Timberland in an Investment Portfolio

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Agenda

I. Why Invest in Forests?
II. A Discussion of Risk
III. Relating Risk and Return
III. Forestry and Modern Portfolio Theory
IV. Observations and Implications
Why Forests?

- Interesting returns in a low-interest rate environment
- Improvement in portfolio efficiency (shift of efficient frontier)
- Source of CAPM alpha
- Inflation-hedge
- Steadiness of returns within the alternative-asset sector
- Independence of growth and ingrowth relative to macroeconomic factors
- Forest markets less efficient
- Match with long investment horizon
- Attractive income-tax attributes

Why Not?

- Rising interest rate environment
- Low relative liquidity
- Are returns commensurate with illiquidity? Risk?
- Duration exceeds investment horizon
- Relatively high denominations required
- Time lags between development and achievement of asset-allocation targets
- Timing
What do these Investors Seek?

Returns!
Investing + Forestry: Unlikely Marriage?

- Portfolio Theory
- Underwriting
- Selection

- Markets
- Operations
- Silviculture

?
KEY CONCEPTS: Let’s define some terms...
Investment Return

The percentage change in value of an investment over a period of time

• Money made or lost on an investment
• Percentage derived from ratio of profit/loss divided by invested capital
Investment

An asset purchased with expectation that it will generate income or appreciate in value in the future
Portfolio

Collection or grouping of financial assets such as stocks, bonds, cash equivalents, or other mutual, exchange-traded and closed-end fund counterparts
Expected Return: $E(R)$

Amount of profit (or loss) an investor would anticipate receiving for investing in an asset of known attributes (for a given period of time)
Required Return

Minimum return an investor will accept for an investment or project that compensates them for a given level of risk
Risk – Return Tradeoff

Central component of any investment decision:
A direct relationship between an asset’s perceived riskiness and its (potential) payoff as an investment
A Discussion of Risk
Systematic Risk

Also known as “market risk” or “un-diversifiable” risk.

The uncertainty or volatility inherent to the entire market

This type of risk is not reduced through diversification or addition of assets to a portfolio
Unsystematic Risk

Also known as “specific risk” or “diversifiable” risk.

The uncertainty or volatility that is idiosyncratic to a company, industry or specific asset.

Such risk in a portfolio is reduced through diversification
What are relevant forest asset risks?

**GOOD:**
- FIRE!
- Earthquake
- Wind
- Bugs
- Disease
- Site (soil) degradation
- Geography

**BETTER:**
- Market (Price)
  - Supply
  - Demand
- Input Costs
- Growth relative to underwriting (trees grow... but...)
- Land Tenure
- Climate Change
- Career
- Lack of Innovation
- Lack of Managerial Talent
- Theft
Relating Risk and Return
Quantifying Risk

Volatility or variance of value (or returns) commonly described with standard deviation, standard error etc.
Correlation

Measure of the degree in which two variables (risky assets) move together.

Correlation Coefficient: ranges from -1 to 1 with zero implying no relationship

\[ r = \frac{n \times (\text{SUM}(X,Y) - (\text{SUM}(X) \times \text{SUM}(Y)))}{\sqrt{(n \times \text{SUM}(X^2) - \text{SUM}(X)^2) \times (n \times \text{SUM}(Y^2) - \text{SUM}(Y)^2))}} \]
Covariance

Measure of the directional relationship between two risky assets: positive – move together; negative – move inversely

\[
\text{Cov}(x,y) = \text{SUM} \left[ (x_i - x_m) \times (y_i - y_m) \right] / (n - 1)
\]

- \(x_i\) = a given x value in the data set
- \(x_m\) = the mean, or average, of the x values
- \(y_i\) = the y value in the data set that corresponds with \(x_i\)
- \(y_m\) = the mean, or average, of the y values
- \(n\) = the number of data points
Sharpe Ratio

\[ S(x) = \frac{(r_x - R_f)}{\text{StdDev}(x)} \]

Describes the **excess** return received for enduring extra volatility of a risky asset where:

