to track an eight-quarter weighted average of timber prices, with the weights declining linearly from the current quarter:

$$\text{Capital Value}_t = (8P_t+7P_{t-1}+6P_{t-2}+5P_{t-3}+4P_{t-4}+3P_{t-5}+2P_{t-6}+P_{t-7}) / 36$$

- P_t is the price of timber during quarter t.

The rationale behind this formulation is twofold. First, capital theory suggests that the values of forestland and timber growing stock are governed by expectations of future timber prices. Second, economic models of timber price expectations suggest that these values are based on observations of current, and to a lesser degree past, timber prices.

The length of the time interval over which past timber prices are assumed to influence expected future prices affects the volatility of the returns generated by the John Hancock Timber Index. An eight-quarter period is consistent with our view of how participants in the timberland market form their expectations. Had we specified a shorter period, perhaps four quarters, our volatility estimates would be higher. A longer period, such as 12 quarters, would produce lower volatility estimates.

Net income is represented by the price of timber during quarter t multiplied by a historical quarterly "income rate" for timberland of 1.25 percent in the U.S. Pacific Northwest, 1.00 percent in the U.S. South, 0.75 percent in the U.S. Northeast, and 1.75 percent in New Zealand and coastal British Columbia:

$$\text{Net Income}_t = \text{Income Rate} \times P_t$$

The income rate measures the average net revenue from timber harvests and other sources as a proportion of the capital value of the forest. It is the historical average rate of cash flow for the timberland investment.

The choice of income rate has a direct influence on the level of historical timberland return estimates produced by the John Hancock Timber Index. Its specification is a matter of informed judgment. The rates that we selected for the Index are consistent with our observations of the historical relationships between timber revenues and forest values in each region. They are lower, however, than income rates we expect from timberland in the future.

Most reconstructed series of timberland returns are based on a model forest in the southern United States. The John Hancock Timber Index is unusual in its ability to estimate returns for timberland investments in other regions of the United States as well as offshore.

Timberland in the U.S. South

Forests in the U.S. South (Virginia, the Carolinas, Georgia, northern Florida, Alabama, Mississippi, Louisiana, Arkansas, eastern Texas and eastern Oklahoma) generate the bulk of their income through the sale of southern pine stumpage. Stumpage is standing timber sold for harvest (generally within six months to one year from the date of sale). A typical southern pine forest produces both pulpwood stumpage (small trees that are used to produce pulp and paper, or oriented strandboard) and sawtimber stumpage (larger trees that are sawn into lumber or peeled into plywood). Although the relative importance of pulpwood and sawtimber production varies throughout the South, on average, about one-half of harvest volumes are from pulpwood and one-half are from sawtimber.

Thus, for the southern component of the John Hancock Timber Index, we assume that the price of timber in quarter t is given by:

$$P_{U.S.\ South,t} = (1/2)\,P_{pulpwood,t} + (1/2)P_{sawtimber,t}$$

- $P_{pulpwood,\ t}$ is the price per ton of southern pine pulpwood stumpage during quarter t, and
- $P_{sawtimber,\ t}$ is the price per ton of southern pine sawtimber stumpage during quarter t.

Accurate quarterly records of prices for southern pine pulpwood and sawtimber stumpage are available from *Timber Mart-South* price reports since 1977. To obtain prices in earlier years, we used rates of change in quarterly prices published by the Louisiana Department of Forestry for both types of timber to backcast from the first quarter 1977 *Timber Mart-South* South-wide levels.

Timberland in the U.S. Pacific Northwest

Forests in the U.S. Pacific Northwest (western Washington and western Oregon) produce the bulk of their income through the sale of sawtimber. About three-quarters of the sawtimber harvested from private forests in the Pacific Northwest are Douglas-fir and about one-quarter is western hemlock. Thus, for the Pacific Northwest component of the Index, we assume that the price of timber in quarter t is given by:

$$P_{U.S.\ Northwest,t} = (3/4)\,P_{Douglas\text{-}fir,t} + (1/4)\,P_{western\ hemlock,t}$$

- $P_{Douglas\text{-}fir,\ t}$ is the price per thousand board feet of Douglas-fir sawtimber stumpage during quarter t, and
- $P_{western\ hemlock,\ t}$ is the price per thousand board feet of western hemlock sawtimber stumpage during quarter t.

