DIRECTIONS FOR FINANCIAL ENGINEERING IN TIMBERLAND MARKETS

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ABSTRACT

The use of derivatives contracts such as futures and options is changing investment managers' perception of asset volatility and portfolio risk management. This paper explores both the implications of the use of financial-asset-based derivatives on the need for timberland allocations and opportunities for developing timber-based derivatives. The concept of a timber-based forward contract is defined and applications, including timberland portfolio hedging and synthetic timberland, are evaluated.

INTRODUCTION

Given its attractive risk-return characteristics, institutions have invested about $3 billion in timberland. Empirical research that evaluates timberland investments from a Modern Portfolio Theory (MPT) perspective has largely been supportive of such allocations to rather diversified portfolios (e.g., Conroy and Miles 1989; Zinkhan et al. 1992). Investment management research and practice are evolving toward the post-MPT era. The purpose of this paper is to outline the possible implications of post-MPT philosophies and practices for timberland investing.

In an MPT framework, investment managers face normal distributions of returns on their portfolios. By adding an investment such as timberland with returns that are loosely and perhaps negatively correlated with the returns of the portfolio's financial asset classes, a manager can reduce the magnitude of the distribution's tails. Or, in other words, the manager can, through controlled diversification, reduce the estimated standard deviation of the portfolio. In contrast, the aim of post-MPT is to truncate the left-side tail of the distribution while leaving the right-side tail as intact as possible (see Burr 1993). The vehicles used to accomplish this mission are derivatives--securities and
contracts with values that are derived from the value of some underlying asset. Financial engineering, in turn, includes any derivative securities-based strategy intended to result in the modification of the distribution of investment portfolio returns or the structure of an entity's liabilities.

Mitigation of overall volatility represents a significant motivation for allocating a portion of an investment portfolio toward timberland. Given the option of utilizing derivatives to reduce downside portfolio risk in a post-MPT context, there may less need in the future for timberland investments to accomplish this particular mission.

Some forms of derivatives—such as options and futures—trade on exchanges. For example, random length lumber futures and options on these lumber futures trade on the Chicago Mercantile Exchange. The underlying asset for one random length futures contract is 160,000 board feet of 2 x 4s in random lengths of specific grades that were manufactured from specific species in certain western U.S. states and Canadian provinces. Other forms of derivatives—such as forward contracts, swaps, and various types of privately negotiated options—are created off-exchange between two or more parties. An example of a private-market derivative was the put option written by the Travelers Insurance Company that provided Diamond International Corporation with the right to sell (to the Travelers) some western timberland at a fixed price over a three-year period (Mason 1984). The creation of a floor value for these properties gave banks sufficient confidence to help finance a merger of Diamond into a subsidiary of General Oriental Ltd.

After discussing and evaluating the use of derivatives to hedge timberland holdings in the next section, two other derivatives-based strategies will be presented: the creation of synthetic timberland and transporting excess returns from timberland to a passively managed financial asset fund. The conclusion will provide directions for future research.

HEDGING PRICE RISK

The most obvious applications of derivatives are their use for short and long hedges. A large lumber mill could minimize the price risk associated with its finished product inventory by selling random length futures contacts. This represents an example of a short hedge. A large building contractor might utilize a long hedge in order to effectively lock-in the future cost of purchased lumber. This could be accomplished by buying lumber futures
contracts. The economic purpose associated with using derivatives for hedging is the provision of "an efficient mechanism for allocating risk from those who wish to avoid risk to those who are interested in bearing the risk" (Stoll and Whaley 1993, p. 11). In a fashion similar to insurance, the availability of derivatives encourages organizations to pursue activities that might otherwise be deemed too risky and also permits them to focus resources on those areas in which they possess maximum expertise.

With its growth as an institutional portfolio asset, investment managers are now considering alternative mechanisms for hedging their timberland positions. For example, a manager with Dayton Hudson Corporation's defined benefit pension fund, which has a 7% allocation to timberland, reported that the fund was evaluating alternatives for hedging the value of the timberland (Burr). In addition to institutional investors, other private owners of timberland, most notably forest products companies, also confront situations in which hedging may be a desirable option.