- X is the investment
- \( r_x \) is the rate of return of X
- \( R_f \) is the rate of return of a risk-free asset
- \( \text{StdDev}(x) \) is the standard deviation of \( r_x \)
## Sharpe Ratios: 1997-2018

<table>
<thead>
<tr>
<th>Category</th>
<th>Sharpe Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>NCREIF Timberland—Total</td>
<td>0.94</td>
</tr>
<tr>
<td>NCREIF Timberland—50/50 SE/NE</td>
<td>0.72</td>
</tr>
<tr>
<td>Hardwood Sawtimber Prices</td>
<td>0.08</td>
</tr>
<tr>
<td>Southern Pine Sawtimber Prices</td>
<td>-0.41</td>
</tr>
<tr>
<td>Long-Term Treasury Bonds</td>
<td>0.34</td>
</tr>
<tr>
<td>S&amp;P 500</td>
<td>0.36</td>
</tr>
</tbody>
</table>
Forestry and Modern Portfolio Theory
Modern Portfolio Theory

A mathematical framework for assembling a portfolio of assets such that the expected return is maximized for a given level of risk.

Harry Markowitz, 1952

Foundation of Capital Asset Pricing Model (CAPM) and components, alpha and beta
Value of 2 Financial Assets

Value

Time
Value of 2 Financial Assets
Value of 2 Financial Assets

Value

Time

X

Y
Parsing (and Reducing) Portfolio Risk

Systematic or Market Risk

Unsystematic Risk

Risk ($\sigma_p$) vs. # of Assets
# Benchmark Risk and Return

**REPRESENTATIVE BENCHMARK INDICES 1997 THROUGH 2018**

<table>
<thead>
<tr>
<th></th>
<th>Return</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>S&amp;P 500</td>
<td>8.09%</td>
<td>16.41%</td>
</tr>
<tr>
<td>T Bonds</td>
<td>6.77%</td>
<td>13.76%</td>
</tr>
<tr>
<td>T Bills</td>
<td>2.11%</td>
<td>1.04%</td>
</tr>
<tr>
<td>Timber</td>
<td>6.88%</td>
<td>5.08%</td>
</tr>
</tbody>
</table>
## Correlation Matrix: NCREIF Timberland

<table>
<thead>
<tr>
<th></th>
<th>T Bonds</th>
<th>T Bills</th>
<th>Timberland</th>
</tr>
</thead>
<tbody>
<tr>
<td>S&amp;P 500</td>
<td>-0.47</td>
<td>-0.06</td>
<td>0.02</td>
</tr>
<tr>
<td>T Bonds</td>
<td>0.04</td>
<td></td>
<td>0.12</td>
</tr>
<tr>
<td>T Bills</td>
<td></td>
<td></td>
<td>0.27</td>
</tr>
</tbody>
</table>
Portfolio Return

\[ RP = w_S R_S + w_B R_B + w_T R_T \]

<table>
<thead>
<tr>
<th>Assets</th>
<th>Weight (w)</th>
<th>Return</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stocks</td>
<td>0.45</td>
<td>8.72%</td>
<td>16.41%</td>
</tr>
<tr>
<td>Bonds</td>
<td>0.45</td>
<td>7.19%</td>
<td>13.76%</td>
</tr>
<tr>
<td>Timber</td>
<td>0.10</td>
<td>7.04%</td>
<td>5.08%</td>
</tr>
</tbody>
</table>

\[ RP = 0.45(8.72\%) + 0.45(7.19\%) + 0.10(7.04\%) \]
\[ RP = 7.86\% \]
\[ \text{Std Dev}(P) = 7.1\% \]
\[ \text{Sharpe Ratio} = 1.1 \]
The Efficient Frontier

Expected Return $E(R_p)$ vs. Risk $\sigma_p$
CAPM in Forest Investments

\[ E(R_a) = R_f + \beta (R_M - R_f) \]

Where:

- \( E(R_a) \): expected return of risky asset
- \( R_f \): risk free rate
- \( R_M \): market portfolio return
- \( \beta \): \( \text{Cov}(R_a, R_M)/\text{Var}(R_M) \)
Beta

A beta coefficient is a measure of the volatility, or systematic risk, of an individual stock in comparison to the unsystematic risk of the entire market.
Risk-adjusted Discount Rate Estimation

\[ I_a = R_f + \beta_a [E(R_M) - R_f] \]

Where:

- \( I_a \) = risk adjusted discount rate
- \( R_f \) = risk free rate
- \( E(R_M) \) = expected market portfolio return
- \( \beta_a \) = \( \frac{Cov(R_a, R_M)}{Var(R_M)} \)
CAPM: Ex post -- alpha

\[ \alpha_a = \text{risky asset} - \text{market} \]
\[ \alpha_a = E(R_a - R_f) - \beta_a E(R_M - R_f) + \epsilon \]

Where:

- \( E(R_a - R_f) \) = expected return of risky asset
- \( R_f \) = risk free rate
- \( R_M \) = market portfolio return
- \( \beta_a = \frac{\text{Cov}(R_a, R_M)}{\text{Var}(R_M)} \)
alpha = risky asset - market
\[ \alpha_a = E(R_a - R_f) - \beta_a E(R_M - R_f) + \varepsilon \]

Where:
\[ E(R_a - R_f) = \text{expected return of risky asset} \]
\[ R_f = \text{risk free rate} \]
\[ R_M = \text{market portfolio return} \]
\[ \beta_a = \frac{\text{Cov}(R_a, R_M)}{\text{Var}(R_M)} \]
CAPM Inputs

$R_f$: 2.4% (10-year US Treasury Bond)

$R_m$: 5.5% (KPMG survey).

$\beta_a$: about zero for core private US timberlands; REIT – highly variable

CAPM implies very low discount rates for private US timberland investments.

Implications? Limitations?
Return and Risk

Security Market Line derived from CAPM equation indicates return for timberland exceeds that which is required to compensate for its perceived risk.

Source: Philip M. Nash, CFA  Alternative Assets, Risk Analysis and Economic Research; Email: pnash500@gmail.com
Timber REITS vs. Private Timberland

Correlation analysis shows difference

<table>
<thead>
<tr>
<th>1999-2018 Correlation Forisk-FTR Index</th>
<th>S&amp;P</th>
<th>NCREIF-Total</th>
<th>NCREIF-Sourth</th>
<th>NCREIF-PNW</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.572</td>
<td>(0.062)</td>
<td>(0.075)</td>
<td>0.009</td>
<td></td>
</tr>
</tbody>
</table>
Correlation with other Asset Classes

Low or negative correlations seem to hold true for certain time periods introducing selection bias into the thesis...

Source: Philip M. Nash, CFA  Alternative Assets, Risk Analysis and Economic Research; Email: pnash500@gmail.com
Timberland: An Inflation Hedge?

Why is timberland a rational portfolio asset during an inflationary environment?

Tangible assets—timber and land.

Trees grow independent of macroeconomic fluctuations, including general pricing.

Most analyses suggest there is a positive correlation between actual inflation and timberland returns.

<table>
<thead>
<tr>
<th>Year Range</th>
<th>Inflation</th>
<th>S&amp;P</th>
<th>NCREIF Total Timberland</th>
</tr>
</thead>
<tbody>
<tr>
<td>1987 - 2018 Correlation</td>
<td>1.00</td>
<td>-0.19</td>
<td>0.58</td>
</tr>
</tbody>
</table>
Historical Sawtimber Prices

Sawtimber pricing in both the U.S. South and West have not kept pace with inflation, even when incorporating early 1990s

Source: Philip M. Nash, CFA  Alternative Assets, Risk Analysis and Economic Research; Email: pnash500@gmail.com
In summary, why forests?

1. Are not without risk
2. Can provide excellent returns
3. In a portfolio framework have shown that they can be excellent portfolio diversifiers with unique characteristics