Timber prices in the U.S. Pacific Northwest are typically quoted for delivered logs rather than standing stumpage. Thus, to estimate a stumpage price series for the U.S. Pacific Northwest that reflects the net revenue received by timberland owners, logging and hauling costs must be deducted from reported log prices.

Accurate quarterly records of log prices for both Douglas-fir and western hemlock can be calculated from monthly *Log Lines* price reports published since 1989. *Log Lines* reports prices for a variety of export and domestic log sorts differentiated by quality and size. The John Hancock Timber Index utilizes a weighted average price for each species based on our assessment of the typical sort distributions for timber harvested from private lands in the region.

We rely on the high correlations between export and domestic log prices, and between Douglas-fir and hemlock log prices to compensate for limited historical price data prior to 1989. The rates of change in quarterly prices reported for exported Douglas-fir logs by the U.S. Department of Commerce are used to backcast both Douglas-fir and hemlock series through 1977. The annual rates of change in prices reported for domestic Douglas-fir logs by the Industrial Forestry Association are then used to backcast both series from 1977 to 1960.

Hancock Timber Resource Group data on logging and hauling costs are available since 1988. Logging and hauling costs in prior years are backcast using data reported by the U.S. Forest Service. We subtract these costs from the sawlog prices to obtain estimates of stumpage prices.

Timberland in the U.S. Northeast

Commercial forests in the U.S. Northeast (Maine, New Hampshire, Vermont, upstate New York and Pennsylvania) typically contain both hardwood (broadleafed trees) and softwood (needled trees) species that are harvested for both sawtimber and pulpwood. To describe the range of products a typical ownership would generate, a blended price of eastern white pine, spruce, maple, birch and beech sawtimber is combined with a blended price of spruce and mixed hardwood pulpwood. We assume that one-half of harvest volumes are pulpwood and one-half are sawtimber. Thus, the price of U.S. Northeast timber in quarter t is given by:

$$P_{\text{U.S. Northeast},t} = (1/2)\,P_{\text{pulpwood},t} + (1/2)\,P_{\text{sawtimber},t}$$

- $P_{\text{pulpwood},\,t}$ is the price per cord of Northeast pulpwood stumpage during quarter t, and
- $P_{\text{sawtimber},\,t}$ is the price per cord of Northeast sawtimber stumpage during quarter t.

From 1960 through 1993, the John Hancock Timber Index utilizes stumpage prices reported by the Maine Forest Service as a benchmark for timber prices throughout the Northeast. Beginning in 1994, data from Hancock Timber Resource Group timber sales in the region are used.

Timberland in New Zealand

New Zealand's commercial timberland is mostly radiata pine plantations. Sawtimber is the primary product harvested from these plantations. New Zealand is a net exporter of wood, sending a relatively large proportion of logs offshore due to the comparatively small and almost static domestic demand, and comparatively small domestic manufacturing base. With this in mind, we utilize the New Zealand Ministry of Forestry's reported price for unpruned radiata pine A-sort export sawlogs to index the price of New Zealand timber. We have these data since 1989. To obtain prices in earlier years, we used rates of change in annual prices provided by Resource Information Systems Inc. (RISI) for NZ export logs, available back to 1980.

To estimate stumpage values, we use 2002 average logging and hauling costs and backcast to 1980 using quarterly changes in New Zealand's Consumer Price Index. We convert prices to US$ using quarterly average exchange rates to capture the effects of currency fluctuations on a U.S. investor. Given these assumptions, the price of New Zealand timber in quarter t is given by:

$$P_{\text{New Zealand},t} = P_{\text{radiata pine},t}$$

- $P_{\text{radiata pine},\,t}$ is the US$ price per cubic meter of New Zealand radiata pine sawtimber stumpage during quarter t.

Timberland in Coastal British Columbia

The forests of coastal British Columbia resemble those of the U.S. Pacific Northwest. Consequently, we use the same mix of Douglas-fir and western hemlock sawlogs to measure timber prices in both regions. Sort-weighted average sawlog prices for each species are calculated from prices reported by British Columbia's Council of Forest Industries (COFI).