From the perspective of an institutional portfolio manager following MPT principles, the wisdom associated with undertaking a long-term short hedge with, say, a timberland forward contract would be questionable. After all, many institutions allocated funds to timberland because its returns move in a countercyclical fashion relative to financial assets. In addition, a complete short-hedge would incur high transaction costs due to the need for continuous rebalancing over time and would eliminate an investor's upside potential. However, numerous institutions might be interested in temporary short and long hedges. For example, consider an institution that has revised its long-term asset allocation mix and has decided to reduce its exposure to timberland. Furthermore, assume that one of the timberland funds in which it participates is scheduled to close out within a year and that the institution's managers are pessimistic regarding the outlook for timber and timberland prices. In this case, the institution's managers may want to consider a short hedge. If an institution has recently approved a higher allocation to timberland but has not yet selected a manager or fund, it might want to protect against higher purchase prices in the future by executing a long hedge.

No organized timber or timberland futures and options markets exist and probably will not be created in the near future. In relation to timberland, only two real estate futures contracts have been created, both initiated by the London Futures and Options Exchange in May 1991 (Case, Shiller, and Weiss 1993). Trading was suspended in October 1991 due to accusations that the exchange had artificially supported trading volume. Traders did not actually take or
make delivery of real estate. The contracts were of the cash settlement variety, with the values contingent upon, in one case, a regression-based hedonic residential price index and, in the other case, an appraisal-based index of commercial real estate prices. The existing derivatives contracts that are most closely associated with timber and timberland are the lumber futures and futures options which trade on the Chicago Mercantile Exchange. Certainly, the use of either of these contracts to hedge a timber or timberland position would be considered a cross hedge since the underlying asset (lumber) is different from timber and timberland relative to a number of dimensions.

The relative effectiveness of a given derivative as a hedging vehicle for a given investment is an empirical question. For that reason, an evaluation of lumber futures as a hedging instrument was undertaken for a timberland investment proxy, the Timberland Performance Index (TPI), an index developed by Caulfield (1994) that is based upon the actual performance of all timberland funds reporting results to Evaluation Associates, Inc.'s Real Estate Profiles. Permanent short hedging with quarterly alterations (using the contract with the shortest maturity beyond one quarter in duration) was undertaken using the optimal hedge ratio, $h^*$:

$$h^* = p \sigma_S / \sigma_F$$  \[1\]

where: $p =$ coefficient of correlation between the change in spot price, $S$, and the change in futures price, $F$

$\sigma_S =$ standard deviation of the change in spot price $S$

$\sigma_F =$ standard deviation of the change in futures price $F$

The hedge ratio represents the ratio of the size of the futures contract position relative to the size of the exposure to the investment position. Hedge ratio $h^*$ is the one that minimizes the variance of the hedger's position.

The hedging effectiveness, $p^2$, represents the proportion of variance that is eliminated by hedging:

$$p^2 = h^*^2 \sigma_F^2 / \sigma_S^2$$  \[2\]

The hedging effectiveness associated with hedging the TPI for the period of December 1983 to December 1992 with lumber futures is displayed in Table 1. The results suggest a rather ineffective cross-hedge situation. Given a constant $h^*$ of 6.50% for the investment period, hedging with lumber futures was expected to eliminate only 5.85% of the variance.
TABLE 1

Performance of Two Alternative Derivatives Strategies for Hedging the TPI and the Wachovia Established Growth Timberland Fund, December 1983 – December 1992

<table>
<thead>
<tr>
<th>Hedging the TPI</th>
<th>Hedging the Wachovia Fund</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lumber Futures</td>
<td>Timber Forward Contract</td>
</tr>
<tr>
<td>$h^*$</td>
<td>0.0650</td>
</tr>
<tr>
<td></td>
<td>0.1399</td>
</tr>
<tr>
<td></td>
<td>-0.0039</td>
</tr>
<tr>
<td></td>
<td>0.2042</td>
</tr>
<tr>
<td>$p^2$</td>
<td>0.0585</td>
</tr>
<tr>
<td></td>
<td>0.1145</td>
</tr>
<tr>
<td></td>
<td>0.0002</td>
</tr>
<tr>
<td></td>
<td>0.2398</td>
</tr>
</tbody>
</table>

An alternative hedging vehicle would be a privately offered forward contract (developed by a financial institution), based upon the price of standing timber. For empirical analysis, the quarterly average price for southeastern state pine sawtimber (per thousand board feet) reported by Timber Mart-South was used as the basis for a cash settlement forward contract. As a cash settlement contract, the buyer of the contract would receive (provide) the positive (negative) difference between the quarter-ending price and the negotiated price as of the beginning of the quarter. A timberland investor would create a short hedge by selling a certain volume of standing timber forward contracts.