To arrive at stumpage values, we use Hancock Timber Resource Group 2002 logging costs from properties in British Columbia and backcast to 1960 using quarterly changes in Canada's Consumer Price Index. We also convert sawtimber prices from Canadian dollars to U.S. dollars. Thus, the price of coastal BC timber in quarter t is given by:

$$P_{\text{Coastal British Columbia},t} = (3/4)\,P_{\text{Douglas-fir},t} + (1/4)\,P_{\text{western hemlock},t}$$

- $P_{\text{Douglas-fir},\,t}$ is the US$ price per cubic meter of coastal British Columbia Douglas-fir sawtimber stumpage during quarter t, and
- $P_{\text{western hemlock},\,t}$ is the US$ per cubic meter price of coastal British Columbia western hemlock sawtimber stumpage during quarter t.

Estimates of Historical Timberland Returns

Our estimates of annual rates of return since 1960 for timberland in the U.S. South, U.S. Pacific Northwest and U.S. Northeast are presented in Table 1. The table also presents returns for a "market portfolio" of U.S. timberland with 50 percent of its value in the South, 40 percent in the Pacific Northwest, and 10 percent in the Northeast. Table 1 further presents estimates of returns since 1960 for timberland in coastal British Columbia, and since 1982 for timberland in New Zealand. A "global market portfolio" with 80 percent of its value in the United States and 20 percent offshore (20 percent in coastal British Columbia prior to 1982 and 10 percent in coastal British Columbia and 10 percent in New Zealand from 1982 onward) is presented as well.

Table 1
Timberland Returns (% per year), 1960-2002*

Year	South	Pacific Northwest	Northeast	Domestic Portfolio	British Columbia	New Zealand	International	Global Portfolio
1960	2.8	8.6	1.6	5.0	10.1	—	10.1	6.0
1961	-0.9	4.3	-3.6	0.9	8.4	—	8.4	2.4
1962	3.3	4.7	0.8	3.6	10.4	—	10.4	5.0
1963	2.6	8.7	4.7	5.2	16.2	—	16.2	7.4
1964	3.2	6.6	4.4	4.7	42.8	—	42.8	12.3
1965	7.1	12.5	4.2	9.0	22.1	—	22.1	11.6
1966	15.6	9.6	10.0	12.6	0.0	—	0.0	10.1
1967	11.5	12.2	6.3	11.2	3.4	—	3.4	9.7
1968	11.6	29.4	8.8	18.2	30.8	—	30.8	20.7
1969	17.2	31.9	10.0	22.2	23.5	—	23.5	22.4
1970	4.0	-3.7	4.8	0.9	-7.3	—	-7.3	-0.7
1971	14.1	-8.1	6.2	4.1	36.7	—	36.7	10.6
1972	18.6	2.7	6.6	10.8	51.2	—	51.2	18.9
1973	25.5	112.1	11.4	54.7	35.9	—	35.9	51.0
1974	16.2	25.2	25.6	20.7	11.9	—	11.9	19.0
1975	1.6	-3.9	20.5	1.1	3.8	—	3.8	1.7
1976	17.5	16.4	7.2	16.0	16.4	—	16.4	16.1
1977	32.3	78.1	11.0	47.1	7.9	—	7.9	39.3
1978	31.0	31.3	14.5	29.4	9.9	—	9.9	25.5
1979	25.1	40.3	22.4	30.8	60.3	—	60.3	36.7
1980	-2.4	14.2	9.4	5.2	19.6	—	19.6	8.1
1981	6.9	-4.5	9.9	2.5	-13.0	—	-13.0	-0.6
1982	3.2	-9.2	3.0	-1.9	-5.2	-3.6	-4.4	-2.4
1983	12.6	-14.7	1.4	0.0	0.8	0.7	0.7	0.1
1984	8.4	-4.1	6.2	3.1	-7.5	8.9	0.7	2.6
1985	-8.0	2.6	4.0	-2.7	15.3	13.9	14.6	0.8
1986	-3.6	11.3	6.2	3.1	15.8	12.4	14.1	5.3
1987	14.1	38.5	8.9	23.1	21.7	14.2	18.0	22.0
1988	14.0	74.6	9.8	35.7	32.3	8.5	20.4	32.6
1989	12.6	74.9	11.0	35.7	32.2	-7.1	12.5	31.0
1990	13.6	7.8	8.5	10.9	7.4	22.0	14.7	11.7
1991	10.9	29.1	3.5	17.1	-3.8	5.0	0.6	13.8
1992	13.1	60.6	8.3	30.7	1.4	21.7	11.5	26.9
1993	15.1	27.1	22.0	21.2	51.4	48.1	49.7	26.9
1994	20.0	10.7	14.0	15.7	38.7	-5.6	16.6	15.9
1995	13.7	15.3	3.3	13.3	27.6	-3.3	12.1	13.1
1996	11.5	8.9	17.6	11.0	-3.8	-5.4	-4.6	7.9
1997	24.3	11.6	18.1	18.6	-3.1	-1.7	-2.4	14.4
1998	10.7	-2.7	34.9	7.7	-22.5	-11.3	-16.9	2.8
1999	7.1	13.7	34.3	12.4	-4.3	-7.9	-6.1	8.7
2000	2.3	8.3	7.5	5.2	12.2	0.2	6.2	5.4
2001	-4.1	-8.4	-6.2	-5.9	-5.0	-7.6	-6.3	-6.0
2002	2.3	-1.1	2.8	1.0	1.4	15.9	8.6	2.5