For this exercise, the negotiated quarter-beginning forward contract's price, $F$, is assumed to equal the theoretical value for a forward contract on an asset (with a spot price $S$) that provides no periodic income (Hull 1991):

$$ F = S e^{rt} \quad \text{[3]} $$

where: $r$ = the continuously compounded risk-free interest rate

$t$ = the maturity of the forward contract

With quarterly data, the estimated $p^2$ associated with the standing timber forward contract was found to be rather low, 11.45%, but was slightly higher than the one associated with the lumber futures contract (see Table 1). The rather low hedging effectiveness associated with both lumber futures and the standing timber forward contracts implies that an investor with a timberland fund with characteristics similar
to those reflected by the TPI should hedge with a forward contract based upon the TPI itself.

Wachovia Timberland Investment Management’s Established Growth Timberland Fund, the first commingled timberland fund for institutional investors, has emphasized southern acquisitions. If the standing timber forward contract were used to hedge this fund, for the time period of December 1983 through December 1992, the hedging effectiveness ratio would have been 23.98% (see Table 1). This fund’s concentration on southern properties probably accounts for the higher estimated \( \rho^2 \) (than estimated in conjunction with the TPI). With a hedging instrument based upon southern sawtimber prices, there is a closer match with the Wachovia fund than with the TPI, the latter of which reflects the performance of properties in both the South and other regions. Still, the rather low hedging effectiveness associated with this forward contract, even when used to hedge a southern-oriented fund, emphasizes the need for customized hedging instruments.

SYNTHETIC TIMBERLAND

Financial engineers have created synthetic stock portfolios by purchasing stock index futures with a contract value equal to the desired value of the index fund. Residual funds not needed for meeting margin requirements are invested in low-risk, interest-bearing securities such as Treasury bills. An analogous vehicle, synthetic timberland, could be created by combining a long position in a timberland forward contract, based upon some timberland performance index (such as the TPI) or perhaps a timber price series, with Treasury bills. Synthetic timberland would be consistent with the needs of investors facing such circumstances as the following:

1. A desire to practice active timberland market timing (i.e., tactical asset allocation) without facing frustratingly long search times and transaction delays and considerable transaction costs.

2. A desire to participate in timberland without having to select a manager and pay significant acquisition and management fees.

3. A belief that it is difficult to select a superior timberland investment manager who will consistently outperform other managers.
(4) A large financial commitment to a timberland separate account has been made, but a medium-term time lag is anticipated before actual timberland holdings are of equal magnitude.

Also, synthetic timberland would provide investors with the mechanism for taking short positions in this asset class when they are pessimistic about its future performance.

Use of a published timber price series represents one alternative benchmark for a synthetic timberland position. However, as shown in Table 2, a synthetic position based upon the quarterly reported southeastern state average pine sawtimber price reported by Timber Mart-South did not replicate the performance of the TPI for the period March 1981 to December 1992. The following are some of the possible reasons for the poor fit:

(1) Biological growth and biological risks were not captured by the synthetic position.

(2) The TPI reflected the performance of both southern and non-southern timber price series.

(3) The weighting of even southern regions included within the TPI may have deviated from the simple arithmetic average estimated by Timber Mart-South.

(4) The performance of the funds included within the TPI reflected prices of timber types other than pine sawtimber.

(5) Timber Mart-South price data for pine sawtimber may not have been reflective of timber sales conducted by the timberland funds.

(6) Value-added practices undertaken by the timberland investment management organizations (TIMOs), such as realization of wholesale purchase discounts, active timing of timber sales, and sale of small tracts for higher-and-better-use purposes were not reflected in the synthetic position.

(7) The market factors influencing timber sale prices may differ from those impacting timberland prices.