Please refer to Note on page 11.

*before management fees

Note: U.S. portfolio is weighted 50% SE, 40% PNW, 10% NE; Global portfolio is weighted 80% U.S., 20% Int'l (50% BC, 50% NZ from 1982-present; prior to 1982, 100% BC)

The mean and standard deviation of the returns for the past 10 years, 20 years, 30 years and 40 years are presented in Table 2 for each region alone and for multi-region portfolios. The calculations assume that the multi-region portfolios are rebalanced each year.

Table 2
Level and Volatility of Timberland Returns*
Return (% per year)/Standard Deviation (% per year)

Timberland Portfolio	1963-2002 Return/Standard Deviation	1973-2002 Return/Standard Deviation	1983-2002 Return/Standard Deviation	1993-2002 Return/Standard Deviation
100% Southeast	10.95 / 9.07	11.14 / 9.93	9.22 / 7.91	9.98 / 8.20
100% Pacific Northwest	16.52 / 27.18	18.95 / 30.02	15.83 / 25.10	7.90 / 9.67
100% Northeast	10.13 / 8.35	11.34 / 9.22	10.37 / 10.08	14.12 / 12.74
50% South / 50% Northeast	10.65 / 7.10	11.37 / 7.77	9.91 / 7.46	12.19 / 8.91
50% South / 50% Pacific Northwest	14.16 / 16.48	15.54 / 18.28	13.00 / 14.37	9.01 / 8.00
Domestic (50% Southeast, 40% Pacific Northwest, 10% Northeast)	13.29 / 13.53	14.50 / 14.94	12.25 / 11.78	9.74 / 7.83
100% British Columbia	12.81 / 19.19	10.34 / 18.85	8.94 / 18.19	7.19 / 21.84
100% New Zealand	NA	NA	5.24 / 13.92	0.98 / 16.86
International**	12.04 / 17.44	9.34 / 16.20	7.43 / 13.60	4.40 / 17.53
Global (80% U.S., 20% Int'l)	13.24 / 12.47	13.62 / 13.85	11.42 / 10.79	8.83 / 8.56

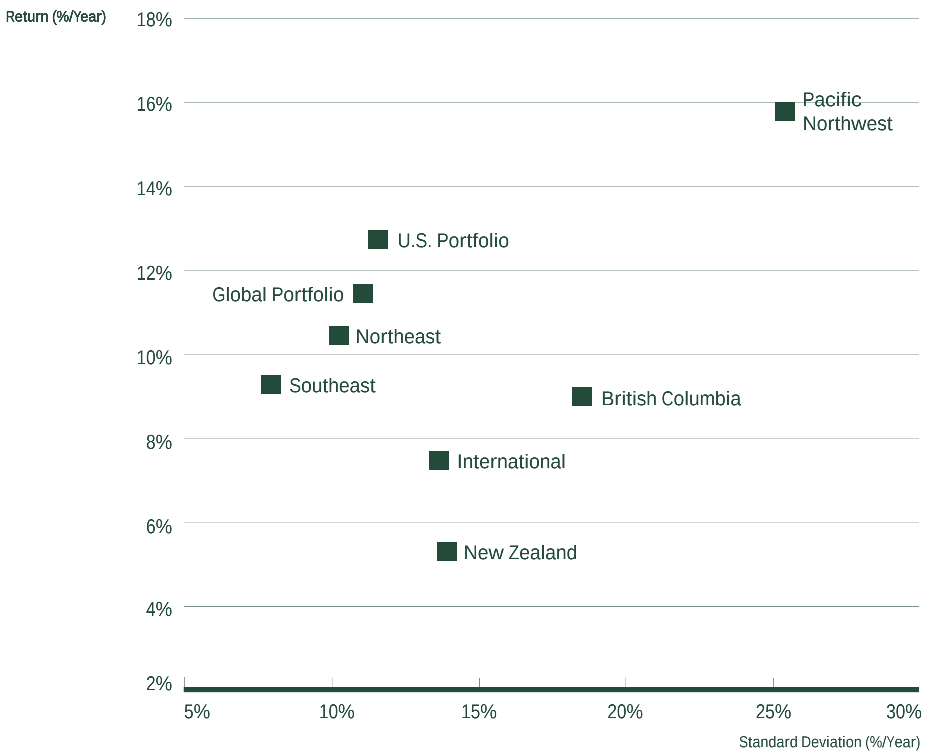
Please refer to Note on page 11.
*before management fees
**International portfolio consists of 100% BC prior to 1982 and 50% BC / 50% NZ after 1982.

Figure 1
Risk and Return of Geographically Diversified U.S. Timberland Portfolios, 1963-2002*

Please refer to Note on page 11.
*before management fees

The 40-year results for U.S. timberland are plotted in Figure 1. The level and volatility of returns have generally been highest in the U.S. Pacific Northwest, lower in the U.S. South, and lower still in the U.S. Northeast. The results also suggest that because rates of return for regional forests do not track one another perfectly, the volatility of returns for portfolios that combine timberland from various regions is less than the simple average of the three regional standard deviations.

Figure 2
Risk and Return of Geographically Diversified U.S. and Global Timberland Portfolios, 1983-2002*



Please refer to Note on page 11.
*before management fees

Figure 2 traces the risk-return combinations produced by different regional mixes of timberland for the same U.S. regions over a 20-year period (1983-2002) with the addition of timberland in coastal British Columbia and New Zealand. Over this period, the relationship between return level and volatility has been fairly straightforward. A portfolio allocation of 100 percent U.S. Pacific Northwest timberland still maintains the highest returns and the greatest amount of volatility over this 20-year period. The fast growth associated with growing timber in New Zealand, however, did not translate into high returns. Falling timber prices constrained New Zealand timberland returns to just over 5 percent.

A globally diversified timberland portfolio, consisting of 80 percent in the U.S. (allocated 50 percent to the South, 40 percent to the Pacific Northwest, and 10 percent to the Northeast) combined with 20 percent invested in a 50/50 mixture of coastal British

Columbia and New Zealand timberland, returned 11.42 percent over this period with a standard deviation of the portfolio's return at 10.79 percent. Global diversification decreased the timberland portfolio's volatility with a small reduction to overall returns. A globally diversified timberland portfolio should continue to decrease the standard deviation from that of a purely domestic portfolio and we expect returns outside the U.S. to improve, increasing overall returns.

Conclusions

To obtain a long-term historical record of timberland investment performance in the U.S. South, Pacific Northwest, and Northeast, as well as New Zealand and coastal British Columbia, we combined returns measured by the NCREIF Timberland Property Index for U.S. regions when available, with returns estimated from the John Hancock Timber Index. The results suggest that there has been a direct long-term relationship between the level and volatility of regional timberland returns. They also suggest that a multi-regional portfolio of timberland properties can deliver a target return with less uncertainty than a portfolio of properties from any single region in isolation.

To be sure, our estimates of historical timberland returns are less precise than records of past returns for traditional financial assets. Nevertheless, we believe that they are a useful source of information for timberland investment decisions.

Notes and Disclosures

Historic timberland performance figures calculated from the John Hancock Timber Index are based on a model containing certain assumptions, including but not limited to assumptions about timber growth rates, harvest levels, prices, production costs and property liquidity. As such, they are hypothetical rather than based on actual reported performance. Historic timberland performance figures should not be construed as guarantees of future returns. Potential for profit as well as for loss exists. The impact of future economic, market and weather factors may adversely affect timberland performance. Some timberland investments managed by HTRG had results materially different from those portrayed here for the asset class as a whole.

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