Empirical research is needed to evaluate the relative behavior of alternative benchmarks for use in conjunction with forward contracts by investors desiring synthetic timberland positions.
TABLE 2

Behavior of a Synthetic Timberland Position Based upon Mean Timber Mart-South Sawtimber Prices Versus the TPI, December 1983 - December 1992

<table>
<thead>
<tr>
<th></th>
<th>TPI</th>
<th>Synthetic Timberland</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correlation Coefficientb</td>
<td>0.2765</td>
<td></td>
</tr>
<tr>
<td>$R^2c$</td>
<td>0.0764</td>
<td></td>
</tr>
<tr>
<td>Compound Quarterly Return</td>
<td>0.0271</td>
<td>0.0059</td>
</tr>
<tr>
<td>Quarterly Standard Deviation</td>
<td>0.0278</td>
<td>0.0719</td>
</tr>
<tr>
<td>Capital Asset Pricing Model Beta\textsuperscript{d}</td>
<td>0.0812</td>
<td>-0.1080</td>
</tr>
</tbody>
</table>

\textsuperscript{a}Synthetic position represents an investment in a timber forward contract at price $F$ (see equation 3), a 10.0% margin requirement provided with three-month Treasury bills (with interest credited to the investor), and the other 90.0% of funds allocated to three-month Treasury bills.

\textsuperscript{b}Between quarterly returns of the TPI and the synthetic position.

\textsuperscript{c}Based upon a linear regression with the quarterly returns of the synthetic position and the TPI serving as the independent and dependent variables, respectively.

\textsuperscript{d}Based upon quarterly data, with the S&P 500 Index serving as the market proxy.

TRANSPORTING EXCESS RETURNS FROM TIMBERLAND TO PASSIVELY MANAGED FINANCIAL ASSET FUNDS

Institutional investors sometimes transport the alpha of an actively managed equity portfolio to an indexed fund of a different category—such as bonds or international equities. This is done when the portfolio manager (1) is confident that the active equity manager will be able to outperform the overall market and (2) wants more exposure to another asset
class and less to the one managed by the active manager. The alpha transportation can be executed by hedging (typically via selling futures contracts) the market risk associated with the asset class managed by the active manager and increasing exposure to another asset class by buying futures contracts or indexing.

For a portfolio manager with an exposure to timberland via an active manager, the superior performance of that manager (versus other timberland managers) could be transported to an indexed stock portfolio. The transportation would require the execution of a short hedge using a timberland forward contract and the purchase of an indexed stock portfolio. As long as the active timberland manager outperformed the timberland performance index, this excess return could, in effect, be added to the actual return of the indexed stock portfolio.

CONCLUSIONS

As a long-term component of a patiently managed institutional portfolio, a modest allocation to timberland represents a potential source of alpha--due perhaps to inefficiencies (at the semi-strong level) in timberland markets and lack of consideration of all relevant factors when estimating alpha. Therefore, many timberland investors will want to maintain their current exposure to the asset class and will refrain from utilizing timber and timberland derivatives for the purpose of risk reduction. However, other motivations, frictions, and sources of time lags will encourage utilization of various varieties of timber and timberland derivatives. For example, the desires for timely increases or decreases in exposure to the asset class and lower transaction costs and management fees will stimulate the development of such contracts.

One possible societal benefit to be gained through the development of timber and timberland derivatives is the generation of more and better quality information regarding timber and timberland markets. Speculators interested in participating in the derivatives markets will attempt to uncover information about these markets that could possibly lead to profitable trades. The generation of additional information in combination with arbitrage-type trades between the real and derivatives markets should improve the quality of timber and timberland prices and thus the informational signaling role of prices, which are critical in the resource allocation process.

The primary research challenge associated with the development of timber and timberland derivatives is the
development and testing of accurate timber and timberland indexes and subindexes. Development of the Russell-NCREIF Timberland Index is an important step but, when released, should be carefully scrutinized. In some cases, a regression-based hedonic model might be required for constructing an appropriate index. Also, financial institutions that choose to serve as dealers in the timber and timberland markets will require research which will enable them to customize indexes for customers with unique needs.

Finally, additional research is needed in the development of pricing models for timber and timberland derivatives. Special challenges are represented by options-based derivatives. Forest economists should cooperate with financial economists in regard to the development of these models to ensure that off-the-shelf pricing models are reflective of the peculiarities of timber and timberland markets.

LITERATURE CITED


